Feb. 2, 1932. S. Y. McGIFFERT ET AL 1,843,237

TRAIN BOARD

Filed March 9, 1929 4 Sheets-Sheet 1

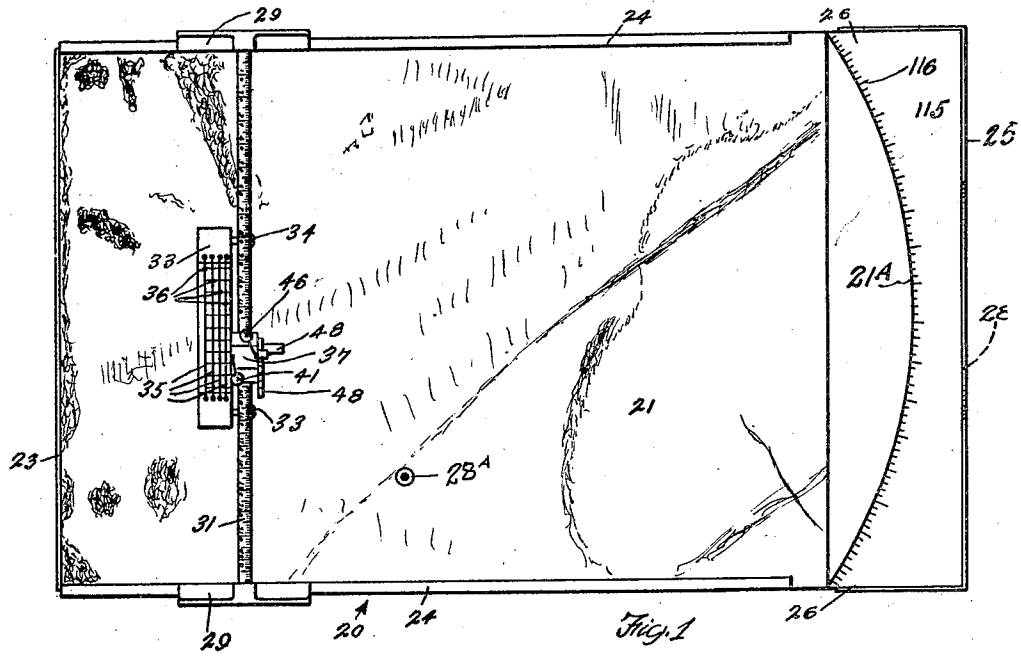


Fig. 1

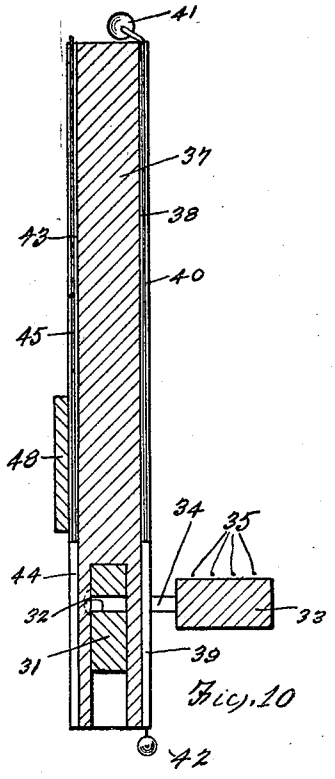


Fig. 10

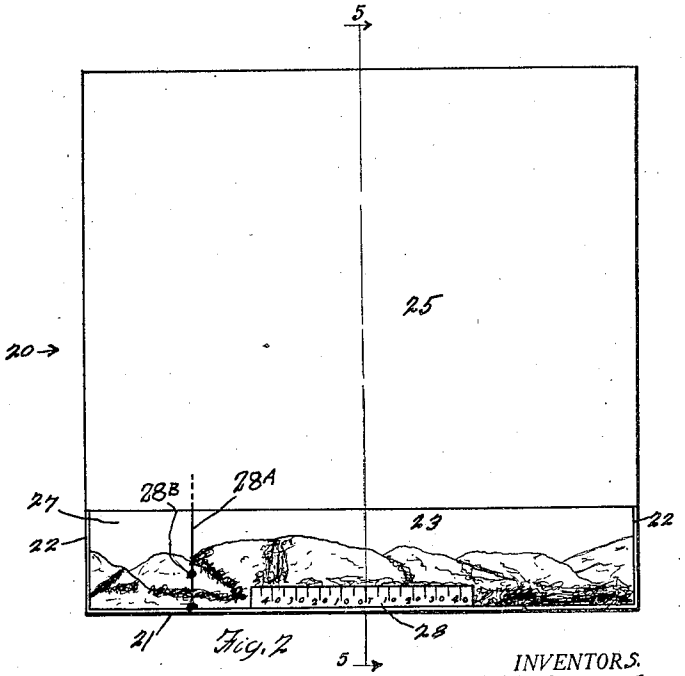


Fig. 2

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TRAIN BOARD

Filed March 9, 1929 4 Sheets-Sheet 2

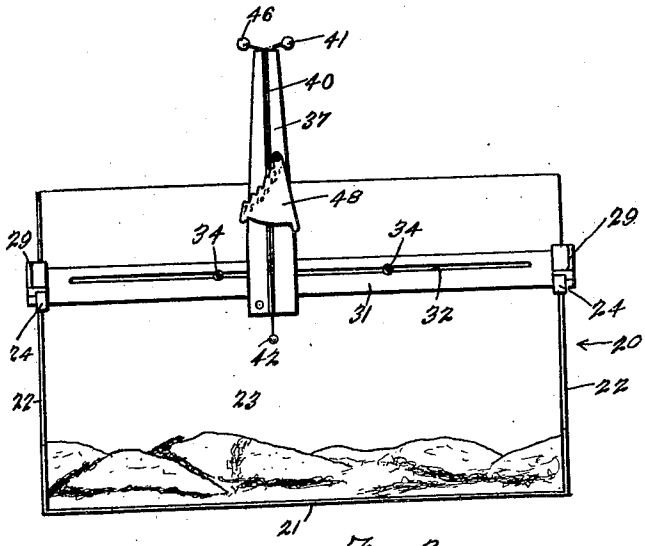


Fig. 3

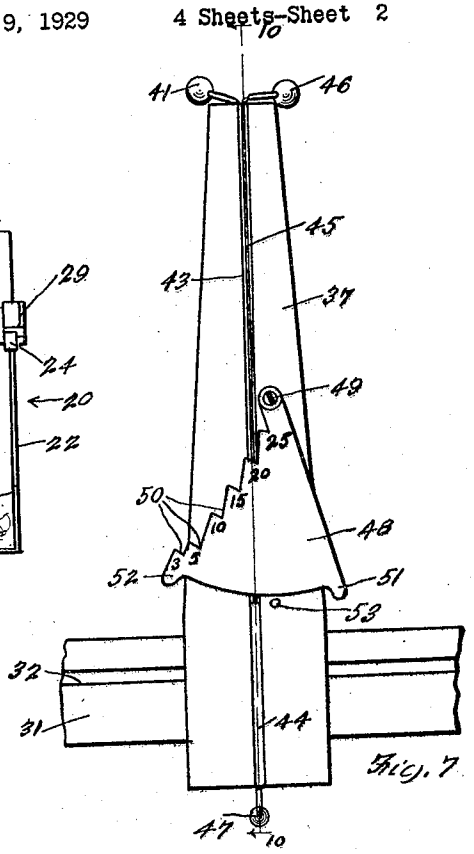


Fig. 7

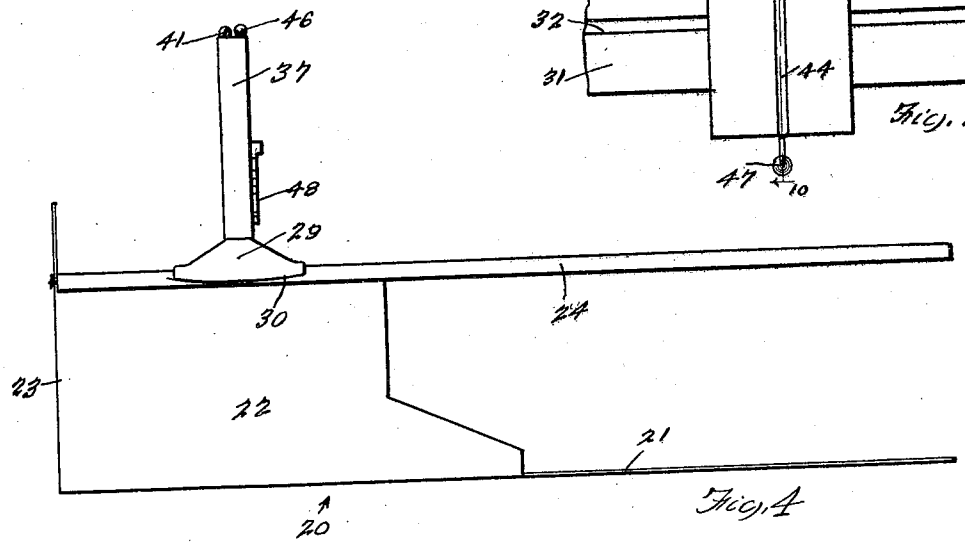


Fig. 4

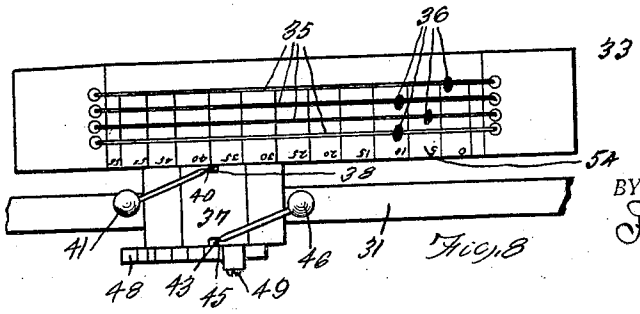


Fig. 8

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TRAIN BOARD

Filed March 9, 1929 4 Sheets-Sheet 3

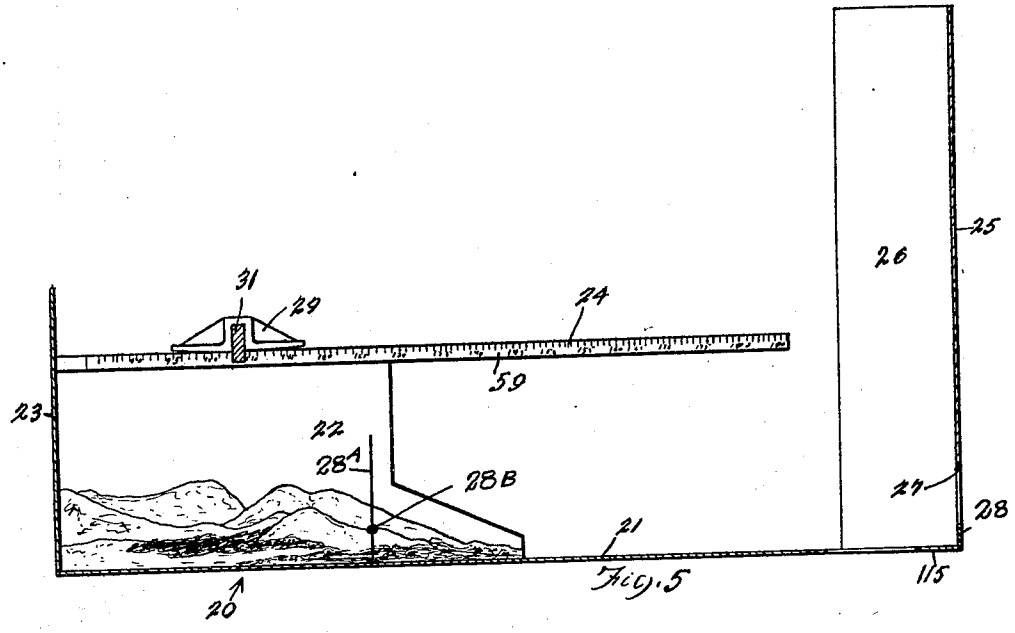


Fig. 5

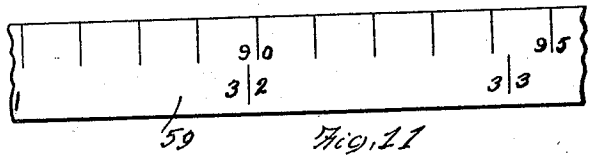


Fig. 11

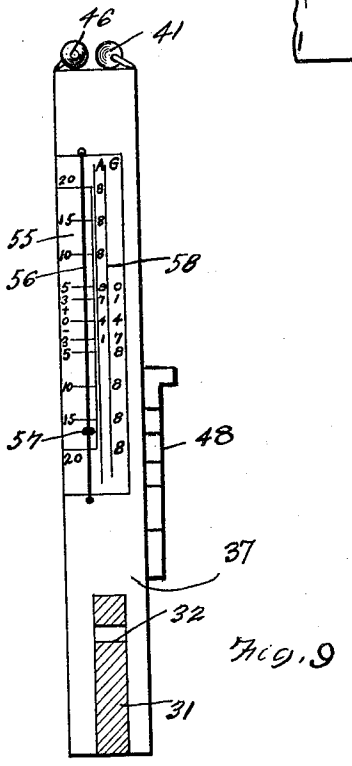


Fig. 9

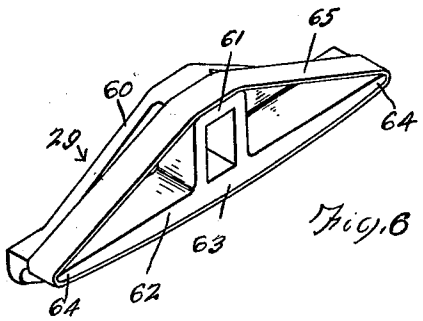


Fig. 6

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TRAIN BOARD

Filed March 9, 1929 4 Sheets-Sheet 4

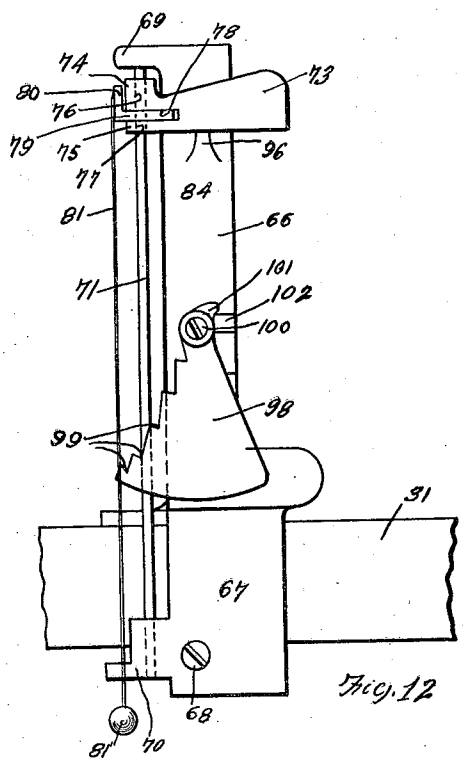


Fig. 12

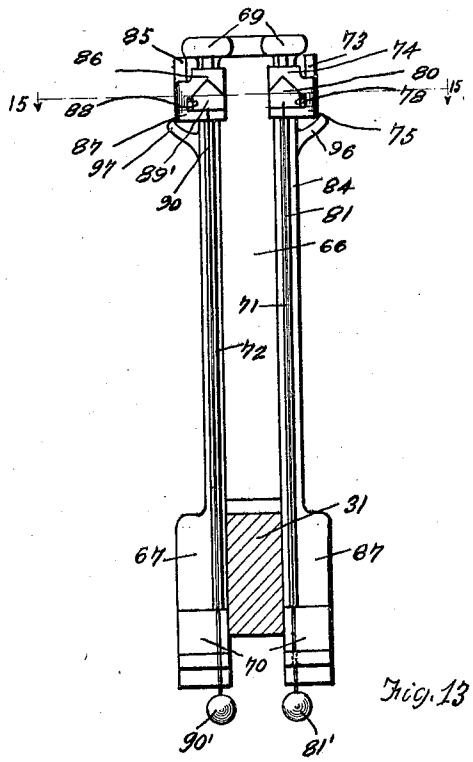


Fig. 13

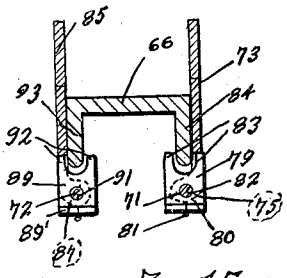


Fig. 15

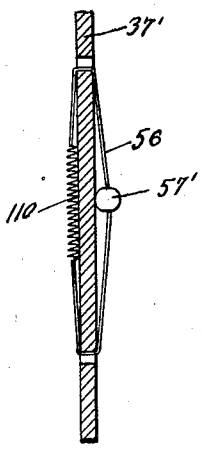


Fig. 16

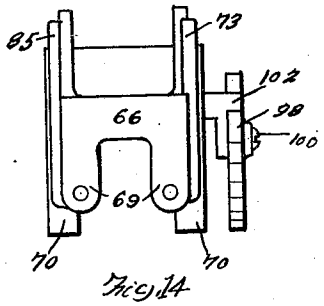


Fig. 14

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1,843,237

UNITED STATES PATENT OFFICE

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TRAIN BOARD

Application filed March 9, 1929. Serial No. 345,717.

The present application relates, as indicated, to a train board which may be described as a device for instructing students in the art of conducting artillery fire. The primary object of the invention is to provide a device of the class described which shall be of sufficient accuracy for training purposes without attempting to attain absolute accuracy beyond the appreciation of the average student or instructor; one which shall be small, easily dismantled, light in weight, and quite inexpensive to manufacture; and one which shall be operable with a fair degree of accuracy by one not especially skilled in artillery fire. Further objects of the invention will appear as the description proceeds.

The present device which is known as a "train board" is a portable terrain board, for use in the training of artillerists in the designation of objectives, and in the conduct of artillery fire. It affords an opportunity for practice in handling the various types of field artillery fire, without great expense, the expenditure of ammunition, and the assistance of several or more assistants and some elaborate and immovable apparatus.

It is a device which represents in a greatly reduced scale a specific area of ground and is provided with scales and other means so that, for any determined firing data the projectile falls at approximately the same point on the ground that it would fall in actual firing, or appears to burst at the same relative point in the air.

An advantageous feature of the device is that it is capable of representing the fire of a four-gun battery firing shell or shrapnel, with considerable speed and accuracy in regard to range, direction, distribution, and height of burst. Having the facilities to represent dispersion as well as a visible difference to the student between a graze and an air burst, it enables the student to simulate accurately and realistically, but on a miniature scale, the firing of an artillery battery under all conditions and relative positions of target, battery, and observation point, which might arise on the target range or in actual warfare. For example, problems may be fired involving the use of either direct or indirect aiming, time or percussion projectiles, ranging or fire for effect, stationary or moving target on the ground or in the air. In addition to the above combination of advantageous features, the apparatus is comparatively simple, inexpensive, and is readily portable and may be easily set up. It requires but a single individual to assist in its operation. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

The invention is illustrated and described for representing the fire of a four-gun battery, but it will be apparent that by changing the number of appropriate elements it can be used to represent the fire of other numbers of guns, or of tactical units other than a battery.

In said annexed drawings:

Fig. 1 is a plan view of a train board constructed in accordance with our invention set up for use; Fig. 2 is a front elevation thereof taken from the right of Fig. 1; Fig. 3 is a view similar to Fig. 2, the screen having been removed; Fig. 4 is a side elevation taken from the left of Fig. 3; Fig. 5 is a longitudinal section taken substantially upon the line 5—5 of Fig. 2; Fig. 6 is a perspective view of a detail; Fig. 7 is a front elevational view of the burst slide; Fig. 8 is a plan view of the elements shown in Fig. 7; Fig. 9 is a side elevation of the burst slide taken from the right of Fig. 7; Fig. 10 is a longitudinal section taken substantially on the line 10—10 of Fig. 7; Fig. 11 is an enlarged view of the scale on the range arm; Fig. 12 is a front elevational view of a modified form of burst slide; Fig. 13 is a side elevation thereof taken from the left of Fig. 12; Fig. 14 is a plan view thereof; Fig. 15 is a transverse section taken substantially upon the line 15—15 of Fig. 13; and Fig. 16 is a fragmentary sectional view of a modification of a detail.

Referring more particularly to the drawings, the reference numeral 20 indicates the train board generally, the same comprising a floor 21 printed or painted to represent the terrain, side walls 22, and a back wall 23 printed or painted to represent a horizon panorama. A pair of range arms 24 are shown supported upon the side walls 22 and rear wall 23, but they may be supported in any desired way. Said arms extend forwardly beyond the ends of the side walls 22 and substantially to the end of the floor 21, the arms being substantially parallel throughout their lengths. A screen 25 is formed with side flanges 26 which constitute bracing wings, and said screen is adapted to stand before the open end of the terrain, the ends of the flanges 26 being slightly spaced from the adjacent end of the terrain. Said screen is further provided with a bottom wall 115 extending between said wings 26. The inner end of said bottom wall is formed, as shown, as an arc of a circle, the center of which is disposed approximately in the middle of the terrain. The forward end of the floor 21 is finished in a convex arc 21^A bearing against the concave arc of the member 115. Said end of the wall 115 is marked, as shown, with graduations 116, whereby, when the terrain is moved with respect to the shield in a horizontal plane, the corners of the terrain will cooperate with the graduations to indicate to the operator the angles "*i*"; i. e., the observer—target—gun angle. The shield is further formed with a cut-away portion at its lower end to provide a sighting space or aperture 27 through which the student is afforded a view of the terrain. A deflection indicator 28, which is preferably transparent, is mounted in a slot in the floor 21 for lateral movement with respect to the terrain. (See Figs. 1, 2 and 5.)

A pair of shoes 29 formed with convex lower surfaces 30 (see Figs. 4 and 6) are secured to opposite ends of a graduated cross-bar 31, said shoes being adapted to be mounted upon the upper surfaces of the range arms 24. The cross-bar 31 is formed with a slot 32 extending substantially from end to end thereof, and a sheaf block 33, the function of which is explained hereinafter, is mounted on said bar through the medium of a pair of screws or rods 34 extending through said slot 32. As is clearly shown in Figs. 1 and 8, the sheaf block is provided with a plurality of strings or wires 35 arranged on its upper surface in parallelism, and a bead 36 is slidably mounted upon each of said members 35. Of course it is to be understood that we may modify this structure by providing guides of different kinds in place of the strings 35 and different movable members in place of the beads 36. One string 35 and bead 36 is provided for each gun the fire of which is to be represented.

Straddling the cross-bar 31 and mounted between the members 34 is a burst slide 37 slidable on said bar 31 (see Fig. 10). In its one face, preferably that face adjacent the sheaf block 33, said slide is formed with a vertical slot 38 in the lower end of which there is secured a sleeve 39. A wire 40 is threaded through said sleeve and is mounted in said slot, said wire being bent at its upper end to provide a hook adapted to be hooked over the upper end of the slide 37 to retain the wire in its uppermost position. At the extremity of said hook portion there is mounted on the wire a bead 41, and at the lower end of said wire there is mounted a similar bead 42. The bead 42, and preferably the bead 41, are formed of glass or other translucent material colored in any manner well known to the art. Preferably the bead 42 is black or dark, to simulate the color of a graze burst of an artillery projectile, and the bead 41 is of the same color.

In the opposite face of the slide 37 there is formed a second vertical groove 43 in the lower end of which is secured a tube 44. A wire 45 is threaded through said tube 44 and lies in the groove 43, the upper end of said wire being bent as is the upper end of the wire 40. A bead 46 is secured to the upper end of the wire 45 and a bead 47 is secured to the lower end thereof. These beads 46 and 47 are similar to the beads 41 and 42 in every way except that the beads 46 and 47 are light in color, preferably smoke gray, to simulate the appearance of an air burst of an artillery projectile. While we have shown the beads 42 and 47 as spherical, it is to be understood that we may use beads of irregular outline intended to simulate more closely the appearance of a cloud of smoke from a bursting projectile.

Referring now to Fig. 7, it will be seen that a quadrant 48 is pivotally secured as at 49 to that face of the slide 37 in which is formed the groove 43. Said quadrant is formed on its one edge with a plurality of numbered notches 50, adapted to stop the hooked upper end of the wire 45 at various heights, thus, when the wire is dropped, holding the bead 47 at a height above the terrain corresponding to the notch set opposite the groove 43. The respective notches may conveniently be marked according to the height in mils above the terrain at which each will hold the bead 47 and at its free end, said quadrant is formed with a pair of ears 51 and 52 adapted to engage, at the limits of motion of said quadrant, with a stop 53 on the slide 37.

The sheaf block 33 carries on its upper surface beneath the members 35 a scale 54 which is graduated, as indicated, for deflection. In the use of the device, the beads 36 are set in relation to this scale in response to the orders of the person conducting fire.

On its one edge, the slide 37 carries a scale

55 which is graduated to indicate the height of burst of projectiles thrown from the hypothetical guns. Mounted adjacent this scale on the slide 37 there is a string or wire 56 upon which is slidably carried a bead 57. The scale 55 comprises also a ratio table 58 which indicates, for any given setting of the bead 57, the ratio of "air bursts" to "graze bursts" which are to be indicated by the operator in responding to the orders of the person conducting fire.

As a modification of the above described arrangement, the slide 37′ may be bored above and below the upper and lower ends respectively of the scale 55, and a string or wire 56 may be passed through the apertures with its ends secured to each other through the medium of a spring 110. A bead 57′ being mounted on the string or wire 56 adjacent the scale 55, the spring 110 will exert sufficient tension upon said wire to hold said bead frictionally in contact with the face of the slide 37 to prevent accidental movement of said bead.

As is clearly shown in Figs. 5 and 11, the range arms 24 carry identical scales 59 graduated to indicate range setting of the piece. In carrying on a problem of fire, the operator sets each shoe 29 at a given point on its respective scale 59 in response to the order of the person conducting fire, it being understood that the two shoes 29 are always set on identical points on the respective scales 59. As is shown in Fig. 6, each of said shoes 29 comprises a substantially triangular web 60 backed by a block 61 substantially midway between the ends of said shoe. The flange 62 of said shoe is, as shown, somewhat thicker at its mid portion 63 than at its end portions 64, thus giving convexity to the lower surface of said flange which is adapted to rest upon the range arm 24. In order to prevent slippage and to assure maintenance of a given setting of the shoes, friction means are provided between the shoes and the range arms. In the present application, we have illustrated this friction means as a rubber band 65 stretched around the shoe, lying flat upon the surface 30 and tensioned over the upper end of the block 61. However, it is to be understood that we do not intend to limit ourselves to this exact structure, but that we may use a piece of friction material cemented or otherwise secured to the surface 30 or a piece of friction material cemented or otherwise secured to the upper surface of each of the range arms 24.

While the above described burst slide is satisfactory for ordinary use, a more substantial slide is illustrated in Figs. 12 to 15. Such slide comprises a body portion 66 having a bifurcated base comprising legs 67 adapted to straddle the crossbar 31, and formed to receive a securing element 68 passing below said bar. At its upper end, the slide is formed with a pair of lateral projections 69 and at its lower end, the same is provided with another pair of projections 70. A rod 71 is secured in apertures in one pair of projections 69, 70 adjacent one side of the slide, and in the other projections 69 and 70 there is secured a similar rod 72 adjacent the opposite side of the slide 66.

A handle member 73 is formed adjacent its one end with a collar 74 and a collar 75, the collar 74 being formed with a bore 76 and the collar 75 with a bore 77 in alignment with the bore 76. The collars 74 and 75 are spaced apart by a slot 78 formed in the handle member on a plane substantially perpendicular to the bores 76 and 77 and the collars 74 and 75 may be, and hereinafter are, considered together as a neck. In assembling the device, the rod 71 is threaded through the bore 77 of the collar 75, through an aperture 82 in a key 79 mounted in the slot 78, and through the bore 76, thus mounting the handle member 73 and the key 79 slidably on said rod. Said key 79 is formed with an upturned end 80 to which is secured in any desired manner the upper end of a wire 81. Said wire depends from said key 79 between the bar 31 and the projection 70 and has secured to its end a bead 81′ similar to the bead 47.

As has been stated, the key 79 is formed with an aperture 82 which, in the assembled device, is aligned with the bore 76 and 77 and is threaded on the rod 71. Said key is bifurcated at its end opposite the end 80, and the furcations 83 thereof, when the device is assembled, lie on opposite sides of the edge of a flange 84 forming a part of the burst slide 66. Thus it will be seen, that the handle member 73 is slidable and oscillable on the rod 71, and that the key 79 is slidable on said rod but is held by furcations 83 and the flange 84 against oscillation with the handle member 73.

A similar handle member 85 is formed with a neck 86, 87 slotted as at 88 for the reception of a key 89 having an upturned outer end 89′ to which is secured a wire 90 similar to the wire 81. A bead 90′ similar to the bead 42 is carried at the free end of the wire 90. As is clearly shown in Fig. 15, the key 89 is formed with an aperture 91 registering with the bore of the neck 86, 87 and threaded on the rod 72, and said key is bifurcated at its inner end, the furcations 92 thereof lying on opposite sides of the flange 93 similar to the flange 84. The handle 85 is thus slidably and oscillably mounted on the rod 72 and the key 89 is slidable on said rod but is held by the furcations 92 and the flange 93 against oscillation with the handle member 85.

Adjacent its upper end, the burst slide 66 is formed with a pair of laterally projecting lugs 96, 97. When the handle 73 is elevated to its upper extreme and is rotated into the

position shown in Figs. 12 to 15, the lug 96 cooperates with said handle to prevent the same from sliding downwardly on the rod 71, and the lug 97 performs the same function with respect to the handle member 85.

On the side of the burst slide 66 adjacent the rod 71, there is mounted a quadrant 98 formed in its one edge with a plurality of notches 99 and pivoted as at 100 for swinging in a plane parallel to said side of the burst slide. At its upper end beyond said pivot, said quadrant is formed with a lug 101 which is adapted to cooperate with a stop 102 on said slide to limit the swinging movement of the quadrant.

In using the above described device, the train board is set up on a table, with the screen in the position illustrated in Figs. 1 and 2. The battery position is assumed at a point removed an arbitrary distance from the board on a line normal to the center of the terrain. For a number of problems, of course, this line is also normal to the center of the sighting opening in the screen 25, but, where problems of fire conduct from a forward and laterally removed observation post are to be presented, the terrain is rotated to provide for different desired observer displacements from the line of fire. Consequently, the terrain is preferably mounted upon a frame or platform (not shown) providing a support for the terrain, it being understood that the terrain is adapted to be moved without any consequent movement of the sighting screen. The person who is to conduct the fire seats himself a given distance from the front end of the board with his eye substantially on the level of the upper edge of the sighting aperture. A target is placed on the terrain, said target comprising, for instance, four burned match heads or beads, or other small objects. The deflection indicator 28 is then moved in its slot until the center line thereof comes into line between the eye of the student and the target which he selects to be fired upon.

In the use of a board of such small dimensions as the one contemplated by the present invention, the phenomenon of parallax causes a relatively large apparent lateral deviation of a shot as a result of a very slight movement of the student's head. It is therefore important to fix the position of the observer's eye when observing fire, inasmuch as a slight movement of the head might have the same effect on the terrain as would a movement of several hundred yards of the observation post in actual practice. Where a target on the terrain is in use, the correct position of the observer's eye is, of course, fixed after the scale 28 has once been located with respect to the target. When, however, high burst range problems are being presented, the target is not in view of the observer, and consequently means must be provided for establishing the proper position of the observer's eye. This may be accomplished by providing a stand comprising a vertical wire carrying a bead, and the line of sight may be established by the operator, by placing the stand in a position to be seen by the observer as he sights across or through the scale 28. Such a stand is shown at 28^{A}, Figs. 1, 2 and 5, the bead being designated 28^{B}.

The student then gives the commands necessary for opening fire. For instance, the student may say "Aiming point, blockhouse on Signal Mountain". This is an imaginary point, and the student gives this command only because it is the usual opening command in field firing. The operator does nothing in response to this command. The next command of the student is "Deflection, Plateau four, Drum 150". This is an arbitrary deflection announced by the student merely as a basis from which to work in adjusting upon the target. In response to this command, the operator assumes that the specified deflection measured from the announced aiming point will place the center of the battery's fire in a lateral position on the cross-bar arbitrarily selected. In practice, there is always some error in the initial deflection setting, and this must be corrected in subsequent firing after noting the effect of the first shots. The student's next command is "On No. 2, Open 10". This command determines the width of the sheaf to be fired by the battery. This command takes No. 2 piece as being on its portion of the target, and the previously announced deflection is to be assumed, in response to this command, by No. 2 piece. No. 1 piece assumes a deflection 10 mils to the right of the announced deflection, No. 3 assumes a deflection 10 mils to the left thereof, and No. 4 piece assumes a deflection 20 mils to the left thereof. Such a wide sheaf is necessary in practice in order to separate the fire of one gun from that of another at the beginning of fire sufficiently so that the fire of each piece may be individually identified and placed upon its proper part of the target. In the operation of the train board, the operator responds to this command by setting the bead 36 representing No. 2 piece at an arbitrary position, setting the bead 36 representing No. 1 piece at a position 10 mils to the right thereof, that representing No. 3 piece at a point 10 mils to the left thereof, and that representing No. 4 piece at a point 20 mils to the left thereof. The student's next command is "Site, plus ten". This command is given on the assumption by the student that the target is at an elevation above the horizontal plane of the gun emplacement corresponding to an angle-of-site setting of 10 mils, and the operator does nothing in response to this command. The student then announces "Shrapnel" as the type of ammunition to be used, "Corrector 30" indicating

the setting of the time fuse of the shell which is to be used, "Battery Salvo Right, 3400".

Temperature and other climatic conditions have a considerable effect upon the location of burst of shrapnel. Thus, under certain climatic conditions, a corrector setting of 30 may result in bursts 15 mils above the surface of the terrain while on another day with different climatic conditions, the same corrector setting may result in "graze bursts". Consequently, in response to the order "Corrector 30", the operator assumes an arbitrary height of burst and sets the bead 57 at this height. The setting of this bead then is changed with each announcement of the change in the corrector setting or the setting of the angle of site.

The command "Battery Salvo Right" indicates that all four guns of the battery are to be fired; that they are to be fired by salvo, that is, in regular order at intervals of three seconds, and that the right-hand piece (No. 1) is to fire first. The command "3400" indicates that the range at which the battery is to be fired is 3400 yards, and after the range is given, the guns are fired as soon as the settings are completed. In response to this command, the operator sets the two shoes 29 at the indicated points corresponding to 3400 yards on the range arms 24.

The various settings having been completed in compliance with the student's commands, the operator calls out "On the way" and, lining the wire 40 with the bead 36 representing No. 1 piece, releases one of the wires 40 or 45 and permits the bead 42 or 47 to drop into the view of the student through the sighting aperture 27, representing the ball of smoke for a shrapnel burst from No. 1 piece. After not more than two or three seconds, about the duration of such an actual smoke ball, the bead is withdrawn and the wire is hooked in place once more. Suppose that the operator has assumed a height of burst of plus three mils. By referring to the table 58, the operator sees that, in a salvo of eight shots, this setting will result in seven air bursts and one graze burst. If only one round from each piece is to be fired, the operator will probably drop the bead 47 for each shot, thus indicating four air bursts, it being understood that the quadrant 48 has been set so that the notch 50 numbered 3, will intercept the handle portion of the wire 45 when the same is dropped, thus stopping the bead 47 at a height of 3 mils above the terrain 21. After the first shot has been indicated, the operator moves the burst slide until the wire 40 is aligned with the bead 36 which represents No. 2 piece and again drops the bead 47 and pulls it up again after a two or three second interval, repeating the operation with the wire 40 in alignment with each of the beads 36, successively. If the battery is to fire two salvos, the operator will drop the bead 42 once during eight shots entirely down to the terrain 21 to indicate a graze burst, there being nothing on the front side of the slide 37 to stop the wire 40. The table 58 is based upon experience and the law of probabilities in view of variations in ammunition, and this table is sufficiently accurate for practice work.

Such variations in ammunition also result in differences in the distance to which various shells are thrown even by the same gun at a given setting. In order to represent as faithfully as possible field conditions, we have provided for indicating such variations in range. As has been stated, the shoes 29 are formed with convex lower surfaces 30 which are supported on the range arms 24. As the operator touches the burst slide to drop one or the other of the beads, he almost unavoidably will rock the slide in one way or the other. Obviously, such rocking causes the shots to be indicated at different points relative to the range set, some at a slightly greater and some at a slightly shorter range.

After the student has noted the results from the settings which he has specified, he commands such changes in the settings as seem to him to be necessary in order to bring the fire of the battery to bear directly on the target, and his commands are carried out by the operator by movements of the shoes 29, the sheaf block 33, the slide 37, and the quadrant 48. The student continues to correct the settings until finally the batery is brought to bear directly upon his target.

As will be obvious, when it is desired to change the direction of the battery as a whole, the sheaf block 33 is moved bodily along the cross-bar 31, whereas, if it is desired to change the direction only of individual pieces, the respective beads 36 are moved on their wires 35.

As has been stated, the whole train board is easily dismantled for transportation, and another advantage of this arrangement lies in the fact that different sets of range arms may be supplied with each board, and these sets may be substituted for each other in order to simulate the fire of guns of different types and the use of ammunition of different types. The scales on the range arms may be made removable as an alternative to the above arrangement, or different scales may be marked on the same set of range arms as shown in Fig. 11. Preferably, light bulbs are supported from the rear wall 23 of the board above the level of the sighting aperture 27, or on the inner surface and adjacent the opposite sides of the screen 25 at a level below that of the cross-bar 31.

Through the use of hooks suspended from the range arms, suspended target work may be simulated, and moving target work may be simulated by drawing a target across the floor 21 by means of a string passed through eyes

(not shown) mounted on the floor. Of course it will be understood that the same bead which indicates a graze shrapnel burst will also indicate a percussion shell burst; and that the same bead which indicates an air shrapnel burst may also indicate a time shell burst.

The operation and use of the burst slide illustrated in Figs. 12 to 15 is substantially identical to that above described, but the latter slide is much more substantial. The arrangement of rods 71, 72, handles 73, 85, and keys 79, 89 removes all possibility of bending of the wires 81 and 90 through rough usage of the handles 73 and 85, since said handles are not directly connected to the wires and any shocks sustained by the handles will be transmitted only to the rods 71 and 72.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, graduated scales associated with said means, an element movable with respect to said scales in response to commands from a student, means screening from the student's sight said scale and said element but permitting a view of the terrain, and means carried by said element and projectible into the view of the student for momentarily representing projectile bursts relative to the terrain.

2. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, graduated scales associated with said means, and means movable with respect to said scales for visibly and momentarily representing projectile bursts relative to the terrain, said last-mentioned means including separate elements for representing respectively "air-bursts" and "graze-bursts".

3. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, graduated scales associated with said means, an element movable with respect to said scales in response to commands from a student, means screening from the student's sight said scales and said element but permitting a view of the terrain, and means carried by said element and projectible into the view of the student for momentarily representing projectile bursts relative to the terrain, said last-mentioned means including separate elements for representing respectively "air-bursts" and "graze-bursts".

4. In a device for giving instruction in the conduct of artillery fire, a frame comprising a base, side and rear walls secured to said base, a pair of arms secured to said side and rear walls and extending forwardly therefrom, said arms being graduated to indicate range and corresponding elevations from a given hypothetical gun placement, and a sighting screen movable with respect to said base into a position either in prolongation of the space between said arms or to the side thereof.

5. In a device for giving instruction in the conduct of artillery fire, a frame comprising a base, side and rear walls secured to said base, said side walls extending to a point short of the front end of said base, and a screen adapted to be moved horizontally independently of said frame, said screen being adapted to mask the upper portion of said frame.

6. In a knock-down device for giving instruction in the conduct of artillery fire, a frame comprising a base, side and rear walls detachably secured to said base, a pair of arms detachably secured to said side and rear walls and extending forwardly therefrom, and a sighting screen movable with respect to said base into a position either in prolongation of the space between said arms or to the side thereof.

7. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain and including a pair of parallel range arms, means mounted on said arms comprising a cross-bar, a shoe mounted on each end of said cross-bar, said shoes being slidably mounted on said arms, and a sighting screen movable with respect to said base into a position either in prolongation of the space between said arms or to the side thereof.

8. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain and including a pair of parallel range arms, means mounted on said arms comprising a cross-bar and a shoe having a convex bottom surface mounted on each end of said cross-bar said shoes having their convex surfaces slidably mounted in said arms, respectively.

9. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain and including a pair of parallel range arms, means mounted on said arms comprising a cross-bar, a shoe having a convex bottom surface mounted on each end of said cross-bar, said shoes having their convex surfaces slidably mounted on said arms, respectively, and friction means between said arms and said respective shoes.

10. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain and including a pair of parallel range arms means mounted on said arms comprising a cross-bar, a shoe having a convex bottom surface mounted on each end of said cross-bar said shoes having equal convex surfaces slidably mounted on

said arms, respectively, and a friction member mounted on the convex surface of each of said shoes.

11. In a device for giving instruction in the conduct of artillery fire in combination with means representing a terrain a cross-bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, a pair of elements suspended from said member and vertically reciprocable with respect thereto, and means adapted to suspend said elements above the terrain and adapted, when released, to permit said elements to fall into close proximity with the terrain.

12. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a cross-bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, a pair of wires suspended from said member and vertically reciprocable with respect thereto, a bead mounted at the lower end of one of said wires, and a bead of different appearance mounted at one end of the other of said wires.

13. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a cross-bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, an element simulating the burst of a projectile suspended from said member and vertically reciprocable with respect thereto, said element being adapted to be dropped into predetermined proximity with the terrain, and means to limit the length of drop of said element.

14. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a cross bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, an element suspended from said member and vertically reciprocable with respect thereto, said element being projectible downward into proximity with the terrain, and means adjustable before the movement of said element to limit, in varying degrees, the degree of downward projection of said element.

15. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a cross-bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, an element suspended from said member and vertically reciprocable with respect thereto, said element being projectible into proximity with the terrain, and means pivoted to said member and swingable to limit, in varying degrees, the degree of projection of said element.

16. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a cross-bar movably suspended adjacent said means, a member slidably mounted upon said cross-bar, an element suspended from said member and vertically reciprocable with respect thereto, said element being projectible into proximity with the terrain, and a notched quadrant pivoted to said member and swingable to project into the path of said element to limit, in varying degrees, the degree of projection of said element.

17. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a graduated cross-arm movably suspended adjacent said means, a slide on said cross-bar, a sheaf-block slidably mounted on said cross-bar, a scale on said block, a plurality of parallel members longitudinally mounted on said block adjacent said scale, an element slidable on each of said members to represent a specific piece of a battery, said slide being movable into registry with any one of said elements, and means suspended from said slide and projectible into close proximity with the terrain.

18. In a device for giving instruction in the conduct of artillery fire, in combination with means representing a terrain, a graduated cross-bar movably suspended adjacent said means, a slide on said cross-bar, a sheaf-block slidably mounted on said cross-bar, a scale on said block, a plurality of parallel members longitudinally mounted on said block adjacent said scale, an element slidable on each of said members to represent a specific piece of a battery, said slide being movable into registry with any one of said elements, a pair of wires reciprocably mounted on said slide, a bead on the lower end of one of said wires adapted to be dropped into contact with the terrain, a bead of different appearance on the lower end of the other of said wires adapted to be dropped toward the terrain, and means on said slide adjustable to stop said last-mentioned bead, when dropped, above the terrain.

19. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, a member movable by an operator relative to said terrain in response to a student's orders, means carried by said member for indicating "graze bursts" relative to the terrain, means carried by said member for indicating "air bursts" relative to the terrain, and means for indicating to the operator the proper ratio of "air bursts" to "graze bursts" for any given height of burst setting.

20. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, a member movable by an operator relative to said terrain in response to a student's commands, means carried by said member for indicating "graze bursts",

relative to the terrain, means carried by said member for indicating "air-bursts" relative to the terrain, and means carried by said member and adjustable by the operator in response to a command of the student for indicating to the operator the proper ratio of "air-bursts" to "graze-bursts" for the specified setting of the piece.

21. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, a member movable by an operator relative to said terrain in response to a student's commands, means carried by said member for indicating "graze-bursts" relative to the terrain, means carried by said member for indicating "air-bursts" relative to the terrain, a scale carried by said member, an element mounted on said member and extending longitudinally of said scale, and means slidable on said element by the operator in response to a command of the student for indicating to the operator the proper ratio of "air-bursts" to "graze-bursts" for the specified setting of the piece.

22. In a device for giving instruction in the conduct of artillery fire, a bar, a slide having a bifurcated base adapted slidably to receive said bar, a rod mounted on said slide, a handle member slidable on said rod, a wire suspended from said handle member, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move said wire to position said simulating means in given relation to said slide and said rod.

23. In a device for giving instruction in the conduct of artillery fire, a bar, a slide having a bifurcated base adapted slidably to receive a bar, a rod mounted on said slide, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move said wire to position said simulating means in given relation to said slide and said rod.

24. In a device for giving instruction in the conduct of artillery fire, a bar, a slide having a bifurcated base adapted slidably to receive said bar, a rod mounted on said slide, a handle member comprising a bored neck slidably and oscillably mounted on said rod, said neck being formed with a slot in a plane perpendicular to the bore thereof, a key received in said slot and slidably mounted on said rod, and a wire secured to said key, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move said wire to position said simulating means in given relation to said slide and said rod.

25. In a device for giving instruction in the conduct of artillery fire, a bar, a slide having a bifurcated base adapted slidably to receive said bar, a rod mounted on said slide, a handle member comprising a bored neck slidably and oscillably mounted on said rod, said neck being formed with a slot in a plane perpendicular to the bore thereof, a key received in said slot and slidably mounted on said rod, said key being formed with an aperture adapted to register with said neck bore and to be threaded on said rod, means to prevent oscillation of said key, a wire secured to said key, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move said wire to position said simulating means in given relation to said slide and said rod.

26. In a device for giving instruction in the conduct of artillery fire, a bar, a slide formed with a pair of parallel flanges and adapted to be mounted on a bar, a rod mounted on said slide in the plane of each of said flanges, a handle member comprising a bored neck slidably received on each of said rods, each of said necks being formed with a slot in a plane perpendiuclar to the bore thereof, a key received in each of said slots, each of said keys being bifurcated at its one end and formed with an aperture intermediate its ends adapted to be threaded on its respective rod, the furcations of each of said keys lying on opposite sides of its respective flange, a wire secured to the opposite end of one of said keys, a bead on the free end of said wire, a wire secured to the opposite end of the other of said keys, and a bead of different appearance on the free end of said second wire.

27. In a device for giving instruction in the conduct of artillery fire, a bar, a slide adapted to be mounted on said bar, a rod mounted on said slide, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, means on said slide for suspending said handle member adjacent the top of said rod, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move saide wire to position said simulating means in given relation to said slide and said rod.

28. In a device for giving instruction in the conduct of artillery fire, a bar, a slide adapted to be mounted on said bar, a rod mounted on said slide adjacent one side thereof, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, a lug on the same side of said slide and positioned to engage said handle member in one rotative position of the latter to suspend the same adjacent the top of said rod, and means

on the same side of said slide adapted to be positioned in the path of said handle member in another rotative position of the latter for limiting the downward sliding movement of said handle member, and means carried by said wire simulating the appearance of the burst of an artillery projectile, said handle being adapted to move said wire to position said simulating means in given relation to said slide and said rod.

29. In a device for giving instruction in the conduct of artillery fire, a bar, a slide adapted to be mounted on said bar, a rod mounted on said slide adjacent one side thereof, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, and means on the same side of said slide adapted to be adjustably positioned in the path of said handle member variably to limit its sliding movement downwardly.

30. In a device for giving instruction in the conduct of artillery fire, a slide, a rod mounted on said slide adjacent one side thereof, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, a bead on the free end of said wire, a lug on the same side of said slide and cooperable with said handle member, in one rotative position of the latter, to hold the same adjacent the top of said rod, a second rod mounted on said slide adjacent the opposite side thereof, a handle member slidably and oscillably mounted on said second rod, means slidable with said handle member but held against oscillation therewith, a second wire secured to said last-mentioned means, a bead of different appearance on the free end of said second wire, and a lug on said opposite side of said slide and cooperable with said last-mentioned handle-member, in one rotative position of the latter, to hold the same adjacent the top of said second rod.

31. In a device for giving instruction in the conduct of artillery fire, a slide, a rod mounted on said slide adjacent one side thereof, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, a bead on the free end of said wire, a lug on the same side of said slide and cooperable with said handle member, in one rotative position of the latter, to hold the same adjacent the top of said rod, a second rod mounted on said slide adjacent the opposite side thereof, a handle member slidably and oscillably mounted on said second rod, means slidable with said handle member but held against oscillation therewith, a second wire secured to said last-mentioned means, a bead of different appearance on the free end of said second wire, a lug on said opposite side of said slide and cooperable with said last-mentioned handle-member, in one rotative position of the latter, to hold the same adjacent the top of said second rod, and means to limit downward movement of said second handle member.

32. In a device for giving instruction in the conduct of artillery fire, a slide, a rod mounted on said slide adjacent one side thereof, a handle member slidably and oscillably mounted on said rod, means slidable with said handle member but held against oscillation therewith, a wire secured to said means, a bead on the free end of said wire, a lug on the same side of said slide and cooperable with said handle member, in one rotative position of the latter, to hold the same adjacent the top of said rod, a second rod mounted on said slide adjacent the opposite side thereof, a handle member slidably and oscillably mounted on said second rod, means slidable with said handle member but held against oscillation therewith, a second wire secured to said last-mentioned means, a bead of different appearance on the free end of said second wire, a lug on said opposite side of said slide and cooperable with said last-mentioned handle-member, in one rotative position of the latter, to hold the same adjacent the top of said second rod, and a quadrant pivoted to said opposite side of said slide, said quadrant being formed with a series of notches in its edge adjacent said second rod, and being swingable to bring such notches selectively into the path of said second handle member when the latter is in another rotative position.

33. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, and means associated with said first-mentioned means for indicating the longitudinal, lateral, and elevational location with respect to said terrain of the bursts of projectiles thrown from a hypothetical piece at any given aim, said last-mentioned means including a bead simulating the appearance of a projectile burst.

34. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, a screen adjacent an edge of said means between said means and the student's eye, said screen being formed with a sighting aperture, and transparent movable means associated with said aperture and carrying indicia adapted to indicate to the student lateral displacement of objects on the terrain from his line of sight.

35. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, a screen intercepting the student's vision of said means, said screen being formed with a sighting aperature through which said means are visible in perspective,

and a transparent scale mounted to slide transversely in said aperture.

36. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, and an upstanding screen adjacent an edge of said means but movable independently thereof, said screen being formed with a sighting aperture adapted to permit vision therethrough along said means.

37. In a device for giving instruction in the conduct of artillery fire, means representing a terrain, said means being mounted for movement in a horizontal plane, a screen adapted to be stationarily mounted upstanding adjacent an edge of said means, said screen being formed with a transverse sighting aperture at the approximate level of said means, and a scale on said screen cooperable with the adjacent end of said means for indicating to an operator the observer-target-gun angle.

Signed by us this 15th day of February, 1929.

STEPHEN Y. McGIFFERT.
HUGH P. ADAMS.