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TECHNICAL INFORMATION
REPORT 9-8-3A8

OFFICE, CHIEF OF ORDNANCE
January 1957

DEVELOPMENT
OF
RANGE FINDER, T52

*PREPARED FOR THE U. S. ARMY
MATERIEL COMMAND BY THE ARMY
MATERIEL RESEARCH STAFF,
UNIVERSITY OF PITTSBURGH,
UNDER CONTRACT DA-36-034-AMC-
3785(X)*.

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In April 1954 a project was authorized for modification of the production model T43E1 tank as the T43E2. The T43E2 was to have a turret different from that of its predecessor and would contain a completely redesigned fire control system based on a concept of dividing between the gunner and the tank commander responsibility for laying the gun. Previously, the gunner acquired the target, found the range, and sighted his weapon. With the new system, target acquisition and range finding would be done by the tank commander, and the gunner would give his full attention to laying the gun. It was believed that such a separation of duties would increase the efficiency of the crew members concerned, reduce the time needed to acquire a target, and result in greater accuracy of fire.

The primary fire control system of the T43E2 tank is electro-mechanical in operation and allows either the commander or the gunner to use either direct or indirect fire against targets at ranges between 500 and 5,000 yards. It is composed of a T52 range finder, a T33 ballistics computer, a range servo amplifier that is a component of the computer, a T1 servomechanism, a T14 superelevation transmitter, a T36 periscope drive-mount, a T44E1 periscope, a T159 infinity sight, a T16 cant corrector, and an inverter. The periscope drive-mount, periscope, infinity sight, and cant corrector listed above constitute one of two alternative installations for the gunner's station; the other would consist of a T38 periscope drive-mount, an M16E1 periscope, and an M30 instrument light. OCO and CONARC will decide which of these installations should be adopted.

A T172 direct-fire telescope in a T209 mount is mounted coaxially with the 120-mm gun to give the gunner a secondary fire control system to use if the primary system becomes inoperative. Two ballistic reticles, one for AP and the other for HE ammunition, are interchangeable in the telescope.

For those occasions when the tank must be used as an artillery-

RELATED TIR'S

TIR 9-8	Development of Fire Control Equipment
TIR 9-8-3	Development of Range Finders for Armored Vehicles

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support weapon it is fitted with an M13 elevation quadrant, a T28 azimuth indicator, and an M30 instrument light as equipment for the control of indirect fire.

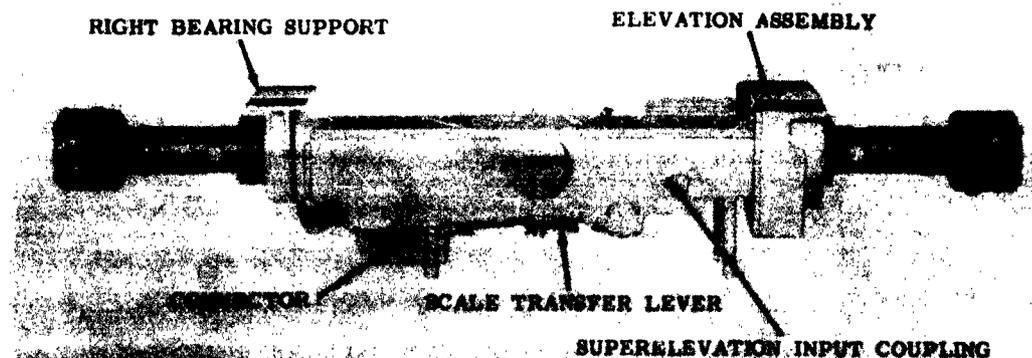
Before discussing the T52 range finder it will help to explain briefly how the system of which it is a part functions. First, the range finder is operated to measure the range, which is then sent to the ballistics computer through the medium of a synchro transmitting system. The computer figures the amount of superelevation for the ammunition to be used at the range fed into it and transmits the calculated data through four mechanical linkages and one electrical output to the periscope, the superelevation-signal generator, the superelevation transmitter, the cant corrector, and the range-finder cant corrector.

Introduction of superelevation data depresses the line of sight of both the range finder and the periscope. These depressions must be compensated for by elevating the gun to an amount equal to the displacement of the sighting instruments to again place the gun-laying reticles on the target. When there is no change in superelevation, the drive-mount acts as a rigid linkage, and angular movement of the sighting instruments corresponds to the movement of the gun. This movement adds the computed superelevation angle to the original gun-elevation angle for a given range and particular kind of ammunition and accurately positions the gun with respect to the target.

The T52 range finder is an auto-collimated, hermetically sealed instrument with a 73-inch base. Although its principal use is for the tank commander to determine the range, it has a secondary function as an offset telescope by which he can lay the gun. In the event of an emergency, the range finder can also be used as a direct-fire telescope. If the left telescope of the instrument should be damaged, its gun-laying reticle can be transferred to the eyepiece of the right telescope by the operation of a transfer lever. A range scale, normally seen through the left eyepiece, also can be transferred to the right eyepiece by means of the transfer lever; it moves when the range knob is turned and shows the distance in yards when the instrument is ranged.

Training in the operation and adjustment of the range finder is essential to its effective use. Among the techniques with which the operator must be familiar is that of calibrating the instrument to adapt it to his own anatomy and vision; this can be done by means of the internal correction-setting knob, the interpupillary-distance knob, and the diopter-adjustment rings, all expressly provided for this purpose.

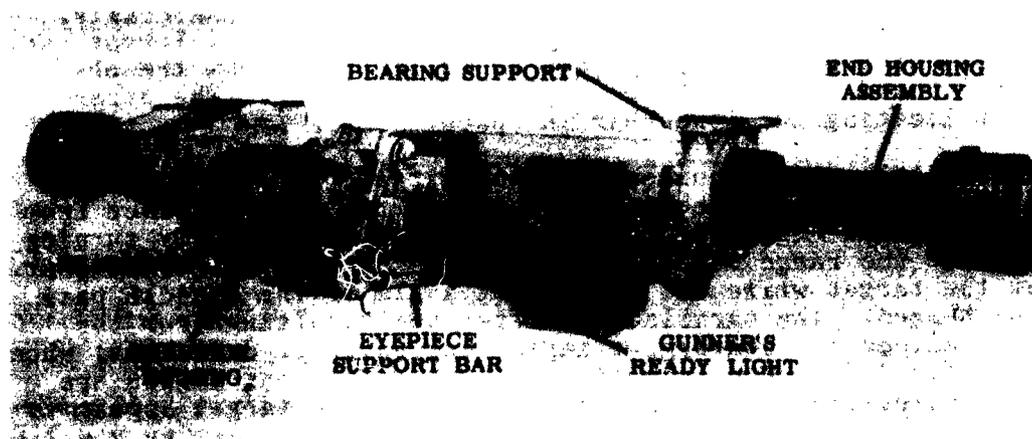
Successful use of the T52 range finder depends upon the ability of its operator to employ stereoscopic vision in judging the distance between two objects in space. This ability can be developed by training in the advantages of binocular fusion, in which the eyes converge on an object at which their visual axes will intersect. The image of the object then falls on the fixation point of each retina and it is seen as a single object occupying a certain area in space. When the object of regard is fixated, the angle between the object and the visual axes is termed the convergent angle. The size of the



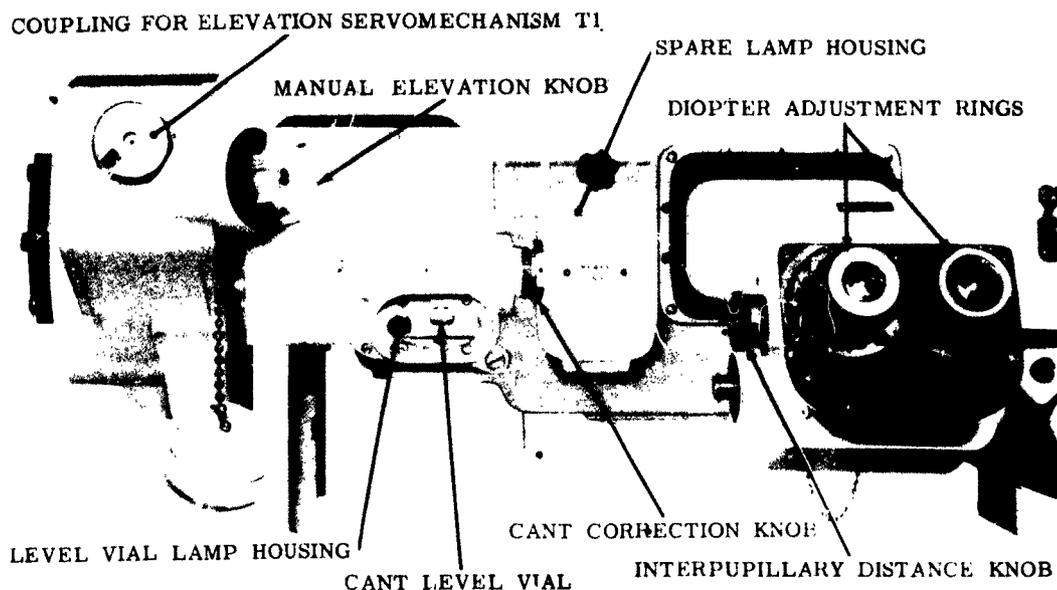
FRONT VIEW OF RANGE FINDER, T52

convergent angle depends on the separation of the eyes and their distance from the object. If the eyes become fixed on any other object in space, another convergent angle results. The difference between the two angles is the parallactic difference, normally interpreted by the brain as a difference in distance between the objects.

A person's stereoscopic acuity depends on his ability to discriminate between small parallactic differences (differences in binocular parallax within the limits revealing relative range) and varies for each individual. The ability to detect relative range differences can be improved by increasing the effective distance between the eyes (base length) by means of a system of reflectors, and by identical telescopes for each eye. Greater base length and higher magnification make it possible to detect smaller binocular parallax differ-



RIGHT REAR VIEW OF RANGE FINDER, T52

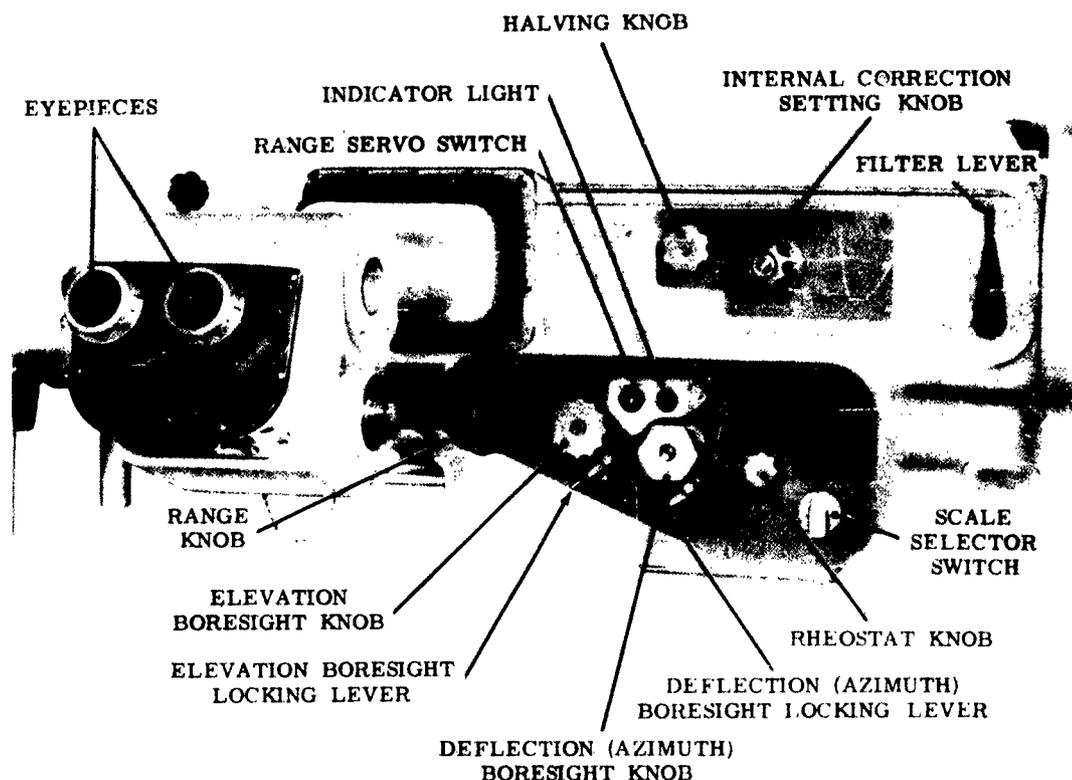


LEFT SIDE OF RANGE FINDER, T52

ences. An optical instrument containing these features can increase the sensitivity of the eyes to binocular parallax differences and allow the observer to determine when there is no apparent difference in range between two objects, although he cannot measure the relative difference in yards.

A stereo-reticle pattern in the internal-collimator system of the T52 range finder gives the effect of a third dimension in which two pairs of vertical bars and a single bar, equally spaced laterally, seem to be at different distances from the observer. The lowest bar, in the center of the pattern, appears to be farthest from the observer and is used as the reference point for ranging. The other bars aid in locating the lower bar in space.

Measuring the range requires that the target, regardless of its apparent or true distance, be made to seem at the same distance from the observer as the reference bar of the stereo reticle. By turning the range knob the range-compensator assembly changes the convergent angle for the target while the convergent angle of the reticle pattern is unchanged. The parallax difference resulting from the difference between the convergent angles increases or decreases; when the parallax difference becomes zero, the convergent angles are equal, and the reference bar of the reticle and the target appear to be at the same distance from the observer. When this seeming equality of distance is obtained, the range is determined and transmitted to the T33 ballistics computer by an electrical signal which corresponds to a logarithm of the range.

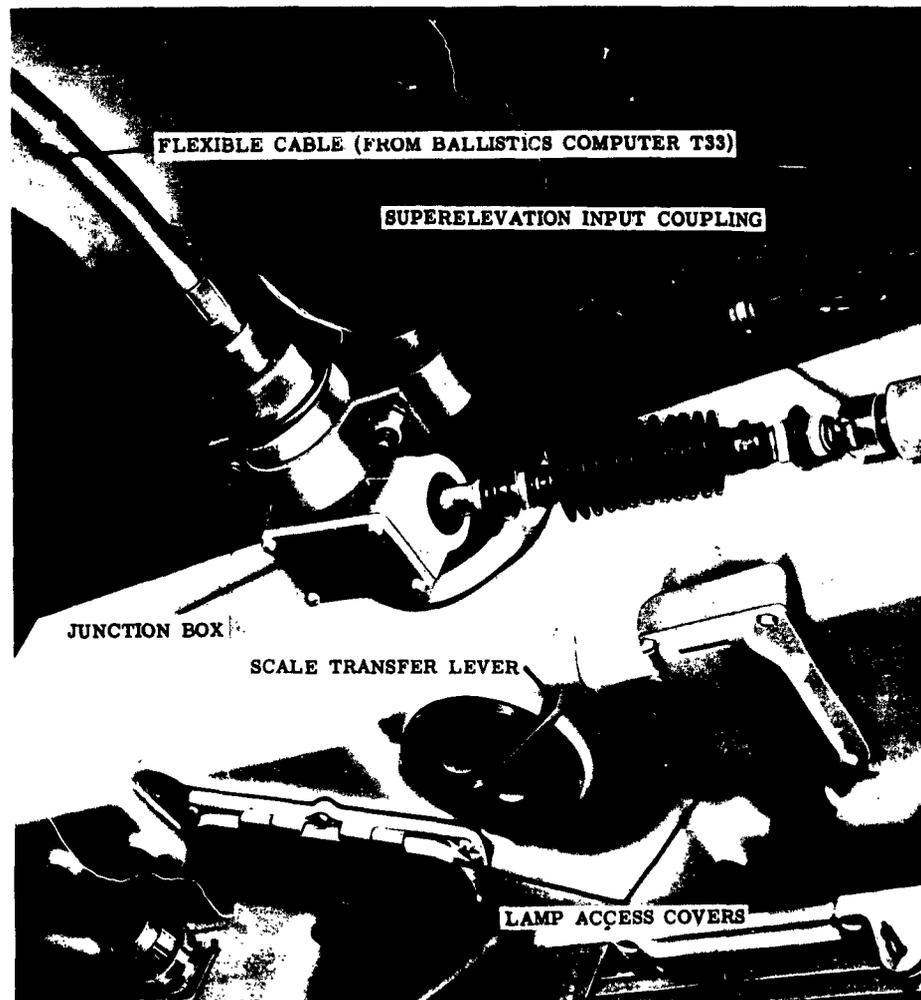


RIGHT SIDE OF RANGE FINDER, T52

When the range signal is received by the computer it is converted into superelevation data that are sent to the periscope drive-mount and the superelevation transmitter. The range finder and the periscope are then moved in superelevation. Movement of the range finder causes the stereo reticle to move up or down (an action known as stereo dip); this condition is overcome when the superelevation-signal generator causes the gun-elevation part of the hydraulic gun-control system to operate. In consequence, gun elevation occurs when the range finder's range knob is moved; during this movement the stereo-reticle pattern stays on the target.

A signal created at the superelevation transmitter by elevation of the gun causes the elevation synchro-mechanism to elevate or depress the range finder correspondingly. If, however, the elevation servomechanism becomes inoperable, it can be disconnected from the range finder, and the instrument can then be elevated or depressed by means of a manual elevation knob.

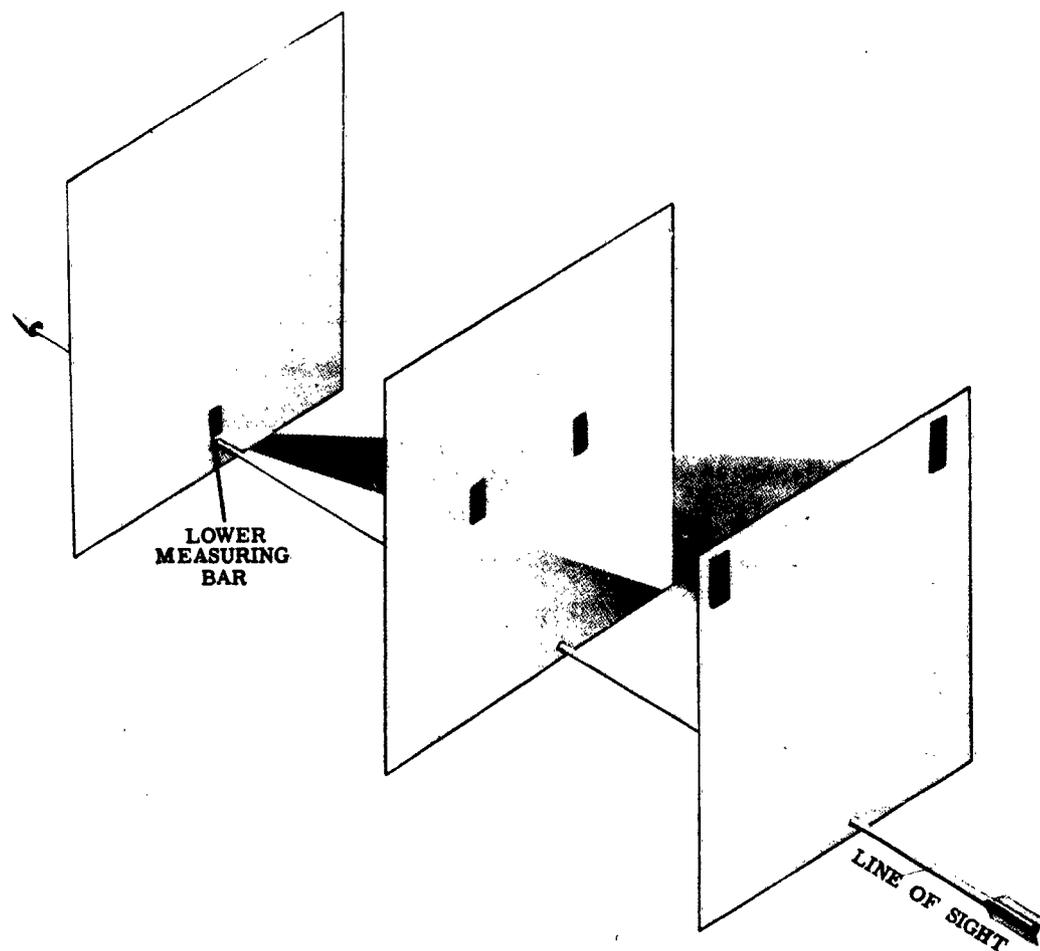
The T52 range finder is mounted in a right bearing support and an



PARTIAL VIEW OF RANGE FINDER, T52, INSTALLED

elevation assembly attached to the roof plate of the turret. The range finder moves with the turret in azimuth, and ball bearings in the mounting units allow it to be rotated about an axis parallel to the gun trunnions so that it can follow the gun in elevation as directed by the servo system.

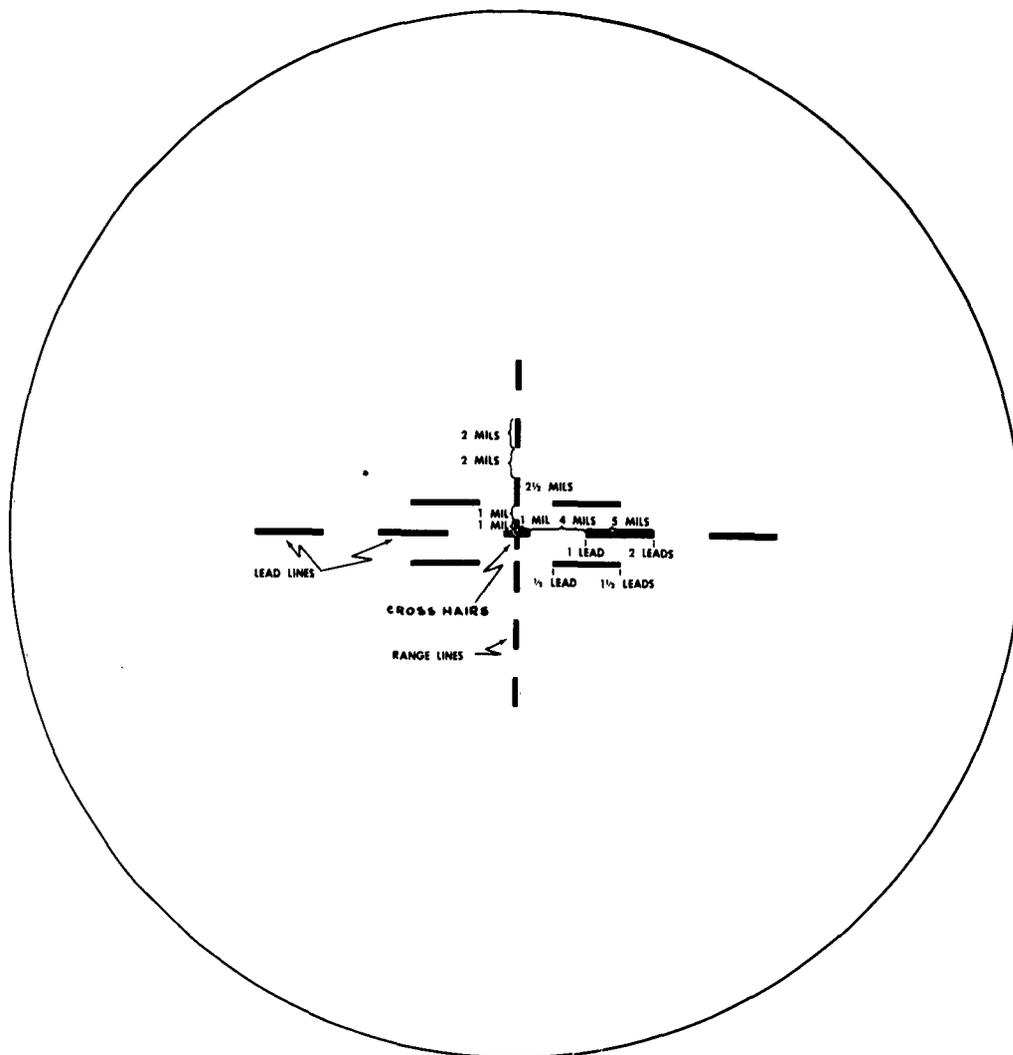
The optical systems and mechanisms of the T52 range finder are contained in a main housing assembly, an eyepiece housing, and two identical end housing assemblies. All the optical components of the instrument except those in the end housing assemblies and the eyepieces are in the main housing assembly. In this assembly there are also the cant corrector and the elevation and range-drive mechanisms. The right and left telescope systems are symmetrical except for the range-compensator assembly, which is in the right system only. A window in the main assembly excludes dust and moisture from the range



STEREOSCOPIC IMPRESSION OF THE RETICLE
OF RANGE FINDER, T52

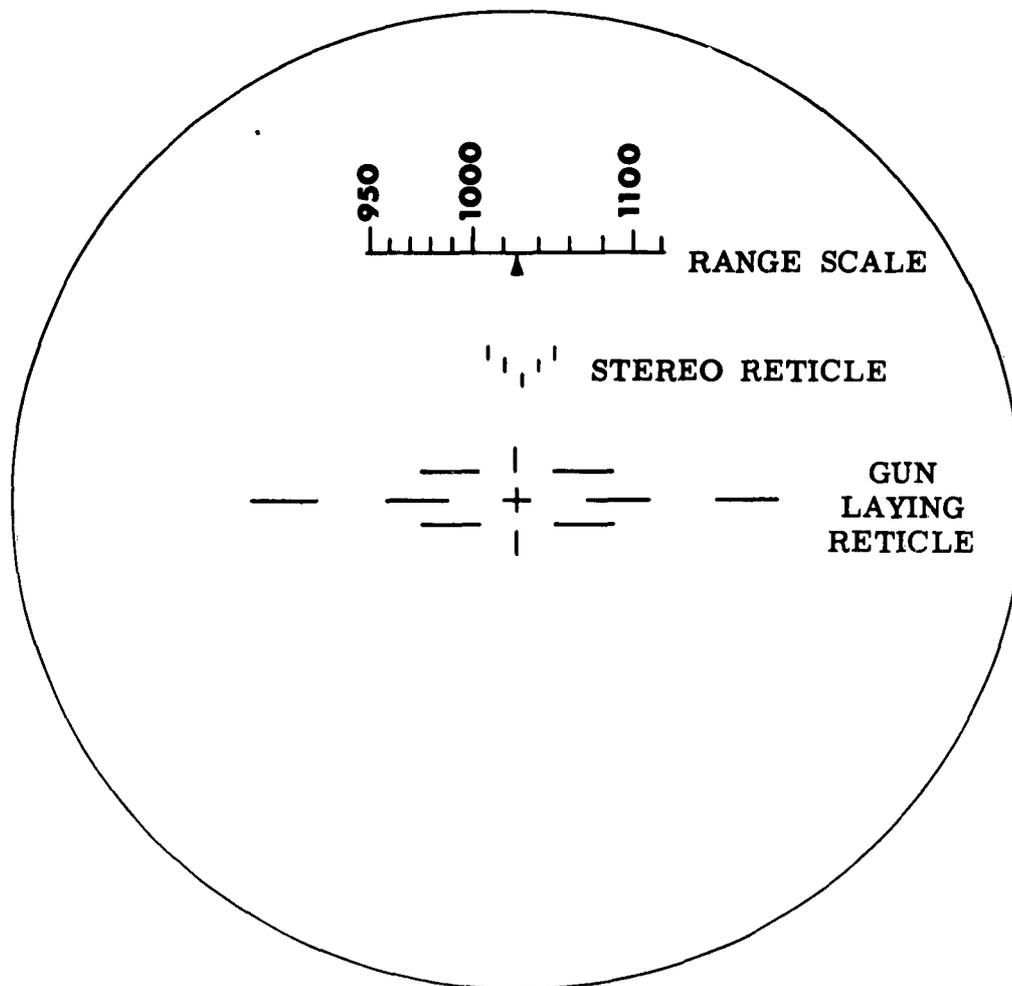
finder while permitting light to enter. A neutral filter controlled by a rod geared to the filter mounts can be used to decrease the brightness of the field image without adversely affecting the image color. This filter can be introduced into the optical system or removed from it at the desire of the operator.

The two end housing assemblies are identical and are interchangeable on the same instrument and other T52 range finders. When such substitutions are made, it is unnecessary to recalibrate or boresight the instruments. Each assembly consists of an aluminum housing with an end window and cover, a penta reflector, an optical wedge, a purging valve through which the assembly can be flushed with dry nitrogen,



GUN-LAYING RETICLE

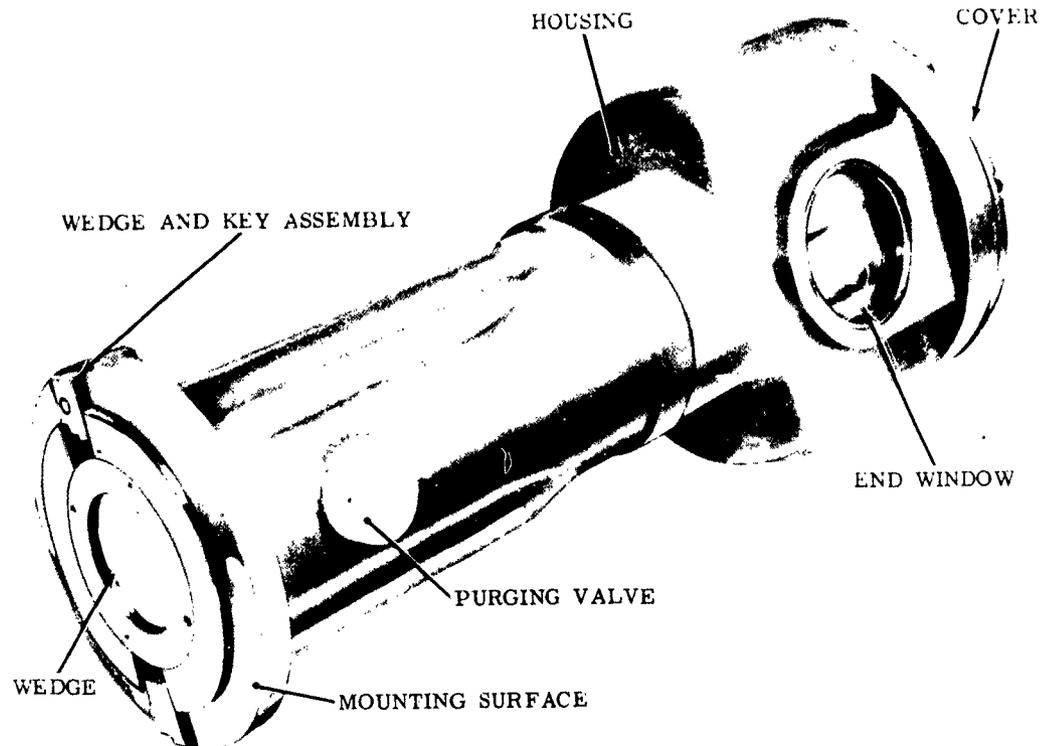
and a mounting surface with a wedge and key assembly for orienting the housing when it is installed. When the target image enters the window it is reflected by the penta reflector to the wedge. Because the two mirror surfaces of the penta reflector are attached perpendicularly to a common glass base there is no effect on the over-all deviation and no error is introduced. Rotating the penta reflector by turning an externally accessible spring-loaded screw in the housing adjusts it for elevation. Image tilt can be corrected by rotating the penta reflector about an axis parallel to the reflected ray.



RETICLE PATTERNS OF RANGE FINDER, T52

Correction for image tilt in the housing assembly is made by loosening the cover screws and rotating the cover the desired amount.

The wedge is a weak prism with a deviation angle of about 5 minutes; it is the last optic through which light must pass before leaving the end housing assembly. The slight error in deviation that may be present in the penta reflector can be compensated for by rotating the wedge. Vertical errors introduced into the wedge can be neutralized by means of the elevation adjustment at the penta reflector.



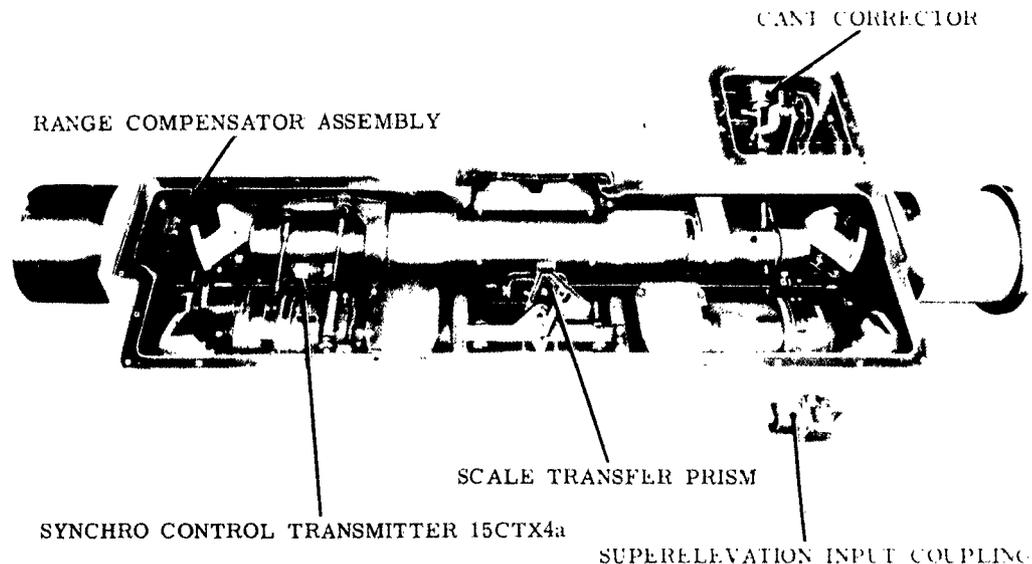
END HOUSING ASSEMBLIES OF RANGE FINDER, T52

Light entering the end housing assemblies is directed toward the center of the range finder, where it enters the telescope systems, passes through various series of lenses and prisms, and then goes through the eyepieces to the eyes of the observer. Light projected from the internal collimator system into the telescope systems enables the image of the gun-laying reticles and scales to be combined with each target image to produce composite images in the eyepieces.

Wherever practicable, the optical elements of the range finder are given a low-reflectance coating that reduces reflections and increases the transmission of light. Internal reflections are reduced by coating or painting almost all mechanisms in the instrument with a dull black finish.

In addition to the optical elements of the end housing assemblies, the T52 has an identical telescope system on each side of its center, a range-compensator assembly, an internal collimator assembly, and an eyepiece assembly.

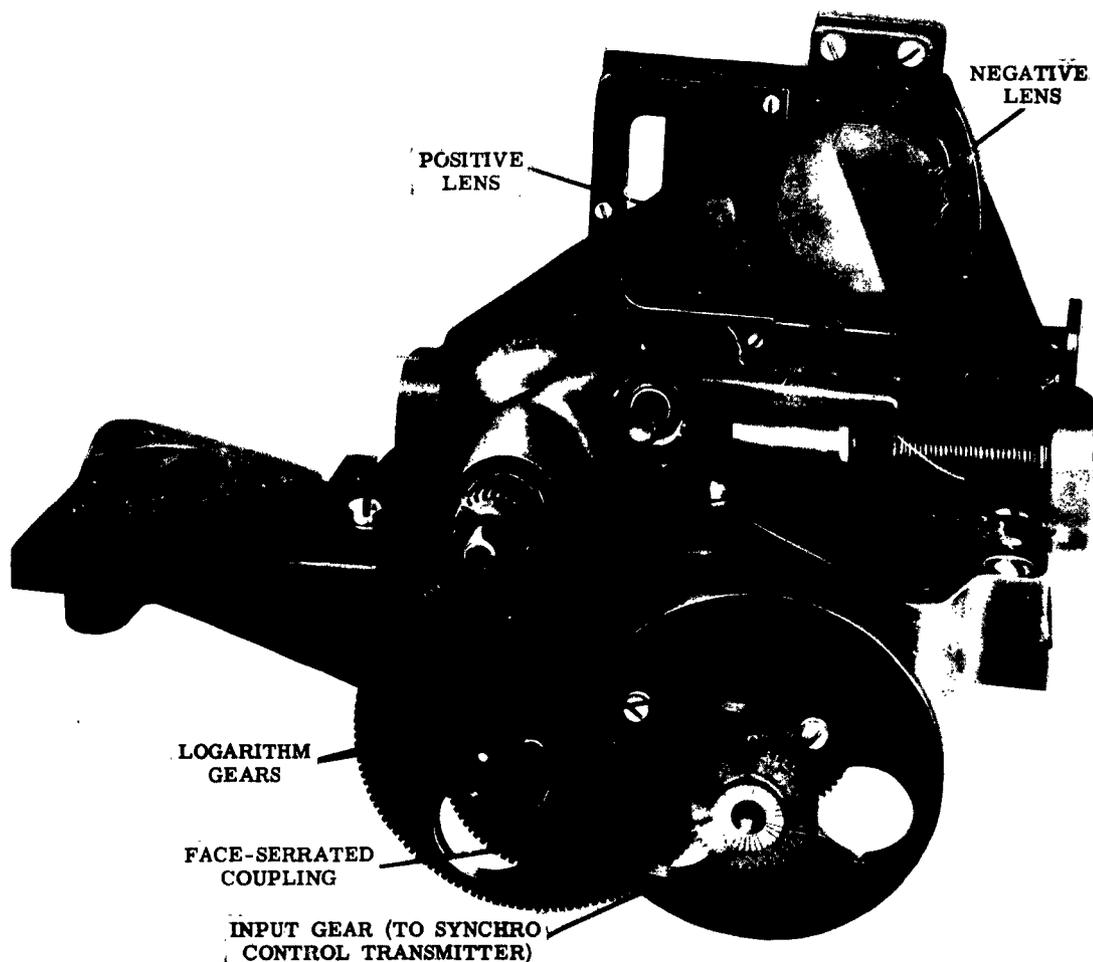
The range-compensator assembly contains two single-element lenses



MAIN HOUSING ASSEMBLY OF RANGE FINDER, T52

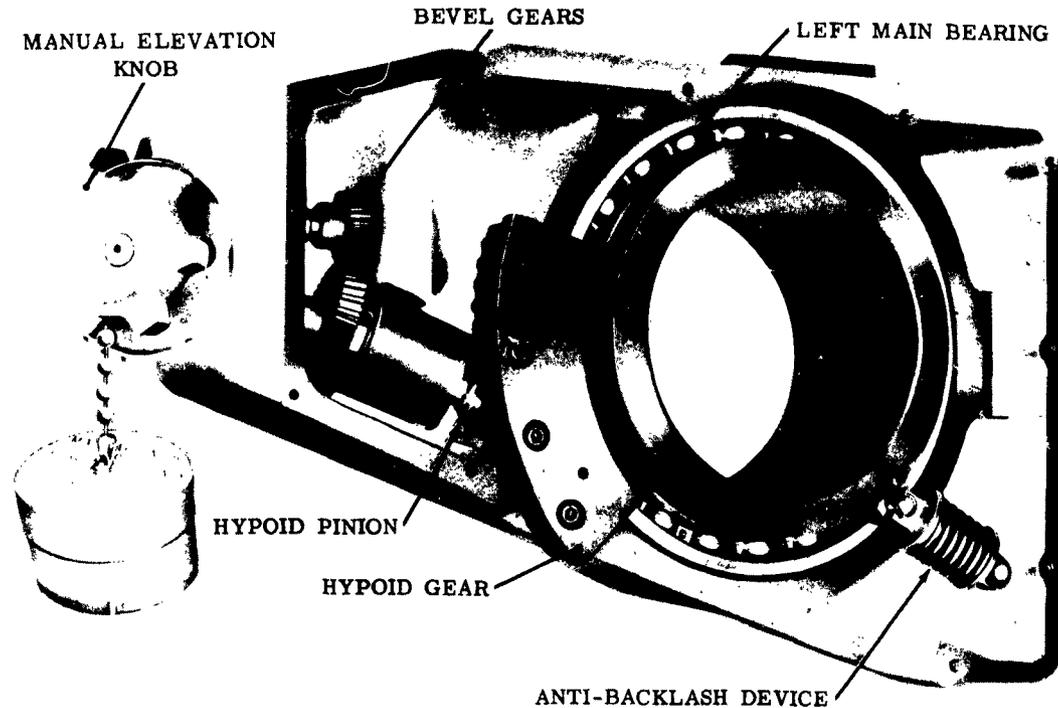
of equal but opposite power and long focal length. The circular negative lens is in a fixed position on the optical axis of the telescope, in front of the rectangular positive lens. Turning the range knob rotates a compensator lead screw that moves the positive lens horizontally until it is about perpendicular to the direction of the light from the target. The deviation resulting from this movement allows the operator to equalize the convergent angles for the target and the stereo-reticle pattern so that the parallax difference is brought to zero.

Light from the internal collimator system is deflected toward the telescope's objective lens by a partial penta reflector mechanically similar to the penta reflector in the end housing assembly. This light, and that from the target, are converged by the objective lens toward its focal plane. The images can be adjusted for focus by moving the objective lens along its optical axis. The limiting aperture of the cell holding the objective lens is 1.5 inches in diameter; it forms the entrance pupil for the telescope system, and determines the amount of illumination of the images in the telescope assembly.



RANGE-COMPENSATOR ASSEMBLY OF RANGE FINDER, T52

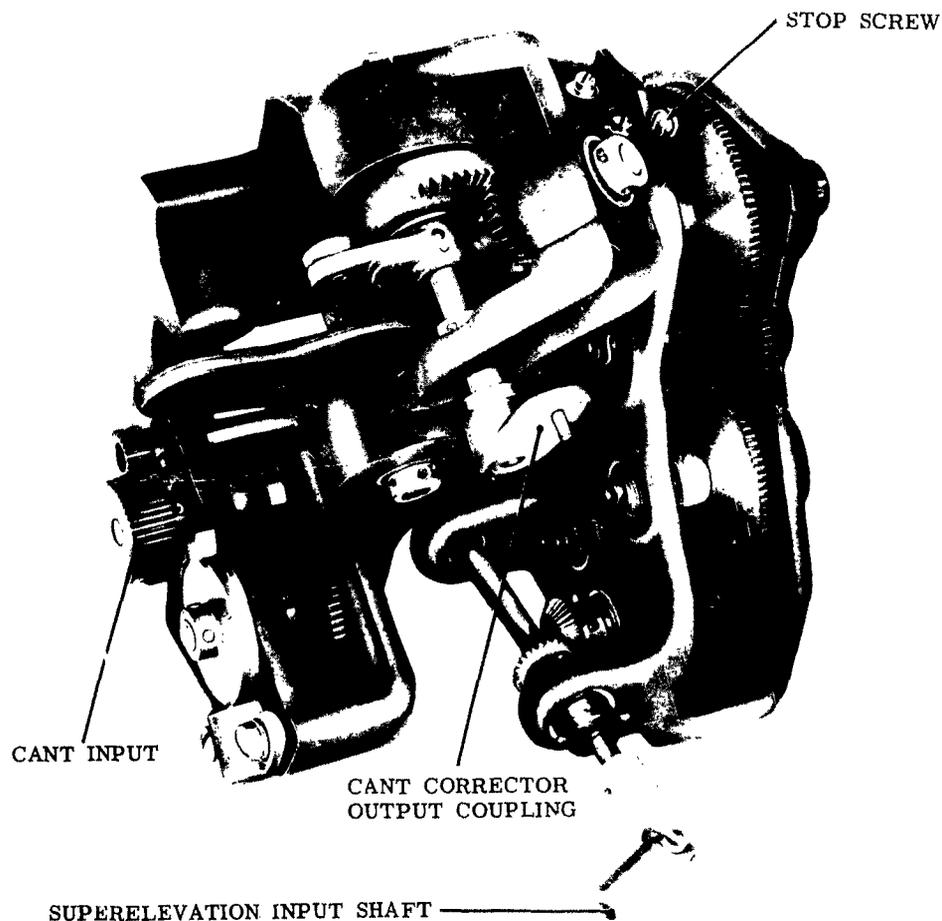
Light from the objective lens continues toward the pechan-prism assembly, which consists of two prisms on a common support of ball bearings. These prisms are so mounted that their positions can be adjusted in relation to each other and to the support. The prism assembly makes it possible to keep the range finder's eyepieces stationary while the instrument is rotated about its axis in elevation or depression. Motion of the range finder is transmitted to the pechan prisms by a differential. Gearing rotates the pechan prisms in the same direction as the range finder but in an amount equal to only one half of the range finder's rotation. This rotation of the prisms keeps the images of the target, gun-laying reticles, and range scales from tilting to one side or the other when the range finder is elevated or depressed. The images are reverted when they leave the



ELEVATION ASSEMBLY OF RANGE FINDER, T52

prisms.

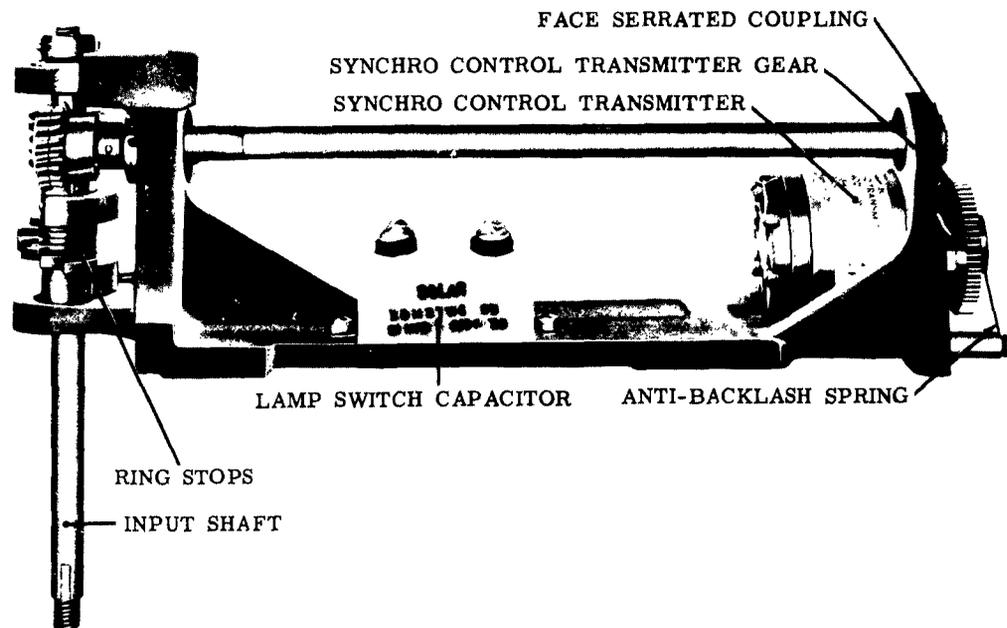
As they proceed toward the first collective lens, which helps to decrease the diameter of the bundle of light rays from the target, the light rays from the pechan prisms converge. Upon entering the collective lens the converging light from the objective lens is further converged and brought to a focus; the rays then form a real, inverted image of the target, the range scales, and the reticles of the internal collimator system. The light rays of the converged image then pass to the first 90° prism, in which reversion of the image cancels the reversion created by the pechan prisms. The light rays are then reflected 90° toward the second collective lens, where the divergency of light from the image formed by the objective lens is overcome and the rays are made nearly parallel. Image quality is preserved by the first erector lens, from which the light rays go to the second erector lens.



CANT CORRECTOR OF RANGE FINDER, T52

The second erector lens converges the light rays it receives to form a real, erect image of the target, the range scale, and the reticles at the focal plane of the eyepieces. Inversion of the image has now occurred twice, and the image at the focal plane of the eyepiece assembly is erect. Converging light from the second erector lens reaches the second 90° prism, from which the rays are deviated downward approximately 90° toward the 110° prism and are inverted at the same time.

The 110° prism has three optically flat surfaces, through the first of which light from the 90° prism enters perpendicularly. The light is then inverted by reflection at the second surface and leaves the prism perpendicularly at the third surface. From this last sur-



RANGE DRIVE ASSEMBLY OF RANGE FINDER, T52

face the light travels upward 20° from the horizontal, which corresponds to the upward tilt of the axes of the eyepieces. This angle of the eyepieces enables the operator to use them from a more comfortable position than would otherwise be possible.

When the light leaves the 110° prism it proceeds to the rhomboid prism, which is bonded to a mount attached to the cell of the eyepiece. The rhomboid prism has four optically flat surfaces, one of which is perpendicular to the light received from the 110° prism. The light enters the first of these surfaces, is reflected from the second surface, is again reflected from the third surface, and leaves the prism through the fourth surface without any inversion having occurred. The rhomboid prism permits adjustments of the interpupillary distance (IPD) to be made without affecting collimation or ranging accuracy. In this operation a mechanism moves the eyepiece assembly laterally and rotates the rhomboid prism about the mechanical axis. When the mechanism is properly adjusted the observer is unable to detect any rotation as he looks through the eyepieces. Light from the rhomboid prism converges toward a focus near the diaphragm of the eyepiece.

Each eyepiece contains an eye lens, a field lens, and a diaphragm

mounted within a cell. The cell can be moved along the optical axis and focused for the individual needs of the operator by turning a diopter-adjustment ring on which there is a scale graduated from -3 to +3 diopters. The distance between the eyepieces can be changed to meet the requirement of the operator by means of the IPD knob on the outside of the range finder. A scale on this knob is graduated from 58 to 72 in one-millimeter increments. The diaphragm, a circular limiting aperture near the final image formed by the telescope system, functions as a field stop and gives a well-defined circular border to the field of view; at the same time, it eliminates unwanted stray light that might disturb the observer. The field lens receives the light coming from the image near the diaphragm and directs it toward the eye lens. The last optic in the eyepiece assembly is the eye lens, which is responsible for the 8.6-power magnification of the range finder. Finally, the eyepiece assembly has an exit pupil with a diameter of 0.174 inch and so placed that the observer's eye is 0.883 inch from the eye lens when the eye is in the proper position for viewing. When his eye is properly placed, the observer can look at any object in the field of view simply by turning his eye in the correct direction.

The stereo reticles, gun-laying reticle, range scale, and the optical elements necessary for projecting their images into the telescope system through the partial penta reflector, are in the internal collimator system. Because the right and left collimator systems are symmetrical, only one of them will be described.

The gun-laying reticle is a thin piece of optical glass, approximately rectangular in shape, on which the reticle pattern is formed by transparent areas in an opaque background. Light from a lamp beneath the reticle passes through a small window, proceeds through the transparent areas of the reticle, and is then directed upward to the first 90° prism, which is directly above the reticle. The intensity of the illumination may be controlled for night firing by adjustment of the rheostat knob on the outside of the range finder's main housing.

The light from the reticle is next reflected from the first 90° prism to the second 90° prism, which reflects it upward to the vertical reflecting mirror. This mirror is fastened to a support that can be rotated about a horizontal axis parallel to the mirror's surface to move the image of the gun-laying reticle upward or downward for making changes in boresight elevation. Light reflected from the mirror goes upward to the scale-transfer prism.

Light from the same lamp illuminates both the gun-laying reticle and the range scale. The range scale, which is adjacent to the gun-laying reticle, has its scale and range numbers formed by transparent areas in an opaque background. After it passes through the transparent areas of the scale the light follows the same path as it does after it goes through the gun-laying reticle.

The scale-transfer prism, located at the mid-point of the internal collimator system, consists of two 90° prisms cemented together at their hypotenuse faces. A thin film of partially reflecting material cemented between the prisms allows only half the light from the

range scale and the gun-laying reticle to be reflected while light from the stereo reticles (also with a 50 per cent loss of illumination) is simultaneously transmitted through the prism. Normally, the prism reflects the light from the range scale and the gun-laying reticle into the left side of the collimator system, but if the left system is damaged the light can be transferred to the right system by means of the scale-transfer lever on the outside of the instrument. In addition, the transfer prism allows the right side of the system to be used as a direct-fire telescope by projecting the gun-laying reticle into the right telescope system.

The right and left internal collimator systems each has its own stereo reticle, which consists of two glass disks cemented together. Slightly above the center of one disk there is a small prism directly in line with a reticle mask on the other disk. The reticle pattern is created when light from a lamp under the prism is reflected from it and passes through the transparent areas of the mask. The pattern is composed of five short, vertical, luminous bars arranged in a wide "V." As seen through the left eyepiece, the horizontal spacing between the bars is slightly greater in the left half of the pattern than in the right half; the reverse is true when the pattern is viewed through the right eyepiece. Thus, the various bars have different convergent angles, which makes them seem to be at different distances from the observer and appear as a three-dimensional projection of only one pattern. Although the light rays from each reticle pass through each opposite reticle there is no significant effect on the image.

Vertical adjustment of the right stereo reticle with respect to the left reticle is made by operation of a halving knob on the outside of the range finder. Turning the halving knob moves the right reticle up or down until in the field of view it appears to be at the same height as the left reticle. This makes it easier for the operator to fuse the images of the two reticles and use the range finder with greater comfort and accuracy.

The two collimator lenses in each side of the system are designed to produce a clear image without unwanted aberrations. Each is a single positive lens composed of two lenses cemented together. Diverging light from the reticles and range scale is received by the first collimator lens, which decreases the divergency. The remaining divergency then is decreased by the second collimator lens until the rays of light that leave it are practically parallel.

The correction wedges in the internal collimator system are similar to the wedge in the end housing assembly. Two optically identical wedges in each side of the collimator system have the same deviating power and make possible a limitless number of combinations of the wedges to obtain the desired amount and direction of deviation produced by a pair of wedges. The final amount and direction of deviation will depend upon the combination of positions in which the wedges are used.

Alignment of the left collimator system with the left side of the telescope system is made by the two left collimator wedges. Rotation of either of these wedges, or of both wedges in combination, moves

the images of the reticles and range scales in any direction to correct small optical misalignments. After alignment is obtained, the wedges are locked in position.

The right and left correction wedges differ only in the mounting and functioning of the right outer wedge, which is mechanically geared to the internal correction system (ICS) knob. When the ICS knob is rotated the image of the stereo reticles seen through the right eyepiece moves to one side or the other, but appears to the observer to move toward him or away from him. This phenomenon enables the observer to adjust the range finder to satisfy his own judgment of stereo contact. Before he uses the instrument in the field, the operator must find what setting of the ICS knob is necessary for him to obtain accuracy in ranging. To determine this optimum setting, the operator must observe a target at a known distance and set the range scale to agree with the known range. He next makes the proper IPD setting, diopter setting, and halving adjustment, after which he observes the apparent relative distance between the lower measuring bar of the stereo pattern and the target. He then turns the ICS knob to make the reticle appear to move toward or from him until, in his judgment, the lower measuring bar and the target are at the same distance. When this is done he notes the reading on the ICS knob scale, which is his personal setting whenever he wishes to range. Although in an emergency this setting could be used with other range finders, it is preferable to establish a new ICS setting for each instrument.

The penta reflector of the internal collimator system is mechanically and optically like the penta reflector in the end housing assembly. Parallel light comes to it from the wedges and is deviated toward the partial penta reflector, which transmits light from the target and reflects the light from the internal collimator system. These two light beams are joined by the partial penta reflector before entering the objective system. This junction of the two beams is accomplished by the first surface mirror, which is coated with a partially reflecting material that both reflects and transmits light and is positioned in the axis of the main telescope housing. When the fused light from the internal collimator system enters the objective system it follows the same path as the light from the target image.

All the controls for operation of the T52 are on the outside of the instrument. In addition, there is a headrest that permits ease of eye placement at the exit pupil and that can be adjusted to fit the facial contour of the user. Two thumb screws at its sides allow the position of the headrest to be altered to give the operator the best head position for viewing.

Before he starts ranging the operator should make the proper adjustments of the controls and ascertain that the instrument is completely ready for use.

Controls other than the IPD knob, diopter-adjustment rings, halving knob, range knob, ICS knob, rheostat knob, filter lever, and scale-transfer lever - all of which have been discussed - are the range servo switch, cant-correction knob, scale selector, boresight

knobs, and manual elevation knob.

The range servo switch allows the range finder to be operated independently without stereo dip normally occurring when other parts of the fire control system are operating. When the switch is in the "OFF" position, the signal from the synchro control transmitter cannot be sent to the computer. An indicator light next to the switch is illuminated when the switch is in the "ON" position.

Correction for cant of the vehicle is introduced into the range finder by turning the cant-correction knob. The knob is rotated until the bubble in the cant level vial is centered, whereupon a multiplying mechanism in the instrument causes the gun-laying reticle to move in azimuth, by means of an involute cam, to correct the deflection cant error. Superelevation, which also must be applied to compensate for cant, is automatically fed into the range finder by the computer through a flexible cable. The azimuth and superelevation-correction signals are combined in the multiplying mechanism to yield the correct deflection shift of the gun-laying reticle.

The scale selector, which has four positions, permits the operator to view only the reticles and scales necessary at the time. When it is turned to the first position, the selector illuminates the stereo reticles only. In the second position, it illuminates the gun-laying reticle and the range scale together. Turned to the third position, it simultaneously illuminates the stereo reticles, a gun-laying reticle, and the range scale. In the fourth position, it turns off all the lights.

A deflection- and an elevation-boresight knob are on the rear of the range finder. Each knob has a lock, an adjustable scale graduated from 0.5 to 5.5 mils in increments of 0.1 mil, a stop mechanism, and the driving portion of a coupling. Turning the hexagonal deflection knob causes the gun-laying reticle to move horizontally in the field of view. Turning the serrated elevation knob rotates a mirror that positions the image of the gun-laying reticle upward or downward in the field of view.

The manual elevation knob is used to elevate or depress the range finder when the T1 elevation servomechanism is inoperative. A cover for the knob bears a legend reading: "Manual knob for emergency use only. Disconnect drive coupling before using." The drive coupling is the coupling between the elevation servomechanism and the elevation gearing of the range finder. A thumb latch clamp on the servomechanism output shaft is the driving portion of the coupling; it must be unlocked and pushed back on the shaft to permit free rotation of the range finder.

The elevation or depression angle directed by the T1 elevation servomechanism is transmitted to the range finder by a gear train in the elevation assembly. A hypoid gear segment secured to the flange of the adapter in which the range finder is mounted is driven by a hypoid pinion rotated by bevel gears. The elevation assembly is equipped with a device that minimizes backlash and variable deflections that would reduce elevation accuracy. Ring stops on the input shaft of the assembly limit the elevation of the range finder to

293 mils and its depression to 240 mils. These limits are greater than the maximum values called for by the fire control system, which are 267 mils elevation determined by gun elevation and 212 mils depression (142 mils for gun depression and 70 mils for superelevation dip). A spring-loaded pivoted brake shoe prevents mechanical feed-back through the hypoid gear of the assembly when the elevation servomechanism is disconnected for manual elevation or depression of the range finder. Access to the gearing and brake mechanism is obtained by removing two cover plates.

Correction of the gun-laying reticle for cant of the vehicle is made through the medium of a linkage-type multiplier in the range finder's cant corrector. The multiplier combines cant and superelevation values to rotate an involute cam that gives the necessary motion to the reticle. The cant function is manually introduced into the cant corrector by rotating the cant-correction knob until the bubble in the cant level vial is centered. A complete revolution of the cant-correction knob is equal to 5.625° of cant. The full range of correction for cant is $\pm 15^\circ$. The correction is zero when the cant-correction knob is in the detent position, at which position range and ballistics functions introduced elsewhere in the system do not appreciably affect the horizontal position of the gun-laying reticle. No correction for projectile drift is fed into the range finder.

The cant corrector automatically receives superelevation data from the T33 ballistics computer over a flexible cable coupled to the superelevation input of the range finder. Rotation of the superelevation-input coupling 12 revolutions clockwise from the extreme counterclockwise position, together with alignment of its index marks, introduces 26.6 mils of superelevation into the cant corrector. This is the position used to make the cant corrector conform with the computer. The counterclockwise rotation of the superelevation input is limited by a stop screw. It is important that excessive torques not be applied to the superelevation-input coupling because of the large gearing ratio in the mechanism of the cant corrector.

Rotation of the range knob to the range-compensator assembly is transmitted by a range-driven assembly with a gear drive having a 10 to 1 ratio. The range input to the range finder is limited to distances between 480 and 5,000 yards by ring stops on the input shaft. A face-serrated coupling on the range-drive assembly mates with a similar coupling on the range-compensator assembly input gear. The input gear meshes with the synchro control transmitter gear and produces a rotation that is equal to the natural logarithm of the range and generates an electrical signal of this range function that is received by the synchro control transformer in the ballistics computer. Backlash in the range drive assembly is removed by an anti-backlash spring that acts on the synchro control transmitter gear.

User tests of the T52 range finder as an integral part of the fire control system of the T43E2 120-mm gun tank are now being made by CONARC Board No 2.

TENTATIVE PRINCIPAL CHARACTERISTICS

Length	80 in
Width	29 in
Height	15.5 in
Weight	275 lb
Field of view	4.3°
Magnification	8.6x
Base length	73 in
Diameter of exit pupil	0.174 in (4.42 mm)
Clear-eye distance	0.883 in
Diopter (one)	0.046 in
Unit of error	$3.4 \left(\frac{R}{1,000} \right)^2$
Range	500 to 5,000 yd
Scale graduation	
Range	500 to 5,000 yd
Diopter	-3 to +3
Interpupillary	58 to 72 mm
ICS	0 to 50 units of error (normal setting, 25)
Azimuth boresight knob	0.5 to 5.5 mils (normal setting, 3)
Elevation boresight knob	0.5 to 5.5 mils (normal setting, 3)
Lamp operating voltage	24 v, dc
Synchro operating voltage	115 v, 400 cycle, ac
Elevation limits (set by internal stops)	16° elevation, 14° de- pression (allows for 6° superelevation)