

July 18, 1944.

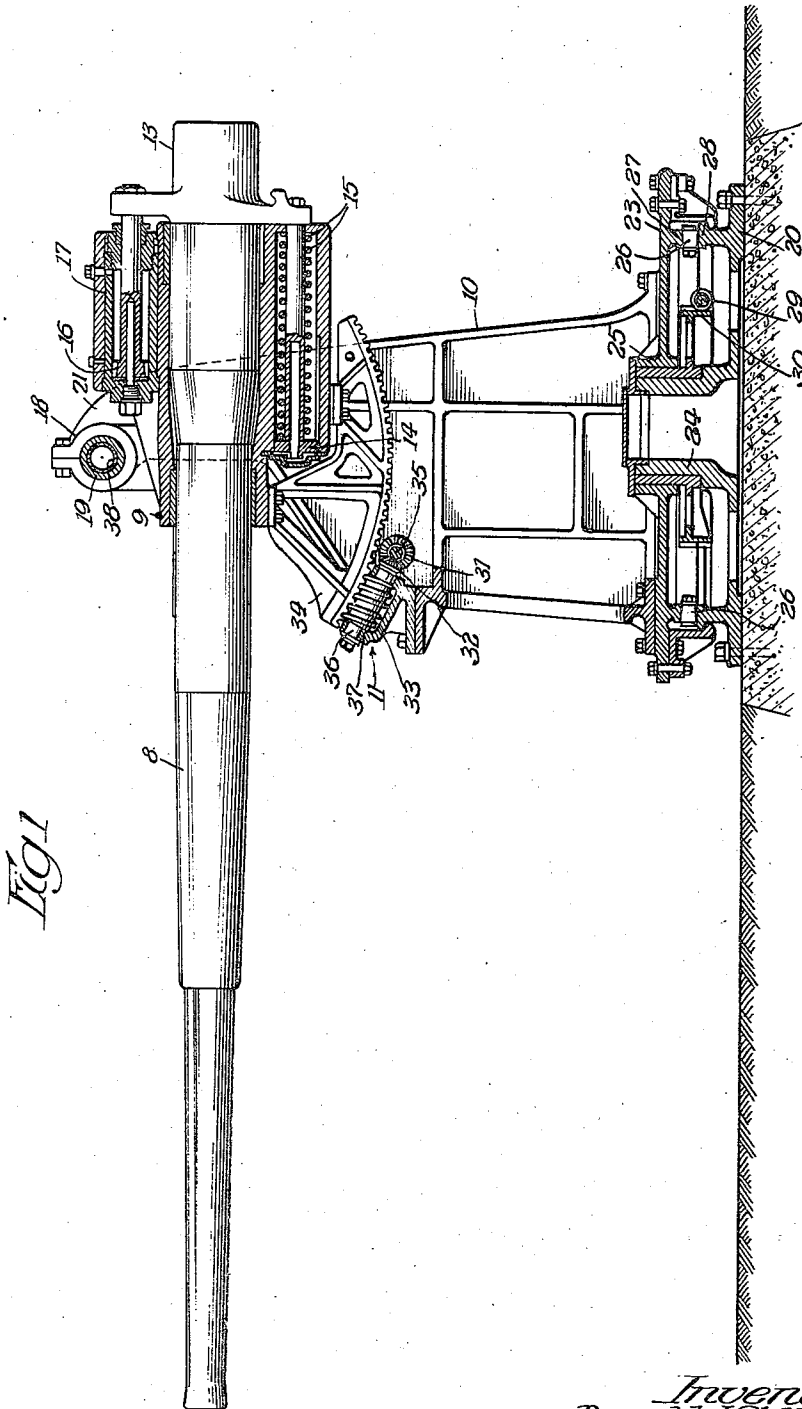
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2,354,153

AUTOMATIC GUN POINTING MECHANISM

Filed Sept. 19, 1941

4 Sheets-Sheet 1



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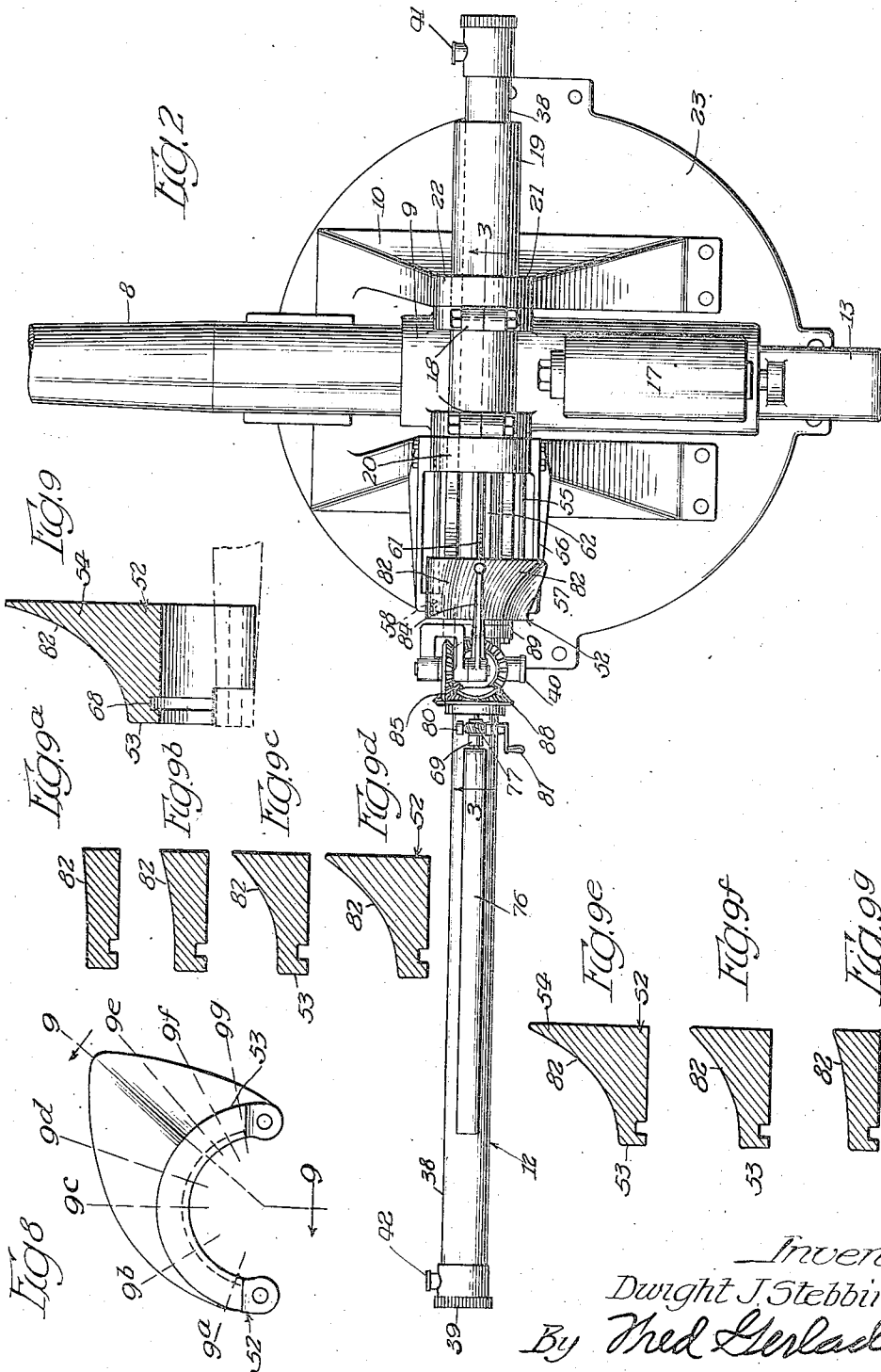
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AUTOMATIC GUN POINTING MECHANISM

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4 Sheets-Sheet 2



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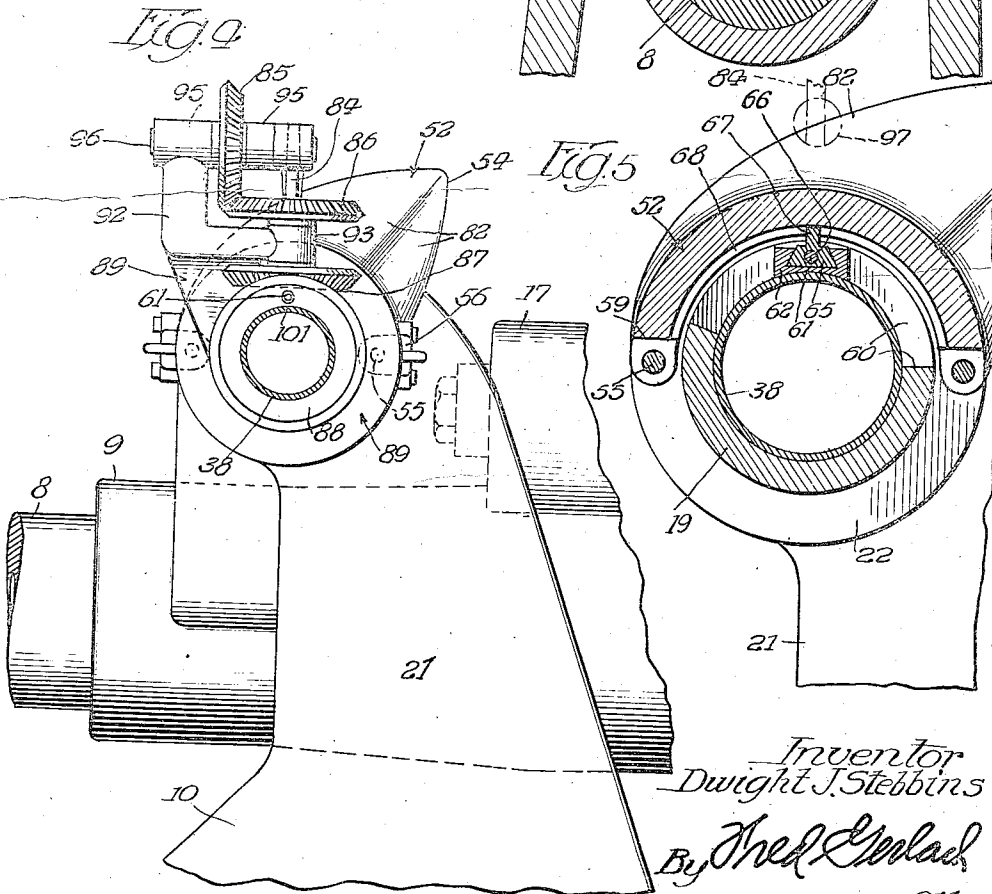
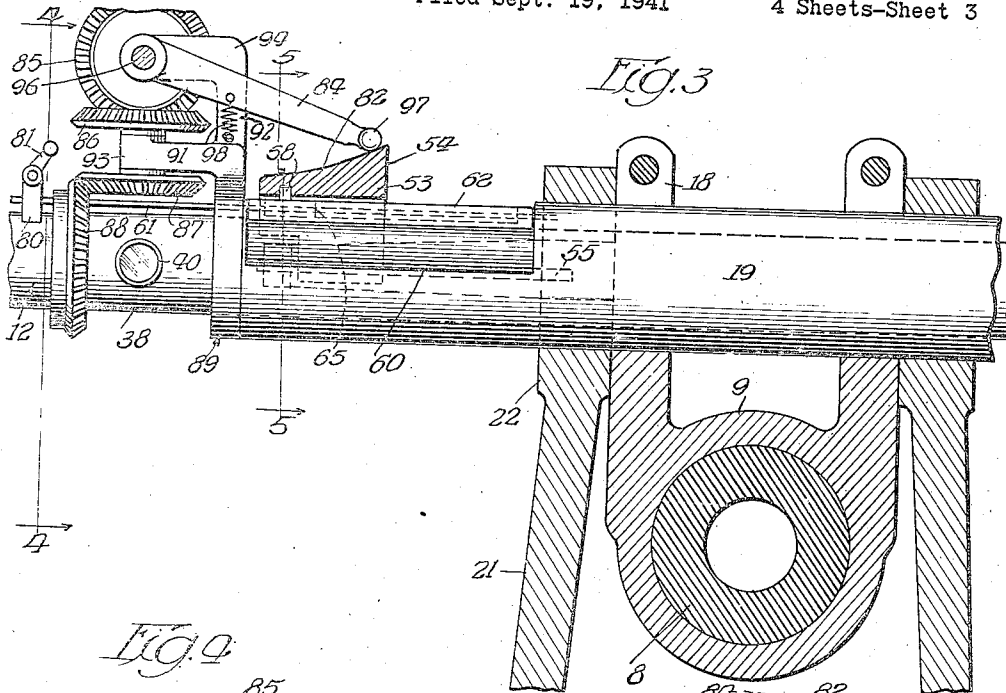
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AUTOMATIC GUN POINTING MECHANISM

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4 Sheets-Sheet 3



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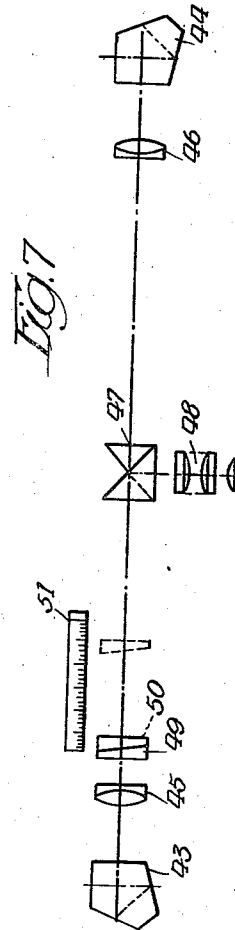
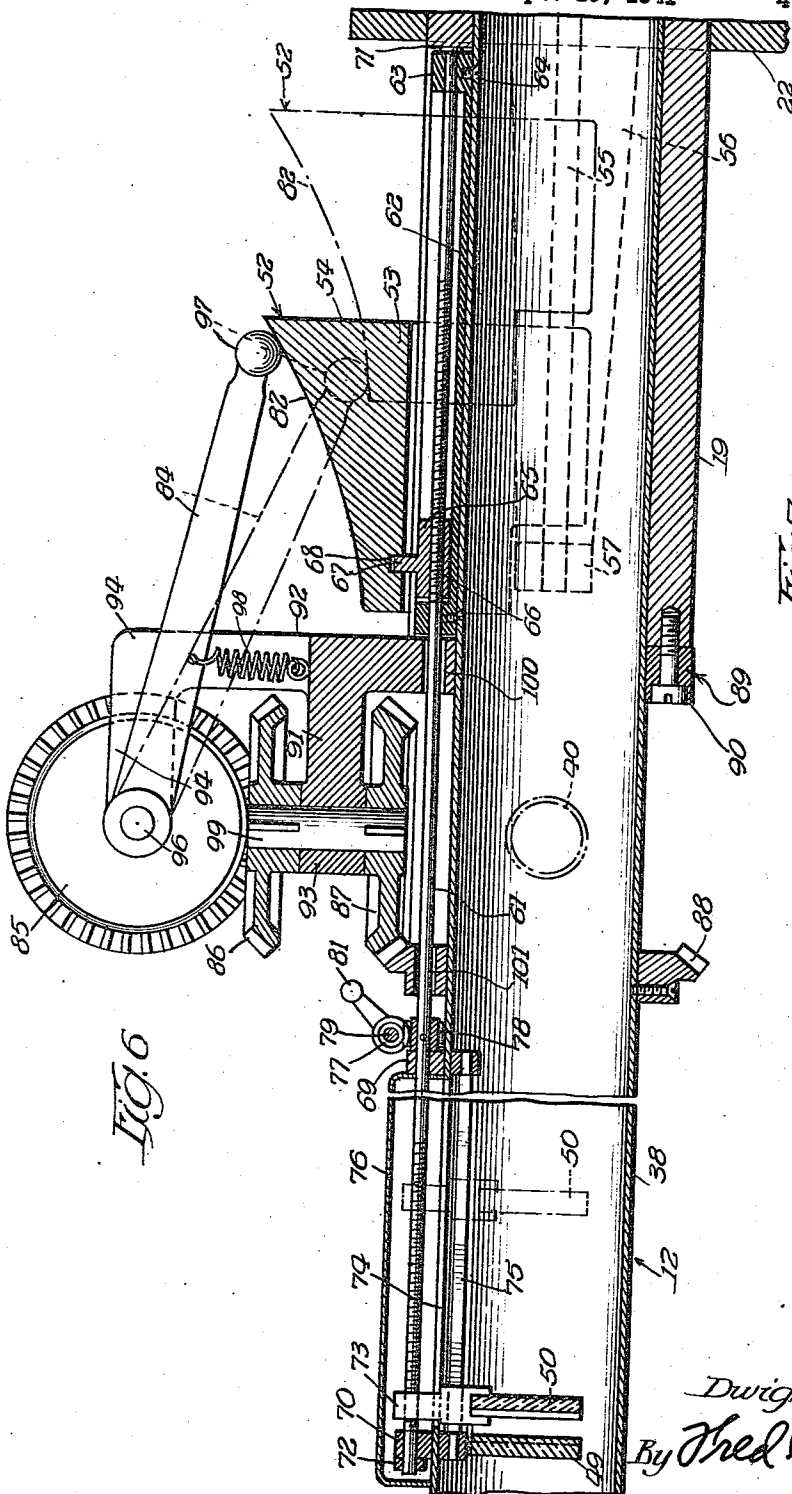
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AUTOMATIC GUN POINTING MECHANISM

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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AUTOMATIC GUN-POINTING MECHANISM

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Application September 19, 1941, Serial No. 411,456

7 Claims. (Cl. 89-41)

The present invention relates to mechanism for use in pointing a gun having associated therewith a range finder and its primary or principal object is to provide pointing mechanism which is automatic in character and operates in such manner that when the barrel of the gun is pointed or aimed the target can not be correctly located in the range finder unless the barrel of the gun is adjusted to the correct elevation for a direct hit.

Another object of the invention is the provision of automatic pointing or controlling mechanism of the type under consideration which is not only simple in design or construction but also compact and accurate.

Other objects of the invention and the various advantages and characteristics of the present gun pointing mechanism will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a vertical longitudinal section of a gun having applied thereto automatic pointing or controlling mechanism embodying the invention;

Figure 2 is a plan view of the gun;

Figure 3 is an enlarged vertical transverse section taken on the line 3-3 of Figure 2 and illustrating in detail certain parts of the gun pointing mechanism;

Figure 4 is a vertical section on the line 4-4 of Figure 3;

Figure 5 is an enlarged section taken on the line 5-5 of Figure 3 and illustrating in detail the construction and design of the cam type guide plate which constitutes a part of the gun controlling mechanism;

Figure 6 is a fragmentary vertical longitudinal section of the range finder and the various parts which are associated therewith;

Figure 7 is a diagrammatic view of the main elements or parts of the range finder;

Figure 8 is a front elevation of the cam type guide plate; and

Figures 9, 9^a, 9^b, 9^c, 9^d, 9^e, 9^f, and 9^g are sections taken respectively on the lines 9, 9^a, 9^b, 9^c, 9^d, 9^e, 9^f, and 9^g of Figure 8.

The automatic pointing mechanism which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is

adapted for use in connection with various forms or types of guns, such for example, as field guns, naval or coast guns, anti-tank guns, and anti-aircraft guns. The gun which is shown in the drawings is intended to illustrate one type of gun to which the invention is applicable. It comprises as its principal or primary parts a barrel 8, a cradle 9, a supporting structure 10, mechanism 11 for tilting the cradle and barrel relatively to the supporting structure, and a range finder 12.

The barrel 8 is of the breech loading variety and has a longitudinal rifled bore (not shown). It is carried by the cradle 9 and has a head 13 at its rear or breech end. This head is provided with a removable breechblock (also not shown). The barrel is loaded by removal of the breechblock, as well understood in the art, and is fired by a lanyard or any suitable button or lever controlled mechanism.

The cradle 9 is tubular and surrounds the rear or breech end of the barrel 8. It is disposed directly in front of the head 13 and permits the barrel 8 to slide or recoil rearwards during firing of the gun. Recoil mechanism in the form of a piston type element 14 and a compression spring 15, and counter-recoil mechanism in the form of a piston 16 and a cylinder 17 are associated with the cradle 9. The former resists or counteracts recoil and the latter operates to retard shift of the barrel to its normal position by the recoil mechanism. The cradle is provided at its front end with a pair of upstanding laterally spaced clamping members 18. A horizontally extending trunnion type sleeve 19 extends through and is clamped within said members 18 and is carried by the supporting structure 10 so that the cradle and barrel are permitted to tilt upwards and downwards about a horizontal axis. As shown in Figures 1 and 2, the sleeve 19 is carried by the members 18 in close proximity to the subjacent portion of the barrel and its ends project appreciable distances beyond the upstanding clamping members 18. The supporting structure 10 is in the form of a heavy metallic casting and overlies a circular base plate 20. The latter, as shown in Figure 1, is anchored to the foundation for the gun. The upper end of the supporting structure 10 is in the form of a pair of upstanding laterally extending arms 21 and these are arranged in straddled relation with the front end of the cradle 9 and have bearings 22 at their upper extremities. The trunnion type sleeve 19 which constitutes a part of the cradle 9 is journaled in the bearings 22 (see Figure 2) in order that the cradle and barrel are supported for free tilting either up-

wards or downwards in a vertical plane. The bearings 22 lap the outer faces of the clamp members 18 and thus serve to hold the sleeve 19 against axial displacement. A circular plate 23 is bolted or otherwise fixedly secured to the lower end of the supporting structure 10 and overlies the base plate 20. An upstanding pintle 24 on the central portion of the base plate 20 fits within a bearing 25 on the central portion of the plate 23 and forms with the bearing a pivotal connection whereby the supporting structure 10 together with the cradle and barrel is permitted to rotate bodily about a vertical axis. An annular series of rollers 26 between a depending annular track 27 on the peripheral portion of the plate 23 and an upstanding annular track 28 on the peripheral or outer marginal portion of the base plate 20 serves as an anti-friction support for permitting rotation of the supporting structure 10 about the pintle 24. Traversing of the barrel 8 of the gun is effected by rotating the supporting structure 10 relatively to the base plate 20. Power mechanism comprising a worm 29 and a gear wheel 30 serves as a medium for rotating the supporting structure 10 as desired. The worm 29 is disposed between the plates 20 and 23 and is in mesh with the gear 30. The latter, as shown in Figure 1, surrounds the upstanding pintle 24 and is fixed to the central portion of the plate 23. When it is desired to swing the barrel 8 horizontally in one direction the worm 29 is driven in one direction and when it is desired to swing the barrel horizontally in the opposite direction the worm is reversely rotated or driven, as well understood in the art.

The mechanism for tilting the cradle and barrel upwards and downwards comprises a pair of bevel gears 31 and 32, a worm 33, and a gear segment 34. The bevel gear 31 is fixed to a horizontally extending shaft 35 which is mounted in suitable bearings on the central portion of the supporting structure 10 and is rotated either by a crank or a reversible electric motor. It meshes with the bevel gear 32 and serves, in connection with drive of the shaft 35, to rotate said bevel gear 32. The latter is fixed to one end of an angularly disposed shaft 36 which is journaled in a pair of axial and longitudinally spaced bearings 37 on the front upper portion of the supporting structure 10. The worm 33 is disposed between the bearings 37, as shown in Figure 1. It is fixedly secured to the shaft 36 and is in meshing relation with the worm gear segment 34. The latter underlies and is bolted or otherwise fixedly secured to the bottom portion of the cradle 9 and is disposed between the bearing carrying arms 21 at the upper end of the supporting structure 10. When it is desired to elevate the barrel the shaft 35 is driven in one direction and when it is desired to lower or swing the barrel downwards in connection with pointing thereof the shaft 35 is reversely driven or rotated.

The range finder 12 is of the so-called coincidence type, and comprises an elongated cylindrical horizontally extending casing 38. The latter has end closures 39 at its ends and houses certain hereinafter described prisms and lenses. One end of the casing 38 extends through, and is journaled in, the trunnion type sleeve 19 of the cradle 9, as best shown in Figure 2. The fit between the range finder casing and the sleeve is such that the casing is free to rotate in either direction relatively to the sleeve while at the same time the range finder as a whole is maintained against any tilting movement. The cen-

tral portion of the range finder casing is located outwards of the adjacent end of the sleeve 19 and is provided with a radially extending sight tube 40. The outer extremity of the end of the range finder casing that is journaled in the sleeve 19 is provided with a radially extending opening 41 and the outer extremity of the other end of the casing is provided with a radially extending opening 42. These two openings face in the same direction and are positioned diametrically opposite the eye piece for the sight tube 40. In addition to the casing 38 the range finder 12 comprises a pair of penta prisms 43 and 44, a pair of objective lenses 45 and 46, an ocular prism 47 and eye lenses 48. The penta prism 43 is located in the range finder casing 38 directly behind the opening 42. The other penta prism, i. e., the penta prism 44, is mounted in the casing at a point directly behind the opening 41. The ocular prism 47 is located in the central portion of the range finder casing and is positioned directly in front of the eye lenses 48. The latter are mounted in the sight tube 40. The objective lens 45 is located between the penta prism 43 and the ocular prism 47 at a point in close proximity to the prism 43, and the objective lens 46 is located directly inwards of the penta prism 44. In addition to the aforementioned prisms and lenses the range finder comprises a pair of wedge shaped measuring prisms 49 and 50. These two prisms are disposed between the objective lens 45 and the ocular prism 47 and are identical except that one of them is placed in an inverted position with respect to the other so that all rays of light passing through them will emerge parallel to the axis of the range finder casing 38. The prism 49 is held in a fixed position with the casing 38 and the prism 50 is disposed inwards of the prism 49 and is mounted or supported as hereinafter described so that it is shiftable to and from said prism 49 in a lengthwise direction with respect to the range finder casing. The penta prisms 43 and 44, as well understood in the art, serve to turn through an angle of 90° the rays of light entering the range finder casing 38 via the openings 42 and 41. The ocular prism 47 serves two purposes. In the first place it divides the image into halves by cutting off along a straight line the lower half of the rays that come from the end of the range finder casing with the opening 42 and the upper half of the rays that come from the opposite end of the casing, that is, the end of the casing with the opening 41. In addition it serves to turn the reflected rays through an angle of 90° toward the eye lenses 48 in the sight tube 40. The observer at the sight tube sees a composite view, the upper half of the image coming through the penta lens 43 when sighting correctly on the target, the objective lens 45 and the measuring prisms 49 and 50, and the lower half coming through the penta lens 44 and the objective lens 46. If the range finder is directed at a target at an infinite distance rays of light from the target entering the two ends of the range finder will be parallel. If the range finder is properly adjusted with the measuring prisms 49 and 50 in contact with one another each ray of light will be reflected through two right angles and the resulting image will not be distorted in any way. In other words, the upper half of the target as viewed in the sight tube will be exactly over the lower half of the target and the two images will be in coincidence. If the range finder is directed at a target at a finite range the rays of light from the target entering

the range finder casing via the openings 41 and 42 will no longer be parallel and therefore the resulting composite image as seen in the sight tube will no longer appear undistorted. The upper half of the image will be displaced laterally with respect to the lower half of the image. In order to bring the upper half of the image into coincidence with the lower half of the image it is necessary to shift the movable wedge shaped prism 50 away from the fixed wedge shaped prism 49. By shifting the prism 50 away from the prism 49 the upper half of the target or image may be made to coincide with the lower half of the image or target. The amount of shift of the movable prism 50 away from the stationary prism 49 determines the range or distance of the target from the range finder. When the target to be viewed for range determining purposes is at a great distance from the range finder, the movable prism 50 will be in close proximity to the fixed prism 49 when the upper and lower halves of the image are in coincidence. On the other hand, when the target is in close proximity to the range finder the movable prism 50 must be shifted a greater distance from the fixed prism in order to bring the upper and lower halves of the target into coincidence. As heretofore pointed out, when the target is properly located in the range finder, that is, when the upper and lower halves of the target as seen in the sight tube coincide, the distance of the movable wedge shaped prism 50 with respect to the fixed or stationary prism 49 determines the range of the target with respect to the range finder. In general when the upper and lower halves of the image or target coincide the range finder is properly adjusted and the distance of the movable prism 50 with respect to the fixed prism 49 is determinative or proportional to the distance of the target from the range finder. If desired a scale 51 having suitable range markings may be associated with the prisms 49 and 50 so that the range of the target from the range finder may be readily ascertained when the finder is properly sighted or adjusted.

The improved pointing or control mechanism coacts with the movable wedge shaped prism 50 of the range finder and, as hereinafter described, operates in such manner that when the barrel of the gun is pointed or aimed the target cannot be correctly located in the range finder unless the barrel of the gun is adjusted to the correct elevation for a direct hit. It is essentially automatic so far as operation is concerned and may be placed in the category of a semi-automatic pointing or controlling mechanism in that it is necessary manually to manipulate or adjust the range finder and also control elevation or tilting of the barrel of the gun. As one of its primary or principal parts the mechanism comprises a cam type guide plate 52. This plate is preferably in the form of a metallic casting and is positioned between the sight tube 40 and the upper portion of the supporting structure 10. It overlies the subjacent end of the trunnion type sleeve 19 and consists of an arcuate semi-cylindrical hub 53, and an outwardly extending wall 54. A pair of horizontally extending laterally spaced rods 55 together with a pair of supporting arms 56 serves as a medium for supporting the guide plate 52 so that it is bodily shiftable horizontally to and from the supporting structure 10 while at the same time it is held against rotation about the common axis of the trunnion type sleeve 19 and the range finder casing 38. The arms 56 are

arranged in straddled relation with the guide plate and have the inner ends thereof bolted or otherwise fixedly secured to the adjoining bearing 22 of the supporting structure 10. They extend horizontally, as shown in Figures 2 and 6, and have inwardly extending lugs 57 at their outer ends. The rods 55 are in parallel relation with the arms 56 and are disposed inwards of the latter. The inner ends of the rods fit within sockets in the adjacent bearing 22. The outer ends of the rods fit within holes in the lugs 57. Set screws 58 extend through said lugs 57 and serve to hold the rods against axial displacement. The central portions of the rods extend through horizontally extending holes 59 in the hub 53 of the guide plate 52 and thus support the guide plate so that it is slidable back and forth to and from the supporting structure. In view of the fact that the rods 55 and arms 56 are carried by the supporting structure the guide plate is held against rotation relatively to the supporting structure 10 although it is shiftable back and forth to and from the latter. The portion of the trunnion type sleeve 19 which underlies the guide plate 52 and is between the guide plate supporting rods 55 is provided with a cutout 60 whereby the adjacent portion of the range finder casing 38 is exposed. In addition to the cam type guide plate 52 the pointing or controlling mechanism comprises a screw shaft 61 for conjointly shifting the plate and the movable prism 50 of the range finder. This shaft is disposed exteriorly and longitudinally of the central portion of the casing 38 of the range finder. The inner end of the shaft is disposed between the hub of the guide plate and the subjacent portion of the range finder casing and is located in the cutout 60 in the sleeve 19. It is confined within, and extends longitudinally of an elongated horizontally disposed guide strip 62 of U-shaped cross section (see Fig. 5). The strip 62 is located in the cutout 60 and fits against, and extends longitudinally of, the range finder casing 38. It has bearings 63 at its ends and is fixedly secured to the casing 38 by way of screws 64. The latter, as shown in Figure 6, extend through the range finder casing and into internally threaded sockets in the bearings 63 at the ends of the guide strip 62. The inner end of the screw shaft 61 extends through, and is journaled in the bearings 63. A slide block 65 is slidably mounted in the guide strip 62 and has an internally threaded bore 66. The inner end of the screw shaft extends through this bore 66, as shown in Figure 6. In addition to the bore 66 the slide block 65 is provided with an outwardly extending dog 67 which fits within an arcuate groove 68 in the hub 53 of the guide plate 52. When the screw shaft 61 is rotated or turned in one direction the slide block is shifted inwards and operates through the medium of its dog 67 to slide or urge inwards the cam type guide plate 52. When the screw shaft is reversely rotated the slide block is slid outwards and operates correspondingly to slide the guide plate 52. By reason of the fact that the dog 67 fits in the arcuate groove 68 the range finder casing may be rotated relatively to the trunnion type sleeve 19 without displacing the guide plate 52. However, regardless of the rotative position of the casing of the range finder turning of the screw shaft 61 operates to slide the guide plate to or from the supporting structure 10, depending upon the direction of rotation of the shaft. By reason of the fact that the guide strip 62 for the slide block 65 is fixed to the casing of the range finder by

screws 64 the strip together with the screw shaft 61 rotates with the range finder casing relatively to the sleeve 19. The outer end of the screw shaft 61 is journaled in an inner bearing 69 and an outer bearing 70. These two bearings are suitably secured to the casing 38 of the range finder, as shown in Figure 6. A head 71 on the inner end of the screw shaft and a set screw equipped collar 72 on the outer end of the shaft serve to hold the shaft against axial displacement. A follower 73 is mounted on the outer end of the screw shaft 61 and carries the movable wedge shaped prism 50 of the range finder. This follower has an internally threaded hole or bore at the outer portion thereof through which the screw shaft extends. The central portion of the follower extends through, and is slidable in, a longitudinal slot 74 in the range finder casing 38. The inner end of the follower is provided with suitable retaining means for the prism 50. When the shaft 61 is rotated in one direction the prism 50 together with the guide plate 52 is shifted inwards, that is, in a direction away from the fixed wedge shaped prism 49. When the shaft is reversely rotated or driven the follower 73 and prism 50 together with the guide plate 52 are shifted or slid in the direction of the fixed prism 49. The thread of the screw shaft is the same in pitch from end to end with the result that the guide plate and movable prism 50 are shifted conjointly in connection with drive or rotation of the screw shaft. A longitudinally extending rod 75 is supported by suitable bracket means in the range finder casing, as shown in Figure 6. This rod extends through a hole in the follower 73. It is in parallel relation with the outer end of the screw shaft 61 and serves in conjunction with the slot 74 in the range finder casing 38 to restrict the movable prism 50 to rectilinear sliding movement. An elongated sheet metal housing 76 overlies and surrounds the outer end of the screw shaft 61 and serves to prevent light from entering the interior of the casing 38 via the slot 74. The inner end of the housing 76 abuts against and is secured to the inner bearing 69 and the other or outer end of the housing engages the range finder casing at a point directly outwards of the outer bearing 70. The screw shaft 61 is rotated or turned by means of a worm 77 and a worm wheel 78. The worm is mounted on, and fixed to, a shaft 79, extends transversely across the screw shaft 61 and is carried in bearing brackets 80 on the range finder casing 38. As shown in Figures 2 and 6, the bearings 80 are located directly inwards of the inner bearing 69 for the screw shaft 61. A hand crank 81 is fixed to one end of the shaft 79 and is adapted when turned to rotate the shaft and the worm 77. The worm wheel 78 is in mesh with, and driven by, the worm 77 and is keyed, pinned, or otherwise fixedly secured to the shaft 61. When the crank 81 is turned in one direction it operates through the medium of the worm and worm wheel 77 and 78 to rotate the screw shaft so as to cause the prism 50 and the guide plate 52 to slide in one direction and when the crank 81 is reversely turned it operates so to drive the screw shaft as to move the prism 50 and guide plate 52 in the opposite direction. Adjustment of the movable prism 50 with respect to the fixed prism 49 is effected by turning the crank 81 in one direction or the other.

The upper or outer face of the wall 54 of the guide plate 52 constitutes a cam surface 82 and is shaped as shown in Figures 4, 5, 8, 9, 9^a, 9^b, 9^c,

9^d, 9^e, 9^f and 9^g. The portion of the cam surface 82 that is at the lower left hand side, as viewed in Figures 4 and 5, is curved substantially conformably to the outer periphery of the trunnion type sleeve 19 (see Figure 9^a). It has substantially no rise from front to back. The portion of the cam surface that is between the lower left hand portion and the top portion slopes gradually upwards and rearwards (see Figure 9^b) and, as shown in Figures 5 and 8, the degree of slope increases from left to right. The upper portion of the cam surface 82 also slopes upwards from front to back (see Figure 9^c) and the slope is of greater magnitude than the slope of the cam surface portions to the left thereof. The degree or magnitude of slope of said upper portion of the cam surface progressively increases from left to right. The portion of the cam surface that is immediately next to the upper portion slopes or is curved sharply upwards from front to back (see Figures 9 and 9^e) and the amount or degree of slope progressively increases from left to right. The lower right hand portion of the cam surface as viewed in Figures 4 and 5 slopes upwards and rearwards (see Figures 9^b and 9^g) as illustrated and the degree or magnitude of slope progressively decreases from left to right.

In addition to the parts hereinbefore described the improved semi-automatic pointing or controlling mechanism comprises an arm 84 and four bevel gears 85, 86, 87 and 88. The arm and the bevel gears 85, 86 and 87 are carried by a bracket 89 between the guide plate 52 and the worm 77. This bracket is preferably in the form of a one-piece metallic casting and comprises an annular hub 90, an inner arm 91, and a pair of laterally spaced outer arms 92. The annular hub 90 surrounds the central portion of the range finder casing 38 and is bolted or otherwise fixedly secured to the adjacent end face of the trunnion type sleeve 19 of the cradle 9. Due to the fact that the hub 90 is fixed to the sleeve the bracket 89 is caused to rotate with the sleeve relatively to the range finder. The inner arm 91 is formed integrally with, and extends at right angles to the outer margin of the bracket hub 90. It projects in the direction of the end of the range finder having the penta prism 43 and the measuring prisms 49 and 50 and has a bearing 93 at its outer end. This bearing, as shown in Figure 6, is arranged so that the axis thereof is radially positioned with respect to the range finder casing 38. The arms 92 are disposed outwardly of the arm 91 and have parts 94 which are in parallel relation with and extend in the same direction as, said arm 91. The outer ends of the arm parts 94 are provided with aligned bearings 95 and these extend transversely of the range finder and carry a shaft 96. The latter is free to rotate in the bearings 95 and is suitably held against endwise or axial displacement. The arm 84 is disposed at the side of one of the bearings 95 of the bracket 89 and has one end thereof mounted on and fixed to the central portion of the shaft 96. The other or outer end of the arm is in the form of a ball 97 which is adapted to engage and ride on the cam surface 82 of the guide plate 52. When the guide plate 52 is shifted outwards in connection with manipulation of the crank 81 the arm 84 is caused to swing upwards in a counter-clockwise direction as viewed in Figure 6 and causes corresponding turning or rotation of the shaft 96. When the guide plate 52 is shifted inwards in the direction of the supporting structure 10 the arm 84, due to contact of the ball 97

with the cam surface 82, swings inwards, that is, a clockwise direction, as viewed in Figure 6, and effects corresponding rotation or turning of the shaft 96. When the sleeve 19 of the cradle is rotated relatively to the supporting structure in connection with upwards or downwards tilting of the barrel 8 of the gun the ball 97 at the outer or distal end of the arm 84 travels over or across the cam surface 82. A tension spring 98 extends between the inner end of the arm 91 of the bracket 89 and the central portion of the arm 84 and serves to hold the ball 97 of the arm 84 in contact or engagement with the cam surface 82. The bevel gear 85 is fixedly secured to one end of the shaft 96 so that it is caused to rotate or turn conjointly with the arm 84. The bevel gear 86 is in mesh with the bevel gear 85 and is keyed or otherwise fixedly secured to the outer end of a shaft 99 which is journaled in the bearing 93 at the outer end of the bracket arm 91 and extends radially with respect to the range finder casing 38. The bevel gear 87 is located inwards of the bevel gear 86 and is in parallel relation with the latter. It is fixed to the inner end of the shaft 99 and meshes with and serves to drive or rotate the bevel gear 88. The latter extends around and is fixedly secured in any suitable manner to the central portion of the range finder casing 38. The hub 90 of the bracket 89 has an arcuate slot 100 through which the screw shaft 61 extends. The bevel gear 88 has a hole 101 and the screw shaft extends through this hole. The slot 100 permits the screw shaft 61 to swing laterally relatively to the bracket 89 in connection with rotation of the range finder relatively to the trunnion type sleeve 19. The bevel gears 85, 86, 87 and 88 operate to rotate the range finder 12 in response to swinging of the arm 84. When the arm 84 is swung upwards in a counterclockwise direction, as viewed in Figure 6, due to outward shift of the guide plate 52 the bevel gears cause the range finder 12 to be depressed, i. e., to rotate in a counterclockwise direction as viewed in Figure 4. When the arm 84 is caused to swing inwards in a clockwise direction as viewed in Figure 6, due to inward shift or displacement of the guide plate 52 and the action of the spring 98, the bevel gears 85, 86, 87 and 88 cause reverse turning of the range finder relatively to the trunnion type sleeve 19 of the cradle. From the foregoing it is clearly manifest that when the guide plate 52 is shifted in one direction or the other in response to adjustment of the movable wedge shaped prism 50 by manipulation of the crank 81 the range finder is angularly displaced or turned relatively to the sleeve 19. When the prism 50 and the guide plate 52 are shifted outwards, i. e., away from the supporting structure 10, the range finder is automatically depressed or rotated in a counterclockwise direction, as viewed in Figure 4. When the prism 50 and the guide plate are shifted inwards the arm 84 and the bevel gears 85, 86, 87 and 88 effect reverse rotation of the range finder relatively to the sleeve 19. The arm 84 is so arranged that it slides on the top portion of the cam surface 82 of the guide plate 52 when the barrel 8 of the gun is in a horizontal position. It is also arranged so that it travels or slides on the portion of the cam surface between the upper portion and the lower right hand portion when the gun is raised or elevated to a position wherein it extends at an angle of between 0° and 45° with respect to the horizontal. The lower right hand portion of the cam surface, that is, the portion 75

wherein the rearward and upward slope progressively decreases in magnitude from left to right as shown in Figure 8, receives the ball on the outer end of the arm 84 when the gun is elevated to a position wherein it extends at an angle from 45° to 90° with respect to the horizontal. The lower left hand portion of the cam surface and adjacent portion receives the ball when the gun is tilted downwards so that it extends at a negative angle with respect to the horizontal. The cam surface 82 of the guide plate is so shaped that the target at which the gun is to be fired cannot be located in the range finder unless the barrel of the gun is adjusted to the correct elevation for a direct hit. When an attempt is made properly to locate the target in the range finder by turning of the screw shaft 61 with a view of adjusting the movable wedge shaped prism 50 to the proper position so as to align the upper and lower halves of the image, displacement of the guide plate 52 occurs. Such displacement due to the action of the arm 84 and the aforementioned bevel gears causes rotative displacement of the range finder and necessitates the operator of the gun to adjust properly the elevation of the barrel before it is possible to bring the upper and lower halves of the image into coincidence.

When the gun is to be used to fire at an elevated target, say for example, a moderately far target at a 45° angle with respect to the horizontal, the barrel is first traversed to the proper extent and then is swung upwards so that it is pointed in the general direction of the target. Upward swinging of the barrel is effected by means of the hereinbefore described tilting mechanism 11. During upward swinging of the barrel and cradle the bracket 89 which is fixed to the trunnion type sleeve 19 of the cradle, rotates or swings with the cradle. The bracket is swung or turned in a clockwise direction as viewed in Figure 4, during upward swinging of the barrel. During clockwise swinging of the bracket the ball 97 at the distal end of the arm 84 comes in contact with the sharply curved portion of the cam surface 82, that is, the portion to the right of the top or upper portion of the cam surface 82 and causes the arm 84 to swing upwards or outwards and results in depression or counterclockwise rotation of the range finder. Upward swinging of the arm is attributable to the fact that the guide plate is of progressively increasing diameter from left to right. In order to compensate for depression or counterclockwise rotation of the range finder it is necessary further to elevate the barrel by manipulation of the mechanism 11. In the event that the target is visible in the range finder due to the barrel being at substantially the proper elevation but the upper and lower halves of the image of the target are not in coincidence due to the target being farther than the distance for which the range finder is adjusted, the crank 81 is turned in the proper direction to bring the prism 50 toward the fixed prism 49 with a view of bringing the upper and lower halves of the image into coincidence. When the screw shaft is turned in connection with an attempt correctly or properly to locate the target or image in the range finder the guide plate 52 is automatically displaced or shifted toward the bracket 89. During shift of the plate towards the bracket the arm 84 rides up on the adjacent portion of the cam surface 82 and operates through the medium of the bevel gears 85, 86, 87 and 88 to depress the range finder. In order again to bring the target into view through the range finder, the barrel

must be further elevated. Further elevation of the barrel compensates for or takes care of the larger trajectory due to the target being at a moderately far distance from the gun in order to again bring the target within the range finder. When the upper and lower halves of the image are finally brought into coincidence by proper adjustment of the movable prism 50 and as a result of the barrel being at the proper elevation firing of the gun will result in a direct hit. The cam surface 82 of the guide plate is so shaped that the target can be located in the range finder only when the barrel is at the proper elevation. If in sighting the gun the upper and lower halves of the image of the target are not in coincidence due to the target being nearer than the distance for which the range finder is adjusted, the crank is reversely turned with a view of bringing the upper and lower halves of the image into coincidence. When the screw shaft is turned so as to shift the movable prism 50 toward the fixed prism 49 with a view of bringing the upper and lower halves of the image into alignment or coincidence the guide plate 52 is shifted away from the bracket 89. During such shift of the plate the arm 84 rides down on the adjacent portion of the cam surface 82 and operates through the medium of the gears 85, 86, 87 and 88 to rotate the range finder in a clockwise direction as viewed in Figures 4 and 5. Such angular displacement on the part of the range finder necessitates downward swing of the barrel in order again to bring the target into view through the range finder. Downward swinging of the barrel effects the necessary trajectory adjustment. If in pointing or sighting the gun the target is visible in the range finder but the upper and lower halves of the image are not in coincidence it is necessary to turn the handle 81 in one direction or the other. If the crank 81 is turned so as to shift the movable prism 50 toward the fixed prism 49 with a view of bringing the upper and lower halves of the image into alignment or coincidence the guide plate 52 in moving conjointly with the prism 50 causes upward swing of the arm 84 and depression of the range finder. In order again to locate the target after depression of the range finder it is necessary further to elevate the barrel of the gun. If when the target is again brought into view in the range finder the upper and lower halves of the image are not in coincidence further adjustment of the screw shaft 61 is necessary and further adjustment of the elevation of the barrel is also necessary. Because of the action of the guide plate, the arm 84 and the four aforementioned bevel gears, the target can only be correctly located in the range finder when the gun is at the proper elevation for a direct hit. If the gun is not at the proper elevation the upper and lower halves of the image or target in the range finder are not in coincidence. The curvature of the cam surface in an axial direction is such that the successive trajectories traced by the range finder are correct for each different angle of elevation of the gun. In other words the cam surface due to its shape automatically takes care of trajectory adjustment. In using the gun it is contemplated that a single operator control the range finder adjustment and the tilting mechanism for the barrel and cradle. When a single operator is used in connection with pointing of the gun it is a comparatively simple matter for him, by proper elevation of the barrel, to be able to adjust the range finder so as correctly to locate the target.

When the target is correctly located in the range finder due to the upper and lower halves of the image being in coincidence firing of the gun will result in a direct hit due to the fact that the barrel of the gun must be at the proper elevation. The mechanism is semi-automatic in the sense that manual manipulation of the range finder adjustment and the elevating mechanism for the barrel is necessary in connection with pointing and firing of the gun. When the gun is sighted at an extremely close target it is necessary to adjust the prism 50 a maximum distance from the fixed prism 49. When the prism 50 is at its maximum distance from the prism 49 the guide plate 52 is in the position shown in dotted lines in Figure 6. In such position the ball 97 at the distal end of the part 84 engages the inner portion of the cam surface 82. Since such portion is concentric with the range finder casing 38 raising or lowering of the barrel does not result in any deflection of the range finder relatively to the sleeve 19 so that the line of sight from it and the barrel are parallel. When the gun is aimed at a target directly overhead, that is, in vertical alignment with the gun, the ball 97 rides on the lower right hand portion of the cam surface 82. Since this surface has no upward and rearward slope there is no angular displacement of the range finder relatively to the sleeve 19 in connection with focusing of the range finder. When a projectile is fired vertically the trajectory is straight. It is for this reason that the lower right hand portion of the cam surface is flat and so controls the arm 84 that there is no rotation of the range finder relatively to the trunnion type sleeve 19. When the gun is fired at a target at a 45° angle with respect to the horizontal the trajectory of the projectile increases rapidly as the distance between the gun and the target increases. It is for this reason that the portion of the cam surface to the right of the top portion is sharply curved upwards and rearwards. When the gun is fired at a negative angle, that is, at a target beneath the horizontal plane in which the gun is disposed, the super-elevation is extremely small and increases at an extremely small rate as the distance of the target to the gun increases. Because of this the portion of the cam surface 82 between the top portion and the lower left hand portion is only slightly inclined upwards from front to back.

The herein described automatic pointing or controlling mechanism is essentially simple and is both accurate and compact. If desired it may be housed within an enclosure (not shown) for secrecy or protection.

Whereas the automatic pointing mechanism has been described in connection with a range finder of the coincidence type it is to be understood that it may be used in connection with a stereoscopic or other type of range finder as well. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. The combination with a gun comprising a supporting structure, a barrel carried by the structure and supported pivotally so that it may be tilted vertically into different angular positions, and power means for tilting the barrel, of a range finder provided with means for ad-

justing the movable part thereof, embodying an elongated tubular casing, and mounted in coaxial relation with the pivot for the barrel and so that it is freely rotatable about its axis, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted to the proper firing angle, including means coacting with the adjusting means and serving to rotate said finder.

2. The combination with a gun comprising a supporting structure, a barrel carried by the structure and pivotally supported so that it may be tilted vertically into different angular positions, and power means for tilting the barrel, of a range finder provided with a longitudinally adjustable measuring prism and mounted in coaxial relation with the pivot for the barrel and so that it is freely rotatable about its axis, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted to the proper firing angle, including a cam type guide plate mounted on said structure for sliding movement lengthwise of the range finder and a connection between the guide plate and the movable prism whereby said plate and prism are connected together for conjoint sliding movement while at the same time the range finder is permitted to rotate about its axis.

3. The combination with a gun comprising a supporting structure, a barrel carried by the structure and supported pivotally so that it may be tilted vertically into different angular positions, and power means for tilting the barrel, of a range finder having a longitudinally slidable measuring prism and mounted in coaxial relation with the pivot for the barrel and so that it is freely rotatable about its axis, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted to the proper firing angle, including a cam type guide plate mounted on said structure for sliding movement lengthwise of the range finder, a connection between the guide plate and said movable prism whereby said plate and prism are caused to slide conjointly while at the same time the range finder is permitted to rotate, and gearing between the guide plate and range finder, actuated by the guide plate and arranged so as to cause the range finder to rotate in response to sliding movement of the guide plate.

4. The combination with a gun comprising a supporting structure, a barrel carried by the structure and supported pivotally so that it may be tilted vertically into different angular positions, and mechanism for tilting the barrel, of an elongated range finder having a longitudinally slidable prism and mounted in coaxial relation with the pivot for the barrel and so that it is freely rotatable about its axis, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted to the proper firing angle, including a cam type guide plate supported by said structure for sliding movement lengthwise of the range finder, a connection between the guide plate and said movable prism whereby said plate

and prism are caused to slide conjointly while at the same time the range finder is permitted to rotate, a gear extending around and fixed to the range finder, a second gear meshing with the first mentioned gear, and an arm for rotating said second gear, having one end thereof in engagement with the guide plate and adapted in response to shift of the guide plate in one direction to rotate the second gear and cause rotation of the range finder in one direction and upon shift of the guide plate in the other direction to turn said second gear reversely and cause reverse rotation of the range finder.

5. In combination with a gun comprising a supporting structure provided with a bearing, a barrel, and a tubular element connected to, and extending transversely of, the barrel, journaled in the bearing, and serving to support the barrel so that it is tiltable vertically into different angular positions, an elongated adjustable range finder extending through, and rotatably mounted in, said tubular element.

6. The combination with a gun comprising a supporting structure provided with a bearing, a barrel, a tubular element connected to, and extending transversely of, the barrel, journaled in said bearing, and serving to support the barrel so that it is tiltable vertically into different angular positions, and power means for tilting the barrel, of a range finder extending through and rotatably mounted in, the tubular element, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted at the proper firing angle, including means for rotating said finder.

7. The combination with a gun comprising a supporting structure provided with a bearing, a barrel, a tubular element connected to, and extending transversely of, the barrel, journaled in said bearing, serving to support the barrel so that it is tiltable vertically into different angular positions, and having a gear carrier secured to one end thereof, and power means for tilting the barrel, of a range finder provided with a longitudinally slidable prism and extending through and mounted rotatably in the tubular element, and mechanism whereby in connection with pointing of the barrel the finder is precluded from being adjusted correctly to locate the target unless the barrel is tilted at the proper firing angle, including a cam type guide plate mounted on said structure adjacent said gear carrier and for sliding movement lengthwise of the range finder, a connection between the guide plate and said movable prism whereby said plate and prism are caused to slide conjointly while at the same time the range finder is permitted to rotate, a gear extending around and fixed to the range finder and located adjacent to the gear carrier, a second gear carried by said gear carrier, and in mesh with the first mentioned gear, and an arm for rotating said second gear having one end thereof in engagement with the guide plate and adapted in response to shift of the guide plate in one direction to rotate the second gear and cause rotation of the range finder in one direction and upon shift of the guide plate in the other direction to turn said second gear reversely and cause reverse rotation of the range finder.

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