April 25, 1939. T. R. ARDEN 2,155,389

SIGHTING MEANS FOR GUNS

Filed March 9, 1937 5 Sheets-Sheet 1

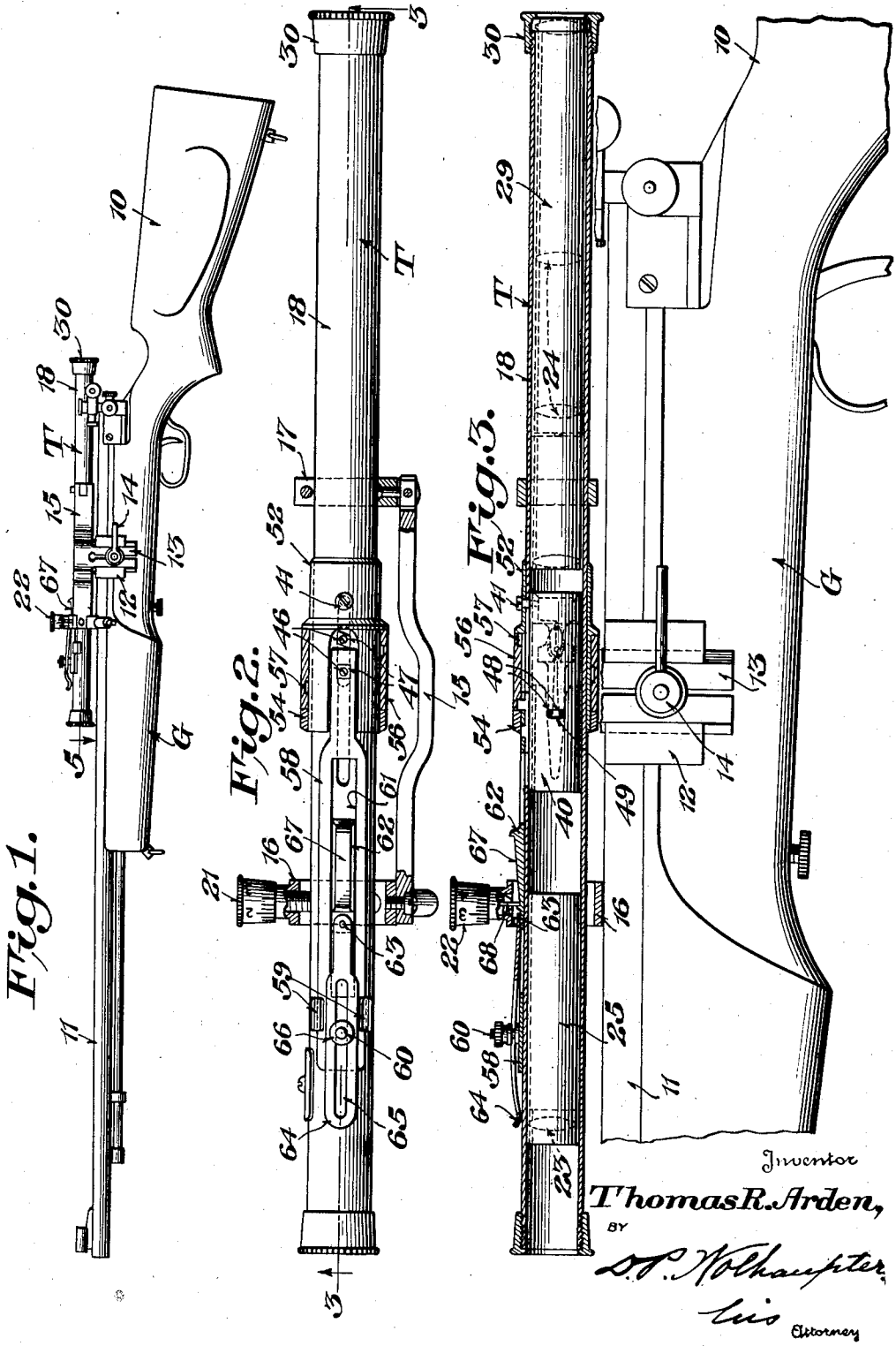

Fig. 1.

Fig. 2.

Fig. 3.

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SIGHTING MEANS FOR GUNS

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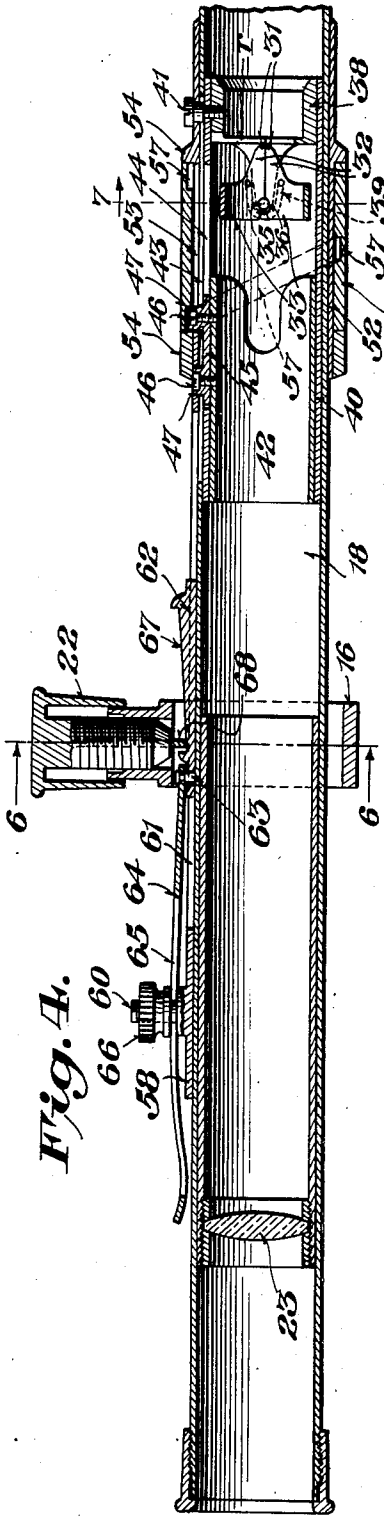

Fig. 4.

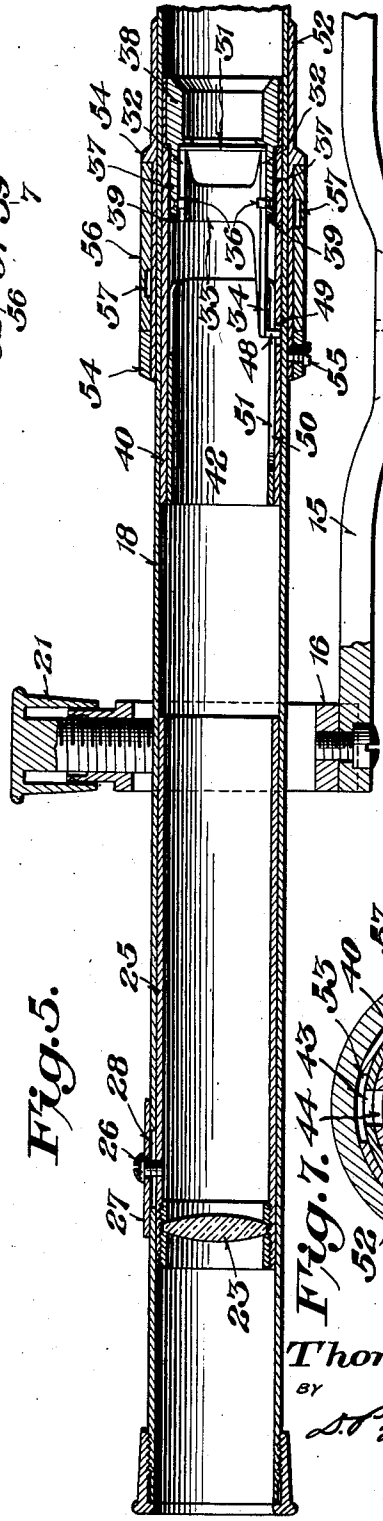

Fig. 5.

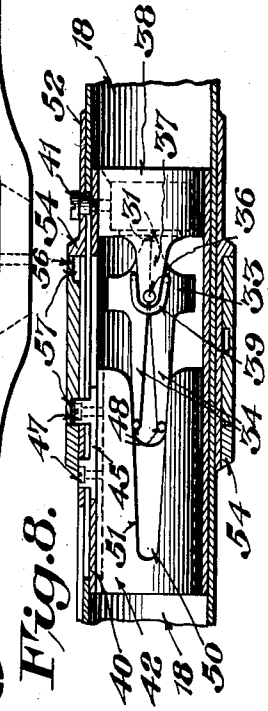

Fig. 8.

Fig. 7.

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SIGHTING MEANS FOR GUNS

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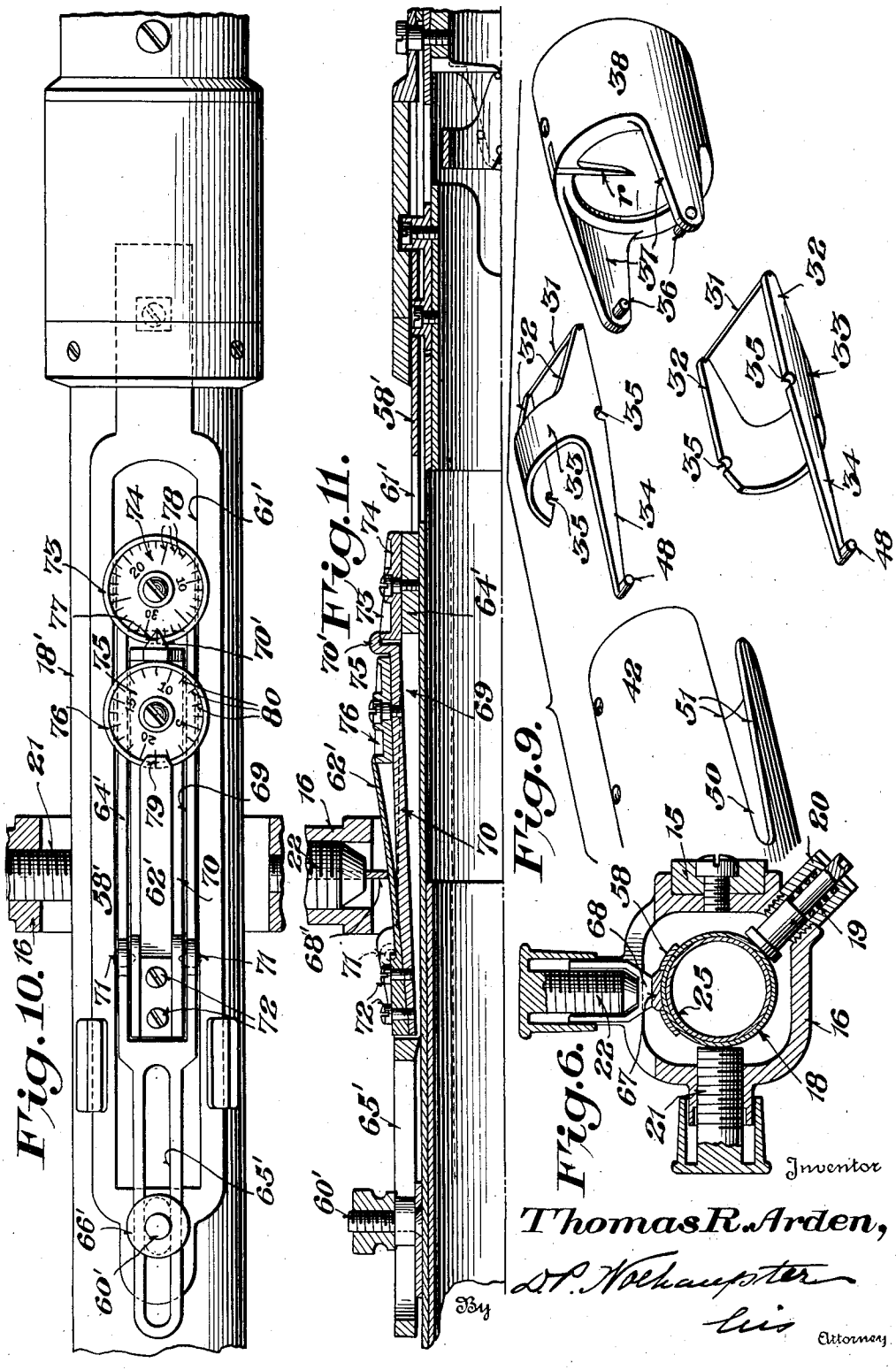

Fig. 10.

Fig. 11.

Fig. 9.

Fig. 6.

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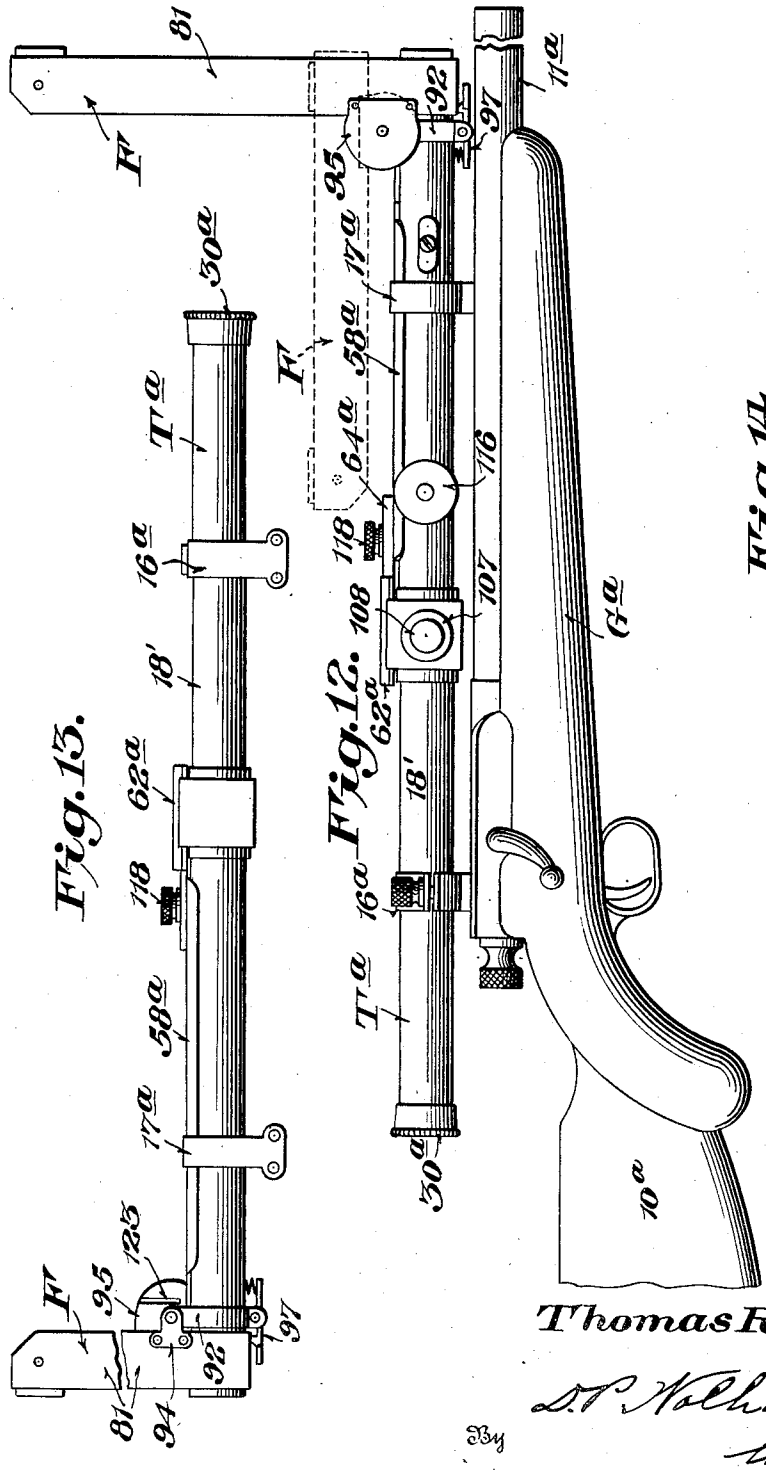
SIGHTING MEANS FOR GUNS

Filed March 9, 1937 5 Sheets-Sheet 4



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SIGHTING MEANS FOR GUNS

Filed March 9, 1937 5 Sheets-Sheet 5

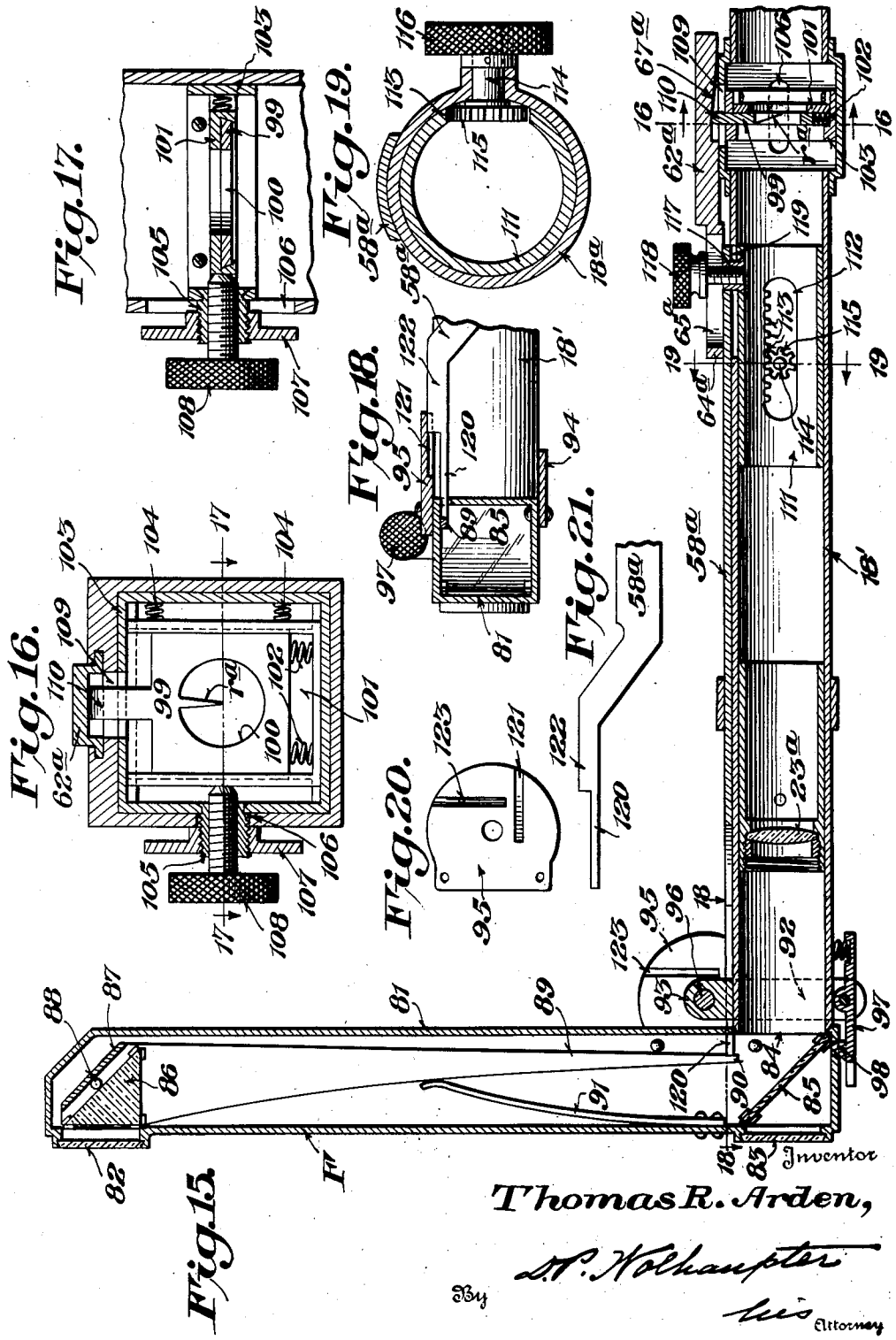

Fig. 15.

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Patented Apr. 25, 1939 2,155,389

UNITED STATES PATENT OFFICE

2,155,389

SIGHTING MEANS FOR GUNS

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Application March 9, 1937, Serial No. 129,951

15 Claims. (Cl. 33—50)

This invention relates to improvements in sighting means for guns, and has for its general object to provide a sighting means including a range finding means embodying a construction and mode of operation and a cooperative relationship with the gun, such that, by adjustment of the range finding means to ascertain the distance to a target, the angular relationship vertically between the axis of the gun barrel and the line of sight through the sighting means is varied by substantially the exact amount required to assure that, for any given projectile having any given muzzle velocity, the mere act of sighting the target through the sighting means will result in the gun being disposed at the proper elevation to compensate for fall of the projectile in flight and to assure impact of the projectile on the target either at the same point, where the line of sight through the sighting means strikes the target, or at a point definitely related to such point, for any range within the maximum effective range of the gun.

According to one practical form of the invention, a novel range finding means is embodied in a telescopic sighting means as a part thereof, and the combined range finding means and telescopic sighting means are mounted on the gun for vertical adjustments relative thereto to vary the angular relationship vertically between the axis of the gun barrel and the line of sight through the telescopic sighting means. In this connection a special and important object of the invention is to provide novel means whereby adjustment of the range finding means to ascertain the distance to a target varies the vertical angular relationship between the line of sight through the telescopic sighting means and the axis of the gun barrel by substantially the exact amount required to assure that, for any given projectile having any given muzzle velocity, the mere act of sighting the target through the telescopic sighting means will result in the gun barrel being disposed at the proper elevation to compensate for fall of the projectile in flight and to assure impact of the projectile on the target either coincidentally with the line of sight thereon, or at a point definitely related to the point of striking of the line of sight thereon, for any range within the maximum effective range of the gun.

According to another form of the invention, a range finding means of a known type is combined with a telescopic sighting means of a known type, and the combined range finding and telescopic sighting means have a fixed operative relationship to the gun. In this form of the invention the usual reticle of the telescopic sighting means is made adjustable to vary the angular relationship vertically between the line of sight through the telescopic sighting means and the axis of the gun barrel, and in this connection another special and important object of the invention is to provide novel means whereby adjustment of the range finding means to ascertain the distance to a target adjusts the reticle of the telescopic sighting means by substantially the exact amount required to assure that, for any given projectile having any given muzzle velocity, the mere act of sighting the target through the sighting means will result in the gun being disposed at the proper elevation to compensate for fall of the projectile in flight, and to assure impact of the projectile on the target either coincidentally with the line of sight thereon, or at a point in definite relationship to the point of striking of the line of sight thereon, for any range within the maximum effective range of the gun.

In connection with the first mentioned form of the invention another special and important object of the invention is to provide an exceptionally accurate range finding means operation of which is predicated upon the known height or width of certain well known relatively small distant objects, as distinguished from mere range estimation and from prior range finding devices operation of which is predicated upon converging spaced lines of sight upon a distant object.

While the mechanisms comprising the present invention may be varied in size and proportions to adapt them for use on large military guns as well as on military and sporting rifles and other firearms, said mechanisms will, for the sake of simplifying the present disclosure, be illustrated and described as applied to a sporting rifle.

With respect to sporting rifles, it is well known that different types of ammunition usually are provided for use therein and that the two most common types are the high velocity or long range type and the normal velocity or shorter range type. In this connection it would appear that, since the mechanism comprising the invention is designed and calculated on the basis of the known characteristics in flight of a given bullet shot from a given gun at a given muzzle velocity, there would have to be employed a different means of coordinating the range finding means with the gun for each of the two mentioned different types of ammunition used in order to obtain accuracy in each case. This, however, is not necessary. On the contrary, it is another special and important object of the invention to provide a range finding

means and telescopic sighting means combination, together with a single adjustable means responsive to adjusting of the range finding means to vary the line of sight through the telescopic sighting means vertically relative to the axis of the gun barrel for the purpose heretofore stated, so that by adjustment of said adjustable means the mechanism may be rendered equally effective to assure proper elevation of the gun barrel to compensate for fall of the bullet in flight and striking of the target either coincidentally with the line of sight thereon, or at a point in definite relationship of the point of striking of the line of sight thereon, regardless of whether high velocity or normal velocity ammunition is used.

With the foregoing and various other objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in the novel features of construction and in the novel combinations and arrangements of elements as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

In the accompanying drawings:

Figure 1 is a side elevation of a rifle equipped with a range finding means and a telescopic sighting means combination constructed and combined with the rifle in accordance with one practical embodiment of the invention.

Figure 2 is an enlarged top plan view, partly in section, of the mechanism shown in Fig. 1.

Figure 3 is a central, vertical, longitudinal section through the mechanism shown in Figs. 1 and 2, parts being shown in elevation.

Figure 4 is an enlarged view similar to Fig. 3 illustrating in section parts shown in elevation in Fig. 3.

Figure 5 is a sectional view similar to Fig. 4 but taken on a horizontal plane.

Figure 6 is a cross section on the line 6—6 of Fig. 4.

Figure 7 is a cross section on the line 7—7 of Fig. 4.

Figure 8 is a fragmentary view similar to Fig. 4 showing the cam tube in elevation.

Figure 9 is a perspective view showing a separated relationship of cooperating parts of the mechanism.

Figure 10 is a top plan view illustrating an alternative form of the invention.

Figure 11 is a longitudinal section through the structure shown in Fig. 10.

Figure 12 is a view similar to Fig. 1 illustrating another alternative form of the invention.

Figure 13 is a view looking at the side of the mechanism of Fig. 12 opposite the side thereof appearing in Fig. 12.

Figure 14 is a top plan view of the mechanism shown in Figs. 12 and 13.

Figure 15 is an enlarged vertical, longitudinal section through the mechanism shown in Figs. 12 to 14.

Figure 16 is a cross section on the line 16—16 of Fig. 15.

Figure 17 is a section on the line 17—17 of Fig. 16.

Figure 18 is a section on the line 18—18 of Fig. 15.

Figure 19 is a section on the line 19—19 of Fig. 15.

Figure 20 is an inner face view of one of the range finder mounting plates of the Figs. 12 to 19 form of the invention.

Figure 21 is a detail plan view of the reticle adjusting slide-piece of the Figs. 12 to 20 form of the invention.

Referring to the drawings in detail, first with particular reference to the form of the invention illustrated in Figs. 1 to 9, G designates, generally, a gun which, within the purview of the invention, may be of any type, large or small, as will hereinafter become apparent, the same being illustrated in the present instance as a sporting rifle merely for the sake of simplicity and convenience.

On the gun G, which includes, as usual, a stock 10 and a barrel 11, is fixed a bracket 12, and in said bracket is slidably mounted for vertical adjustment an arm 13 which, by a suitable clamping means, designated as 14, may be secured in different vertically adjusted positions relative to the gun.

Rigid with the arm 13, at the top thereof, is a horizontal bar 15 which extends longitudinally relative to the gun and carries at its front and rear ends a pair of rings 16 and 17, respectively, which are disposed vertically and transversely relative to the gun and serve as supports for the present sighting telescope designated generally as T.

The telescope T includes a barrel 18 which extends through the rings 16 and 17 and is suitably clamped in the rear ring 17, which ring is mounted for swinging movement in a horizontal plane and for rotation about a horizontal axis. On the other hand said barrel is supported within the front ring 16 for vertical and lateral adjustments relative thereto so that the optical axis of the telescope may be shifted laterally and vertically relative to the axis of the gun barrel to compensate for windage and to obtain an initially correct angular relationship vertically between the optical axis of the telescope and the axis of the gun barrel.

Since lateral angular adjustments of the telescope relative to the gun barrel to compensate for windage cannot be predetermined, but must necessarily be made in accordance with prevailing wind conditions at the particular time of use of the gun, the present invention is not concerned with windage adjustment means, other than that the same is provided and may be used if found to be necessary or desirable. Yieldable means comprising a spring 19 housed within a cup-like member 20 carried by the ring 16 constantly urges the telescope barrel upwardly and laterally in one direction in accordance with known practice. Also, in accordance with known practice, the windage adjustment means may comprise a screw member 21 carried by the ring 16 at one side thereof for exerting a lateral shifting force thereagainst counter to the lateral shifting force exerted thereagainst by the spring 19. Similarly and further in accordance with known practice, the means for vertically adjusting the telescope may comprise a screw member 22 carried by the ring 16 at the top thereof for exerting a downward shifting force on the barrel 18 counter to the upward shifting force exerted thereon by the spring 19. These adjustment means will not further be referred to because the invention is not, as aforesaid, concerned with windage adjustment means, and because, once a proper initial vertical adjustment of the telescope has been made by means of the screw 22 for point blank range, the said adjustment screw 22 is not again disturbed. In other words, for purposes of the present description, it may be assumed at the outset that the optical axis of the telescope lies in a vertical

plane including the axis of the gun barrel and that the angular relationship vertically between the optical axis of the telescope and the axis of the gun barrel is such that said axes intersect at some suitable point blank range such, for example, as twenty-five feet.

The telescope may, of course, be disposed in any longitudinally adjusted position relative to the rings 16 and 17 and, consequently, relative to the gun, to suit any particular marksman. Moreover, the provision for bodily adjusting the telescope vertically in accordance with known practice, permits the telescope to be elevated to and fastened in an out-of-the-way position when it is desired to use the ordinary gun sights or when, for any reason, use of the telescope is not desired.

Within the barrel 18 is a telescopic lens system of any suitable type including an object lens 23 and any desired plurality of cooperating converging lenses 24. The object lens 23 is disposed near the front end of the barrel 18 and is longitudinally adjustable relative thereto to sharpen the image and to bring it into focus with the eye. In the present instance said object lens is mounted in a tube 25 which fits snugly and slidably within the barrel 18 and which may be secured in any longitudinally adjusted position relative to said barrel by means of a screw 26. This screw extends loosely through a clamp plate 27 disposed against the outside of the barrel 18 and through a slot 28 in the barrel extending longitudinally thereof, and is threaded into the tube 25. Thus, by loosening said screw, the tube and lens are released for adjustment, and by tightening said screw the tube and lens are secured in any adjusted position.

While the converging lenses 24 may be mounted in the barrel 18 in any suitable manner, they are illustrated in the present instance as being mounted as a unit in a tube 29 which snugly fits the barrel 18 and is retained therein by an eyepiece 30 threaded on the inner end of the barrel.

Now, in accordance with the present invention, there also is mounted in the barrel 18 a range finding means including a pair of stadia hairs 31, 31 which are disposed in a plane transversely of the telescope including the focal point of one of the lenses of the lens system and which are mounted for adjustment toward and away from each other. Preferably, said stadia hairs are disposed horizontally in a plane transversely of the telescope including the focal point of the object lens 23, and since said lens is adjustable longitudinally relative to the barrel 18, said stadia hairs also are mounted for adjustment longitudinally relative to said barrel so that they may be disposed in a plane transversely of the telescope including the focal point of said object lens no matter what the position of adjustment of said object lens may be.

The operation of the present range finding means consisting essentially of the stadia hairs 31, 31 in combination with the telescope lens system, is predicated upon the known approximate height or width of certain well known objects of more or less relatively small height, or width, depending upon whether the stadia hairs are disposed horizontally or vertically, upon maximum range to be determined in any given case, and upon the magnifying power of the lens system. For example, in the case of a firearm of the small caliber, sporting rifle type, the maximum effective range of which is, for example, two hundred yards, and in the case of a lens system having a magnifying power sufficient to render relatively small objects clearly visible at a distance of two hundred yards, operation of the range finder may appropriately be predicated upon objects well known to have some arbitrary small height, or width, such, for example as approximately six inches. On the other hand, in the case of guns having longer effective ranges, and in the case of telescopes having more powerful lens systems, operation of the range finder may be predicated upon objects having well known greater height, or widths.

Assuming that the present telescope T has a sufficient magnifying power to render small objects clearly visible at a distance of two hundred yards and that the gun G is of the small caliber, sporting rifle type having a maximum effective range of two hundred yards, well known objects of approximately six inches in height, or width, or of other arbitary small height, or width, suitable on which to predicate operation of the range finder are, for example, a man's head, the head of a deer, or in fact, any object which is known to the marksman to have a height, or width, of approximately six inches or any other small height or width, which may arbitrarily be chosen.

By sighting through the telescope T and adjusting the stadia hairs so that they exactly bracket an object six inches in height or of other arbitrarily chosen small height, located at different known distances from the gun G, and by recording the distance apart of the stadia hairs for each such distance, it is apparent that when, subsequently, the stadia hairs are adjusted to exactly bracket an object known to be of the same or approximately the same height as the object or objects on which the stadia hair adjustment records were based, but of unknown distance from the gun, such distance may very accurately be determined by the spaced apart relationship of the stadia hairs. In other words, there will be a definite and different spaced apart relationship of the stadia hairs for an object of a given height at every different distance from the gun, and if the distances represented by different spaced apart relationships of the stadia hairs are known, it is manifest that by sighting through the telescope at an object an unknown distance away, but known to be of approximately the basic small arbitrary height on which operation of the range finder is predicated, and by adjusting the stadia hairs so that they exactly bracket such object, or bracket a portion thereof of the small known arbitrary basic height, reference to the record previously made will show that the object is a definite distance away. Manifestly, this way of determining unknown distances or ranges is exceedingly accurate due to the small angles involved. Moreover, once a record has been made of the distances or ranges represented by certain spaced apart relationships of the stadia hairs for a telescope of any given magnifying power, the same record applies to all other duplicately constructed telescopes, which, of course, is important from a manufacturing standpoint. Manifestly, the use of a telescope or magnifying lens system is not essential. However, by the use of a magnifying lens system, the range finder is rendered much more accurate than it would be if used without a magnifying lens system. Of course, if height is to constitute the basis of operation of the range finding means, the stadia hairs will be disposed horizontally. If, on the other hand, width is to constitute the basis of operation of the range finder, the stadia hairs will be disposed vertically.

According to the present invention, the means for adjusting the stadia hairs 31, 31 preferably is calibrated to indicate a definite range for every spaced apart relationship of said stadia hairs. However, the provision of such calibrations is not essential for reasons which will subsequently appear.

Each of the stadia hairs 31 is suitably fastened at its ends to the ends of a pair of arms 32, 32 of a related rockable element 33 and extends between the arms 32, 32 of said element.

There are two of the rockable elements 33 and they are duplicates of each other. Each comprises a substantially semi-cylindrical body portion having extending from one end and at opposite side edges thereof the pair of arms 32, 32, and from its other end, at one side edge thereof, a single arm 34. In the two opposite longitudinally extending edges of the body portion of each of said rockable elements are alined, small, semi-circularly-shaped recesses 35, and from each of said recesses the related longitudinal edge of the body portion recedes outwardly so that by placing the two rockable elements at opposite sides of a pair of pivot pins, with the pivot pins disposed in the recesses 35, the two rockable elements are capable of rocking movement about said pins to move the stadia hairs 31, 31 toward and away from each other.

The two rockable elements 33, 33 are rockably mounted on a pair of pivot pins 36, 36 which extend inwardly from a pair of arms 37, 37 projecting from one end and from opposite sides of a hollow, cylindrical mounting block 38. The pivot pins 36, 36 are alined with each other and are disposed, in the present instance, in a horizontal plane, and the rockable elements 33, 33 are disposed, respectively, above and below said pivot pins with their recesses accommodating said pivot pins.

For retaining the rockable elements 33, 33 in assembly with each other and with the mounting block 38, two small, U-shaped, wire springs 39, 39 are employed, one at each of the two adjacent side edges of said rockable elements. Each spring is anchored at one end in one of the elements 33 and at its other end in the other of said elements 33, and said springs act contractively. The rocking elements, 33, 33 thus are urged constantly toward each other and are held pivotally or rockably engaged with the pivot pins 36, 36 and in assembly with each other and with the mounting block 38. Moreover, because of this manner of mounting said rockable elements, there obviously is a constant take-up to compensate for any wear on the pivot pins 36 or in the recesses 35. Thereby any looseness in the mounting of the rockable elements and which, if permitted, would affect the accuracy of the range finder, always is avoided.

The ends of the springs 39, 39 are anchored in the rockable elements 33, 33 between the plane of the pivot pins 36, 36 and the ends of the arms 32, 32 carrying the stadia hairs 31, 31. Thus, said springs function additionally to tend constantly to rock said rockable elements to swing their arms 32, 32, and consequently the stadia hairs 31, 31, toward each other.

The mounting block 38, which carries the usual reticle r, fits snugly within the rear end of a tube 40 and is fixedly secured therein by a clamp screw 41 which passes loosely through a side opening in said tube and is threaded into said mounting block. The tube 40 fits snugly within the barrel 18 and is slidably adjustable therein longitudinally with respect thereto. Similarly, a cam tube 42 fits snugly within the forward end of the tube 40 and is slidably adjustable therein longitudinally with respect thereto.

In the top of the barrel 18 is an elongated slot 43 which extends longitudinally relative to said barrel, and in the top of the tube 40 is a similar slot 44. In the slot 44 is disposed a block 45 of a width equal to said slot and which is fastened by screws 46 to the cam tube 42. The cam tube thus is free to be slid longitudinally relative to the tube 40, but is held against rotation relative thereto. A pair of lugs 47, 47 on the block 45 are disposed in the barrel slot 43 and are of widths equal to said slot. Thus, both the cam tube 42 and the tube 40 are held against rotation relative to the barrel 18, but the tube 40 with the cam tube therein is free to be slid longitudinally relative to said barrel.

At the outer ends of the arms 34, 34 of the rockable elements 33, 33 are outwardly directed pins 48, 48, one on each arm, which are accommodated in a small transverse slot 49 in one side of the tube 40. These pins extend through a longitudinally extending slot 50 in one side of the cam tube 42 and respectively cooperate with the side edges of said slot which constitute cams 51, 51. Generally speaking, the side or cam edges of said slot converge forwardly. Therefore, when the cam tube 42 is slid rearwardly or inwardly, the cam edges 51, 51 cooperate with the pins 48, 48 to swing the arms 34, 34 toward each other, which, of course, results in rocking of the elements 33, 33 about their pivot pins 36, 36 and consequent relative outward swinging movement of the arms 32, 32 of said elements and separation of the stadia hairs 31, 31. On the other hand, when the cam tube 42 is slid forwardly or outwardly, the arms 34, 34 are permitted to move apart, and are moved apart, by the springs 39, 39. At the same time, the arms 32, 32 of the respective rockable elements are moved toward each other with consequent movement of the stadia hairs 31, 31 toward each other.

The cam edges 51, 51 are duplicates of each other and they are shaped so that in any given longitudinally adjusted position of the cam tube relative to the tube 40 the stadia hairs 31, 31 are disposed a definite distance apart. Moreover, they are plotted with reference to bracketing by the stadia hairs of an object of arbitrarily small height disposed at different distances from the mechanism, so that each different longitudinally adjusted position of the cam tube corresponds to a different and definite range.

On the barrel 18 is a sleeve 52 which is locked rigidly to the tube 40 by the clamp screw 41. The sleeve 52 is provided with a slot 53 alined with the barrel slot 43 and with a spaced pair of annular shoulders 54, 54, one of which is constituted by a ring fastened by a screw 55 to said sleeve 52. On said sleeve, between said shoulders, is rotatably mounted a cylindrical finger-piece 56 which is held by the shoulders 54, 54 against longitudinal movement relative to said sleeve. Said finger-piece is formed with an internal spiral groove 57 and in said groove is disposed the outer end portion of the innermost lug 47 which extends outwardly into said groove through the slot 53 in the sleeve 52. By this arrangement it is obvious that by rotating the finger-piece 56 in one direction the cam tube will be slid inwardly, and that by rotating said finger-piece in the opposite direction the cam tube will be slid outwardly, with consequent adjustments in the spaced relationship of

the stadia hairs 31, 31. It will also be obvious that if the sleeve 52 is provided with an index and the finger-piece 56 is properly calibrated, adjustment of said finger-piece to cause the stadia hairs to bracket an object viewed through the telescope and of the known small height on which the design of the instrument is predicated, the range of the object will be indicated by the position of a calibration on the finger-piece relative to the index on the sleeve. The sleeve preferably is provided with an index and the finger-piece preferably is calibrated so that there may be had an indication of the range of any object of the arbitrary small height on which operation of the instrument is predicated and which may be bracketed by the stadia hairs 31, 31. As previously stated, however, this is not necessary, since, according to the invention, the marksman need not know the range to a target at which he may be shooting. In other words, in accordance with a very important feature of the present invention, means is provided whereby adjustment of the cam tube 42 to vary the spacing of the stadia hairs 31, 31, effects angular adjustment of the telescope vertically relative to the gun barrel so that, for any given projectile having any given muzzle velocity, the mere act of sighting an object of the known small height on which operation of the range finding means is predicated, and of adjusting the stadia hairs to bracket such object, will result in the gun being disposed at the proper elevation to compensate for fall of the projectile in flight and to assure impact of the projectile on the target either coincidentally with the point of striking of the line of sight thereon, or at a point in definite relationship to the point of striking of the line of sight thereon, for any range within the maximum effective range of the gun.

On top of the telescope barrel 18 is disposed a slide-piece 58 which, at its rear or inner end, is connected with the cam tube 42 and which, at or near its outer end, is disposed between a pair of guide members 59, 59 on the barrel 18 whereby it is retained in assembly with said barrel and is guided for longitudinal movement relative thereto. While this slide-piece may be connected with the cam tube 42 in any suitable manner, it preferably is detachably connected therewith through the block 45. In other words, according to the present construction, the slide-piece is provided near its inner end with an opening in which is disposed the outermost of the lugs 47 on the block 45. Thus, when the cam tube is shifted the slide-piece is shifted therewith.

At or near its forward end the slide-piece 58 is provided with an upstanding screw threaded stud 60, and inwardly of this stud said slide-piece is provided with a longitudinally extending slot 61. In the slot 61 is disposed a cam 62 which is of a width equal to said slot whereby it is held against lateral movement, and which seats at its bottom against the top of the barrel 18. In the outer end of said cam is a small hole in which is engaged a pin 63 depending from the inner end of a leaf spring 64.

The leaf spring 64 is provided with a longitudinally extending slot 65 through which the stud 60 extends, and threaded on said stud is a nut 66 for clamping said leaf spring to the slide-piece 58. Preferably the leaf spring has a normal bow so that when it is clamped by the nut 66 its inner end is depressed to maintain the pin 63 engaged in the hole in the outer end of the cam 62. In any event, the construction described provides for securing the cam 62 to the slide-piece 58 in different longitudinally adjusted positions with respect thereto, and while the construction described is practical, it is apparent, of course, that any other suitable construction may be employed in lieu thereof. In fact, that is true of the entire device.

The cam 62 has a top cam surface 67 which, generally speaking, slopes forwardly and downwardly and cooperates either directly with the inner end of the adjusting screw 22 or with a narrow cam follower element 68 which is adjustable with said screw and affords line or edge contact with said cam across the same. In either case, it is apparent that since the element 67 has a fixed relationship to the gun G, shifting the cam 62 forwardly will result in downward and forward tilting of the telescope T relative to the gun, and shifting of said cam rearwardly will result in forward, upward tilting of the telescope relative to the gun by the spring 19.

For a given gun using given ammunition, the necessary elevation of the gun to compensate for fall of the projectile in flight for different ranges either is known or may very readily be ascertained. The cam tube 42 has a definite position for each different range, and since the cam 62 moves with said cam tube, said cam 62 must also have a definite position for each different range. Also, the gun G must have a definite angular position relative to the telescope for each different range to assure impact of the bullet with the target either at the point where the line of sight through the telescope meets the target or at some other point in definite relationship to the point where the line of sight meets the target. Therefore, all that is required to obtain proper angular adjustment between the telescope and the gun by adjustment of the range finding means is so to shape the cam surface 67 of the cam 62 that for any given longitudinally adjusted position of the cam tube 42 and the cam 62, the angular relationship vertically between the axis of the gun barrel and the optical axis of the telescope is such that for a given ammunition, the gun will be disposed at the proper angle or elevation relative to the line of sight through the telescope to assure impact of the projectile on the target either coincidentally with the point at which the line of sight through the telescope meets the target or at a point in definite relationship to said first mentioned point. The cam surface 67 has such a shape. It follows, therefore, that responsive to adjustment of the present range finding means there occurs a relative angular adjustment between the axis of the gun barrel and the optical axis of the telescope such that, for a given projectile having a given muzzle velocity, sighting of the target through the telescope will result in proper elevation of the gun to assure striking of the target either at the point where the line of sight through the telescope meets the target or at some other point in definite relationship to said first mentioned point. Of course, it is most practical in this respect to provide for impact of the projectile on the target coincidentally with the point of striking of the line of sight thereon, but so long as the point of impact has a definite relationship to the point of striking of the line of sight on the target, the point of impact obviously may be spaced from the point of striking of the line of sight on the target and the marksman merely is required to make allowance for such spacing in aiming the gun. Preferably the line of sight is the optical axis of the telescope, but this is not essential.

Of course, a different cam surface 67 is required for each different type of ammunition, but usually only two types of ammunition are used—high velocity and normal velocity. Consequently, only two cams 62 will, as a rule, be required. By the construction illustrated and described these may very readily be interchanged. Alternatively, a single cam 62 may be formed with two or more distinct cam surfaces 67 and provision may be made for using said cam surfaces selectively.

In adapting the mechanism for use by any given marksman, the telescope T first is adjusted longitudinally in the supporting rings 16 and 17 and vertically relative to the gun so that when the gun is brought to shoulder the telescope is disposed in the natural line of sight of the marksman's eye. If necessary, the object lens 23 then is adjusted to sharpen the image and to bring it into focus with the eye. The stadia hairs then are adjusted to zero or point blank range and the assembly comprising the stadia hairs and their adjusting means is adjusted to bring the stadia hairs into the focal plane of the object lens. The cam 62 then is adjusted for point blank range relative to the follower element 68 and the nut 61 is tightened to connect said cam with the cam tube 42 for adjustments in unison with the latter. The mechanism then is in readiness for use. The marksman sights his target and selects a part thereof which he knows is approximately of the height, or width, on which operation of the range finder is predicated, depending, of course, upon whether the stadia hairs are disposed horizontally or vertically. He then adjusts the stadia hairs 31, 31 by means of the finger-piece 56 until the selected part of the target is exactly bracketed by said stadia hairs. This results in shifting of the cam 62 and adjustment of the angular relationship vertically between the line of sight and the axis of the gun barrel such that, by the mere act of sighting the target, the gun barrel is disposed at the proper elevation to cause the projectile to strike the target either at the point where the line of sight strikes the target or at a point in definite relationship to the point of striking of the target by the line of sight, depending, as aforesaid, upon whether the arrangement is or is not such that the point of impact of the projectile and the point of striking of the target by the line of sight are or are not intended to be coincidental.

As stated and as is apparent, the mechanism described is suitable only for a given gun using a single type of ammunition, although, as also stated and as also is apparent, the mechanism may readily be suited for the use of a different type of ammunition in the same gun simply by substituting for the cam 62 another cam formed in accordance with the known characteristics of the different type of ammunition to be used. In this connection the invention further contemplates the provision of a mechanism embodying a single cam in lieu of a plurality of the cams 62 to assure a proper angular relationship between the optical axis of the telescope and the axis of the gun barrel upon adjustment of the range finding means for each of a plurality of different types of ammunition.

A mechanism of the type referred to is illustrated in Figs. 10 and 11 of the drawings and comprises a cam and adjustment means assembly to be used in lieu of the assembly comprising the slide-piece 58, the cam 62 and the connecting spring 64 used in the form of the invention heretofore described. The slide-piece is designated as 58' and is substantially a duplicate of the slide-piece 58, the only essential difference being that its slot 61' is wider than the slot 61 of the slide-piece 58 to accommodate a cam mounting bar designated as 64' which is used in lieu of the spring 64.

A stud 60' is rigid with and rises from the slide-piece 58' near the front end thereof, and in the front end portion of the mounting bar 64', and extending longitudinally thereof is an elongated slot 65' through which said stud extends, there being threaded on said stud a nut 66' for clamping the bar 64' to the slide-piece 58' in desired longitudinally adjusted relationship thereto.

In the bar 64', toward its rear end, is a second elongated slot 69 which also extends longitudinally relative to said bar and accommodates a cam mounting plate 70.

The plate 70 is pivoted near its front end to the bar 64', as indicated at 71, for vertical swinging movement, and has fastened on top thereof, at its front end, as indicated at 72, the front end of a bendable cam 62' of leaf spring form.

Extending rearwardly from the cam mounting plate 70 is a lip 70', and underlying this lip is a spiral cam 73 comprised by the upper edge of a marginal flange on a disk 74 which is rotatably mounted on the rear end portion of the bar 64'. A similar disk 75 is rotatably mounted on the plate 70 and has a spiral cam 76, comprised by the upper edge of a marginal flange on said disk, underlying the rear, free end of the bendable cam 62'. By this arrangement it is apparent that by rotation of the disk 74 in one direction or the other the plate 70 may be raised or lowered to vary the angular relationship of the top or cam surface of the cam 62' relative to the axis of the telescope, and that by rotation of the disk 75 the cam 62' may be flexed so that its top or cam surface will be more or less curved. In this connection it is pointed out that said cam is formed so that when its free end is fixed upwardly by the cam 76 its top surface partakes of a circular curve.

On the lip 70' is an index 77 with which cooperate calibrations 78 on the disk 74, while on the free end of the cam 62' is an index 79 with which cooperate calibrations 80 on the disk 75.

The cam 62' underlies and cooperates with a follower 68', and the slide-piece 58' is connected with the cam tube of the range finding means as in the first described form of the invention.

The trajectory curve of a projectile in flight is due, of course, primarily to gravity and to a lesser extent to deceleration of the projectile. In this connection it is known that fall due to gravity may be resolved into a straight line. On the other hand, it has been ascertained that fall due to deceleration may be resolved into a curve which is circular. Therefore, in constructing a cam such as the cam 62 of the Figs. 1 to 9 embodiment of the invention for use in connection with ammunition of only a single definite type, the cam surface 67 may be a composite of a straight surface corresponding to that portion of the trajectory of the bullet due to gravity, and of a curved surface corresponding to the deceleration curve of the bullet. In other words, the cam 62, for any given projectile, will have a certain general inclination to the line of sight through the telescope T to compensate for fall of the projectile due to gravity, and a progressively increasing inclination to compensate for fall of the projectile due to deceleration. In the case of a pro-

jectile having maximum muzzle velocity the cam will have least general inclination and least progressively increasing inclination, and for projectiles having lesser muzzle velocities the general and progressive inclinations of the cam will be increased, the progressive inclination becoming more pronounced with increase in the general inclination, since, as aforesaid, the deceleration curve is circular. From these observations it will be apparent that since the cam 62' is bodily adjustable to vary its general angularity relative to the axis of the telescope, it may be set to compensate for fall of any given bullet at any given muzzle velocity due to gravity. As aforesaid, the cam 62' is formed so that when its free end is flexed upwardly its top surface partakes of a circular curve. Therefore, it will be further apparent that for any given general angular adjustment of said cam 62' to compensate for fall of any given bullet due to gravity, the necessary progressively increasing angularity of said cam to compensate for fall of the same bullet due to deceleration, may be effected by properly flexing the free end of said cam. It follows, therefore, that by means of the two stated adjustments of said cam the same may be caused to partake of the proper general and progressively increasing angularity to compensate for fall of bullets having various different muzzle velocities, due to both gravity and deceleration.

The necessary adjustments of the cam 62' for any given ammunition may readily be predetermined and may be indicated on the boxes or cartons containing the ammunition as supplied by the manufacturer and with reference to the calibrations on the cam disks 74 and 75. Thus, in the case of ammunitions of different velocities being used in any given gun, all that the marksman is required to do to assure a proper adjustment of the cam 62' for proper operation of the present mechanism when using any one of the ammunitions, is to adjust the cam disks 74, 75 in accordance with the indications on the box or carton containing that particular ammunition. Obviously, according to either of the forms of the invention, the cam 62 or 62', instead of being movable relative to the gun, may be fixed relative to the gun and the cam follower 68, instead of being fixed relative to the gun, may be movable relative thereto.

According to each of the heretofore described forms of the invention, the telescope is tiltable relative to the gun and the range finder comprises stadia hairs relatively adjustable to bracket a distant object of known small height or width. There will now be described a form of the invention in which the range finder is of a known type operable on the principle of converging lines of sight upon a distant point, and in which the telescope is in its operative position, to all intents and purposes fixed with respect to the gun, although it may be mounted on the gun for elevation to an out-of-the-way position with respect thereto and may be laterally adjustable to compensate for windage. In other words, according to the form of the invention now to be described, adjustment of the angular relationship vertically between the axis of the gun barrel and the line of sight through the telescope is obtained by adjusting the reticle of the telescope responsive to adjustment of the range finder, thereby to adjust the line of sight through the telescope relative to either the optical or the physical axis of the telescope so that for any given range adjustment of the range finding means, and for any given projectile having any given muzzle velocity, the angular relationship vertically between the line of sight and the axis of the gun barrel will be such as to assure a proper elevation of the gun barrel to cause the bullet to strike the target coincidentally with striking of the line of sight thereon.

Referring now particularly to Figs. 12 to 21 of the drawings, which are illustrative of one practical embodiment of the last mentioned form of the invention, G^a designates, generally, a gun in the form of a rifle having a stock 10^a and a barrel 11^a, and T^a designates, generally, a telescope mounted on said gun. In this connection, while the telescope T^a is shown as being mounted on the gun G^a by means of rings or blocks 16^a, 17^a solely for longitudinal adjustment relative to said gun to bring the eyepiece 30^a of the telescope into a position best suited for any particular marksman, the telescope may also be mounted for lateral adjustments to compensate for windage, and also for elevation to an out-of-the-way position, as in the case of the telescope T of the first mentioned forms of the invention, as will hereinafter become apparent. Essentially, however, when the telescope T^a is in its operative position relative to the gun G^a, the optical axis of the telescope and the axis of the gun barrel are disposed in a fixed definite relationship to each other, preferably in parallel planes horizontal with respect to the gun.

In the telescope T^a is the usual recticle r^a, but instead of said reticle being fixed, in accordance with common practice, the same is, according to the present invention, mounted for vertically radial movement so that its end may be caused to approach and recede from the optical axis of the telescope. The line of sight is, of course, over or across the end of the reticle. Therefore, by adjusting the reticle the angular relationship vertically between the line of sight and the axis of the gun barrel may be varied and in this way the same results may be obtained as are obtained in the first described forms of the invention by angularly adjusting the telescope itself relative to the gun.

On the front end of the telescope T^a is mounted a range finder of a known type designated generally as F. This range finder comprises a tube 81 of square or other suitable cross section having in its front wall near the top and the bottom thereof, windows 82 and 83, respectively, and in its rear wall, in alinement with the window 83, a sight opening 84.

In the lower end portion of the tube 81, in alinement with the window 83 and the sight opening 84 is mounted a mirror 85 which is disposed at a downward and inward inclination of forty-five degrees relative to the common axis of said windows and which is of a known construction to reflect a certain portion of any light striking the same and to permit the remaining portion to pass therethrough substantially without absorption.

In the upper end of the tube 81, in alinement with the window 82, is a prism 86 by means of which light rays entering the window 82 are directed downwardly onto the mirror 85 for reflection through the sight opening 84. The prism 86 is carried by a frame 87 which is pivoted to the tube 81, as indicated at 88, so that the prism may be rockably adjusted to cause rays of light directed downwardly thereby and reflected by the mirror 85 to have different angular relationships to the common axis of the window 83 and the sight opening 84. The frame

87 includes a depending arm 87 having a free lower end 90 disposed at one side of the tube 81 directly above the sight opening 84, and cooperating with said arm is a leaf spring 91 which tends constantly to swing said arm rearwardly and to rock the prism 86 to direct rays of light toward the lower, rear end of the mirror 85 for reflection upwardly and rearwardly by said mirror.

By sighting through the opening 84 at a distant object two images of the object will be seen, one through the window 83 and the other through the window 82. The prism 85 may be adjusted to superimpose these images, and when this is done the prism will be disposed in a certain rocked position depending upon the spaced apart relationship of the prism 86 and the mirror 85 and the distance of the object from the range finder. Ordinarily, the means for adjusting the prism 86 is calibrated, so that for any rockably adjusted position thereof a definite range is indicated. However, such means is dispensed with according to the present invention and is replaced by means whereby adjustment of the prism effects an adjustment of the telescope reticle r' such that, for any given adjustment of the prism, the line of sight through the telescope is disposed at an inclination vertically relative to the axis of the gun barrel so that when the object or target is sighted through the telescope, the gun will be disposed at the proper elevation to cause a projectile of a given muzzle velocity to strike the object or target either coincidentally with striking of the line of sight thereon or in a certain definite relationship to the point of striking of the line of sight thereon.

The range finder F is pivotally mounted on the telescope T^a for swinging movement between an upright or operative position relative to said telescope, as shown by full lines in Figs. 12 to 15, and a folded or inoperative position in overlying, parallel relationship to said telescope, as shown by dotted lines in Fig. 12 of the drawings. For pivotally mounting the range finder there is suitably fastened to the front end of the telescope T^a a band 92 having at its top a lug 93, and on the sides of the range finder tube 81 near the bottom thereof there are suitably fastened plates 94 and 95 which are disposed, respectively, against opposite ends of the lug 93. A pivot pin 96 extends through the lug 93 and the plates 94, 95, thereby mounting the range finder on the telescope for swinging movement between the operative and inoperative positions mentioned.

In its operative or upright position relative to the telescope T^a, the range finder F is disposed at right angles to said telescope and is releasably held in this position by means of a spring pressed latch 97 which is carried by the bottom of the band 92 and has a lug 98 engaged in a hole in the bottom wall of the range finder tube.

Reverting to the reticle r^a, it will be observed that the same is carried by a plate 99 and depends into an opening 100 in said plate. The plate 99 is mounted for vertical sliding movement in a second plate 101 and by means of a spring or springs 102 is urged constantly upward relative to said plate 101. On the other hand, the plate 101 is mounted for lateral sliding movement in a frame 103 and is constantly urged laterally in one direction relative to said frame by a spring or springs 104.

Preferably the frame 103 is of rectangular or other polygonal shape and is accommodated within a correspondingly shaped portion of the barrel 18' of the telescope T^a, whereby it is held against rotation relative to the telescope barrel. It may, however, be of any desired shape and may be held against rotation relative to the telescope in any other desired manner. In any event it is adjustable longitudinally relative to the telescope and may be secured in any adjusted position in any suitable manner. In the present instance the frame 103 is provided with a bushing 105 which extends through a slot 106 in the telescope barrel and has threaded thereon a clamp nut 107 for cooperation with the telescope barrel to either side of the slot 106 therein. Moreover, according to the present construction, the bushing 105 has threaded therein a screw 108 for laterally shifting the plate 101 counter to the direction in which said plate is shiftable by the spring or springs 104. Provision thus is made for shifing the reticle r^a laterally to compensate for windage, and in the event of such provision it is not necessary nor even desirable that the telescope be adjustable relative to the gun for the same purpose. Alternatively, however, the telescope may be adjustable relative to the gun to compensate for windage and the provision for laterally shifting the reticle r^a relative to the telescope may be eliminated.

Extending upwardly from the plate 99 through an opening in the top of the frame 103 and through an elongated slot 109 in, and extending longitudinally of the telescope barrel 18^a, is a tongue 110 which, at its upper end, engages a cam surface 67^a on the under side of a cam block 62^a which is suitably mounted on the telescope barrel 18^a solely for sliding movement longitudinally with respect thereto.

Mounted in the telescope barrel 18^a forwardly of the reticle r^a for adjustments longitudinally of said barrel, is a tube 111 having in one side thereof and extending longitudinally thereof an elongated slot 112 one side edge of which is formed with rack teeth 113. In the related side of the telescope barrel 18^a is journaled a shaft 114, on the inner end of which is a pinion 115 disposed in mesh with the rack teeth 113 and on the other end of which is a knurled head 116 for effecting its rotation, thereby to rotate the pinion 115 and to adjust the tube 111 longitudinally relative to the telescope barrel.

The cam block 62^a includes a forward extension 64^a having therein an elongated slot 65^a extending longitudinally thereof, and extending downwardly through said slot into threaded engagement with a lug 117 carried by the tube 111, is a screw 118 whereby the cam block 62^a may be secured to said tube 111 in desired longitudinally adjusted relationship thereto. As shown, the lug 117 extends through an elongated slot 119 in the top of the telescope barrel 18^a. Thereby the tube is free to be adjusted longitudinally and, at the same time, is held against rotation.

Connected at its inner end in any suitable manner with the tube 111, is a slide-piece 58^a which rests on top of the telescope barrel 18^a and passes through and is guided by the ring or block 17^a and the band 92. In the present instance this slide-piece is connected with the tube 111 through the instrumentality of the lug 117, the said slide-piece having an opening in which said lug is disposed.

At its forward end the slide-piece 58^a is laterally offset and provided with a finger 120 which extends through an opening in the rear wall of the range finder tube 81 into contact with the

rear face of the lower, free end 90 of the arm 89 when the range finder is in its operative or upright position relative to the telescope T^a. In this connection, in order to insure a correct operative position of the range finder, and to lock the same in such position, the plate 95 has formed in its inner face, at right angles to the range finder tube 81, a groove 121 which is disposed in alinement with an edge portion 122 of the slide-piece 58^a when the range finder is in its operative position. When the slide-piece 58^a is in its operative position with the end of its finger 120 contacting the free end 90 of the arm 89, the edge portion 122 of said slide piece is slidably engaged in said groove, which it snugly fits. The range finder thus is held securely in its operative position against any rocking movement about its pivotal connection with the telescope barrel. Moreover, because of this arrangement, it is necessary to slidably retract the finger-piece 58^a to disengage its edge portion 122 from the groove 121 before the range finder can be swung to its folded or inoperative position overlying the telescope T^a. This insures a retracted position of the finger 120 such that it cannot be harmed by swinging movement of the range finder to its folded or inoperative position.

In the inner face of the plate 95 is a second groove 123 which is disposed either at right angles or in other suitable angular relationship to the groove 121 and in such a position relative to the pivot of the range finder as to aline with the edge portion 122 of the slide-piece 58^a when the range finder is in its folded or inoperative position. Thus, upon folding of the range finder it merely is necessary to project the slide-piece 58^a to cause its edge portion 122 to engage the groove 123 to fasten the range finder securely in its inoperative position.

The range finder is so mounted on the front end of the telescope T^a that when the range finder is in its upright or operative position the forward end of the telescope fits snugly within the sight opening 84. Thereby, extraneous light is effectively excluded.

In a front end portion of the telescope barrel 18^a is an object lens 23^a which is mounted for focal adjustments longitudinally relative to said barrel. Once this lens has been adjusted to a correct position it is secured in its adjusted position and is not again disturbed. An adjustment for parallax then is made by shifting the frame 103 until the reticle r^a is clearly defined and does not appear to move when the eye is shifted from one side to the other of the field of view. The frame 103 then is secured by the clamp nut 107 in its adjusted position and is not again disturbed. These adjustments preferably are made while the range finder is in its inoperative position. The range finder then is swung to and secured in its operative position; the screw 118, if not already loose, is loosened, and the tube 111 is adjusted to shift the slide-piece 58^a to obtain a point blank range adjustment of the prism 86. The tube 111 then will be in, or substantially in, its rearmost position. The cam block 62^a then also is adjusted for point blank range and when so adjusted it, too, will be disposed in, or substantially in, its rearmost position. The screw 118 then is tightened to fasten the cam block 62^a to the tube 111 and the slide-piece 58^a, whereupon the mechanism is ready for use.

The cam surface 67^a is formed so that for any given range adjustment of the range finder and for a projectile or bullet of given muzzle velocity, the reticle r^a will be disposed so that the line of sight on the target will be angularly related to the axis of the gun barrel to cause the gun to be disposed at the proper elevation to compensate for fall of the projectile or bullet in flight and assure its striking the target either coincidentally with or in definite relationship to the point of striking of the line of sight thereon. In this connection there will, of course, have to be provided a different cam 62^a for each of a plurality of projectiles having different muzzle velocities, or else the cam 62^a may be made adjustable as in the case of the cam of the second described form of the invention.

From the foregoing description considered in connection with the accompanying drawings, it is believed that the construction, operation and advantages of the different described forms of the invention will be clear. Also, it is believed to be clear that the invention is not restricted to use on rifles, but may be adapted for use on practically any gun, large or small. Moreover, while only certain specific structural embodiments of the invention have been illustrated and described, it is apparent that these structural embodiments are readily capable of modification in various respects, and that the invention is readily capable of embodiment in various other specifically different mechanical structures, within its spirit and scope as defined in the appended claims.

I claim:

1. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, an adjustable range finder included in said telescope so that sighting therethrough to ascertain the range of a target can be effected only by sighting the target through the telescope, means mounting said telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto and means, responsive to adjustment of said range finder to ascertain the distance to a target, to effect a vertical angular adjustment of the line of sight through the telescope relative to the axis of the gun barrel, such that, for a given projectile having a given muzzle velocity, sighting of the target through said telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

2. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, an adjustable range finder included in said telescope so that sighting therethrough to ascertain the range of a target can be effected only by sighting the target through the telescope, means mounting said telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto and for tilting movement in a vertical plane with respect thereto to vary the angular relationship vertically between the line of sight therethrough and the axis of the gun barrel, and means, responsive to adjustment of said range finder to ascertain the range to a target, to effect a vertical angular adjustment of the telescope relative to the axis of the gun barrel, such that, for a given projectile having a given muzzle velocity, sighting of the target through the telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definte rela-

tionship to the point of striking of the line of sight thereon.

3. In a telescopic sight for a gun having a barrel, a telescope having a reticle, an adjustable range finder, means mounting the telescope on the gun in a fixed operative position relative thereto, and means, responsive to adjustment of the range finder to ascertain the distance to a target, to adjust said reticle and thereby effect a vertical angular adjustment between the line of sight through the telescope and the axis of the gun barrel, such that, for a given projectile having a given muzzle velocity, sighting of the target through the telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

4. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, an adjustable range finder, means mounting the telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto and for vertical tilting adjustment relative thereto to vary the angular relationship vertically between the line of sight therethrough and the axis of the gun barrel, and means, including a cam and a cam follower, one on the telescope and the other carried by the gun, for cooperation responsive to adjustment of said range finder to ascertain the range to a target, to effect a vertical angular adjustment between the telescope and the axis of the gun barrel, such that, for a given projectile having a given muzzle velocity, sighting of the target through the telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

5. In a telescopic sight as set forth in claim 4, means for adjusting the shape of the cam.

6. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, means mounting said telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto, and for tilting movement in a vertical plane relative thereto to vary the angular relationship vertically of the line of sight therethrough relative to the axis of the gun barrel, range finding means including a pair of stadia hairs mounted in the telescope for movement toward and away from each other to ascertain the distance to a target, means for adjusting said stadia hairs to vary their spaced relationship, and cam means, responsive to actuation of said adjusting means to adjust said hairs to ascertain the distance to a target, to effect a vertical angular adjustment of the telescope relative to the gun, such that, for a given projectile having a given muzzle velocity, sighting of the target through said telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

7. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the movement, means mounting said telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto and for tilting movement in a vertical plane relative thereto to vary the angular relationship vertically of the line of sight therethrough relative to the axis of the gun barrel, a lens in said telescope focally adjustable longitudinally of the telescope, range finding means including a pair of stadia mounted in the telescope for movement toward and away from each other to ascertain the distance to a target, means for adjusting said stadia hairs to vary their spaced relationship, means mounting said stadia hairs and their adjusting means for adjustment as a unit longitudinally of the telescope to bring the stadia hairs in a plane transversely of the telescope including the focal point of said adjustable lens for any given adjusted position of said lens, and cam means responsive to actuation of said adjusting means to adjust said hairs to ascertain the distance to a target, to effect a vertical angular adjustment of the telescope relative to the gun, such that, for a given projectile having a given muzzle velocity, and for any position of adjustment of said lens and said stadia hairs longitudinally of the telescope, sighting of the target through said telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

8. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, means mounting said telescope on the gun in a fixed operative position relative thereto, a reticle in said telescope, a range finder mounted on said telescope, said range finder being of the spaced window type having a sight opening and having means including a prism behind one of its windows adjustable to converge lines of sight through its sight opening and windows upon a distant object to ascertain the range of the target, said range finder having an operative position with its sight opening at and alined with the front end of the telescope, so that sighting therethrough to ascertain the range of a target can be effected only by sighting the target through the telescope, and means responsive to adjustment of said prism to ascertain the range of a target, to adjust said reticle and thereby effect a vertical angular adjustment between the line of sight through the telescope and the axis of the gun barrel, such that, for a given projectile having a given muzzle velocity, sighting of the target through the telescope and the range finder will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

9. In a telescopic sight for a gun as set forth in claim 3, means to adjust the reticle laterally to compensate for windage.

10. In a telescopic sight for a gun as set forth in claim 6, a pair of members rockably mounted in the telescope and carrying the stadia hairs, an arm on each rockable member, a pin on each arm, and a tube slidably mounted in the telescope and having a slot the edges of which comprise cams cooperatively engaged with said pins, whereby sliding adjustment of said tube adjusts said stadia hairs toward and away from each other.

11. In a telescopic sight for a gun as set forth in claim 6, a finger-piece rotatably mounted on the telescope exteriorly thereof and operatively connected with said stadia hairs for adjusting the latter toward and away from each other.

12. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, means mounting said telescope on the gun for movement therewith and in a fixed

operative position longitudinally with respect thereto and for tilting movement in a vertical plane with respect thereto, said telescope including an object lens and a reticle substantially in the focal plane of said object lens, range finding means comprising a pair of stadia hairs mounted in the telescope substantially in the focal plane of said object lens, at least one for adjustment toward and away from the other to subtend a target of a known dimension, means for adjusting at least one of said hairs toward and away from the other, and means responsive to adjustment of said adjusting means to adjust said hairs to subtend a target, to effect a vertical angular adjustment of the telescope relative to the gun such that, for a given projectile having a given muzzle velocity, sighting of the target through said telescope will result in the gun being disposed at the proper elevation to cause the projectile to strike the target at a point in definite relationship to the point of striking of the line of sight thereon.

13. In a telescopic sight for a gun as set forth in claim 12, a movable cam for adjusting at least one of the stadia hairs toward and away from the other and a second cam movable in harmony with said first mentioned cam to adjust the angular relationship of the telescope relative to the gun.

14. In a telescopic sight for a gun as set forth in claim 12, a cam slidable longitudinally of the telescope for adjusting at least one of the stadia hairs toward and away from the other, and a second cam slidable in harmony with said first mentioned cam longitudinally of the telescope to adjust the angular relationship of the telescope relative to the gun.

15. In a telescopic sight for a gun having a barrel, a telescope disposed longitudinally relative to the gun, means mounting said telescope on the gun for movement therewith and in a fixed operative position longitudinally with respect thereto and for tilting movement in a vertical plane with respect thereto, range finding means comprising a pair of stadia hairs mounted in the telescope at least one for adjustment toward and away from the other to subtend a target of a known dimension, means including a cam slidable longitudinally of the telescope for adjusting at least one of said hairs toward and away from the other, and a cam and a cam follower, one on the gun and the other on the telescope and slidable longitudinally thereof in harmony with said first mentioned cam, cooperating responsive to adjustment of said first mentioned cam to effect a predetermined angular adjustment of the telescope relative to the gun for each different spaced apart adjustment of said stadia hairs.

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