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ARMY AIR FORCES

# GUNNERY AND BOMBARDMENT RANGES

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HEADQUARTERS, ARMY AIR FORCES

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# ARMY AIR FORCES GUNNERY AND BOMBARDMENT RANGES

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HEADQUARTERS, ARMY AIR FORCES  
Washington 15 June 1945

AAF Manual 85-0-1, *Army Air Forces Gunnery and Bombardment Ranges*, is published for the information and guidance of all concerned.

BY COMMAND OF GENERAL ARNOLD:



IRA C. EAKER  
Lieutenant General, United States Army  
Deputy Commander, Army Air Forces

## Section I

# FIGHTER GUNNERY AND BOMBARDMENT RANGES

### 1. AIR-TO-AIR RANGE

- a. **General:**—The length and width of the air-to-air range (see Figure A) are determined by the altitude at which the firing is to be done.
- b. **Length of Range:**—The length of the range will depend upon the true airspeed of the towing aircraft, the types of attacks being made on the target, and the number of aircraft that are to fire on the target at any one time. The following figures are given for firing up to altitudes of 20,000': For training type aircraft, towing at true airspeeds up to 150 mph, a firing range 10 miles long is sufficient. For tactical type aircraft, towing up to 200 mph true airspeed, a firing range 15 miles long is advisable. Danger zones will extend at least eight miles beyond each end of the firing range.  
For firing above 20,000', the firing range should be at least 20 to 25 miles long with danger zone areas extending at least 10 miles beyond each end of the firing range.
- c. **Width of Range:**—There must be a danger or restricted area *in the direction of fire*. This may be designated the width of the range. The dimensions of this area will be determined by the effective range of the ammunition being fired which, in turn, is determined by the altitude and speed of the firing aircraft. The graph in Figure B may be used to determine the width of the range.
- d. **Targets:**—The conventional targets are the banner type, A-6-A, 6' x 30'; A-10, 4' x 20', and the sleeve type, A-7, 27" x 15'. When more than one aircraft is firing at a target, colored bullets will be used to distinguish between the hits of the firing aircraft.

*Air to Air  
see also  
2.7-1*



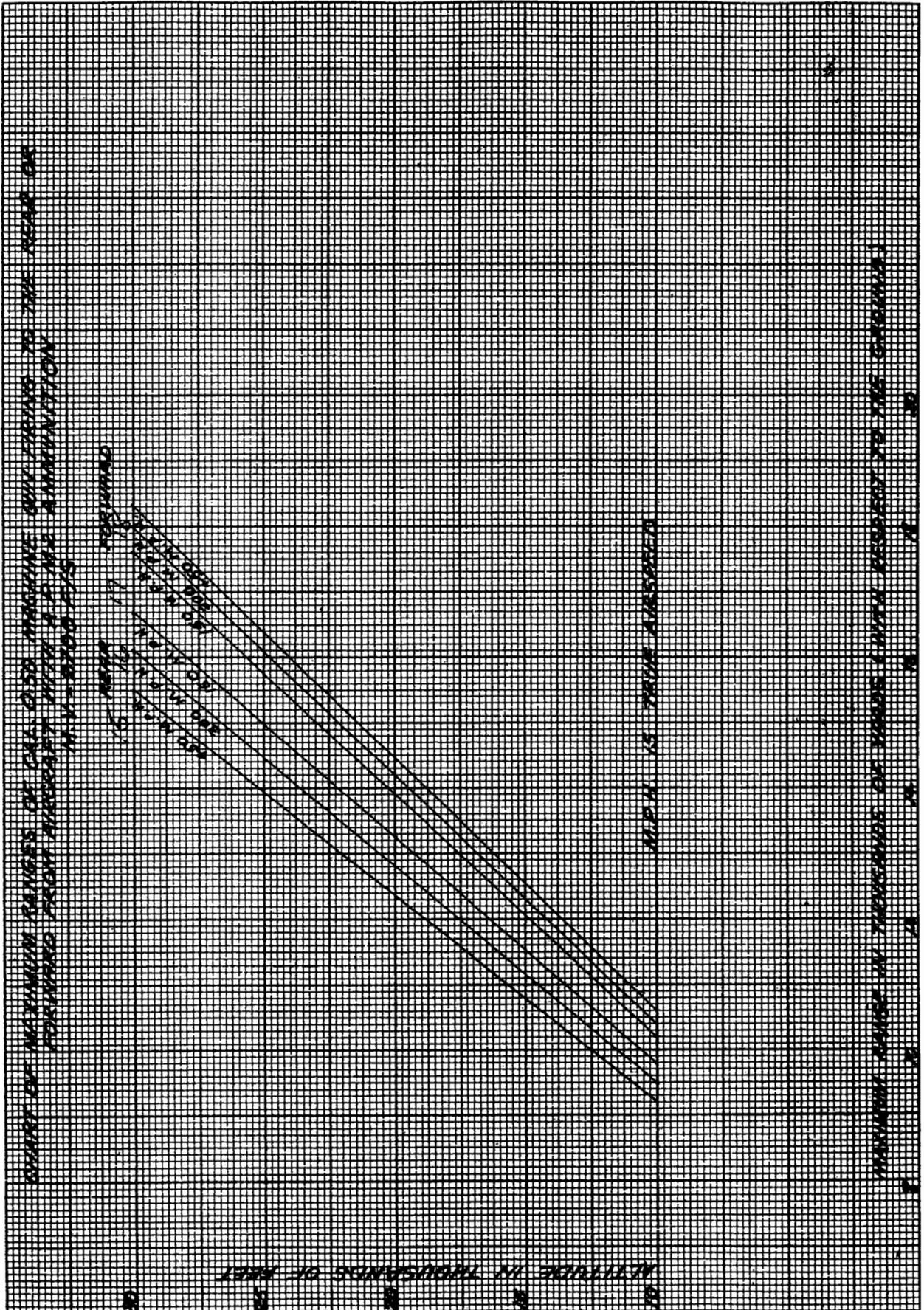


Figure B

## 2. AIR-TO-GROUND RANGE

- a. **General:**—The location and size of air-to-ground gunnery installations will vary considerably with local conditions. Maximum and minimum requirements, however, can be set forth.
- b. **Dimensions:**—An area of approximately five miles behind the targets, subject to fire and ricocheting bullets, will be designated a danger zone and be cleared of persons, live stock, and buildings. A safety area in front of the targets will be marked off. A foul line should be clearly marked 600' in front of and parallel to the target line, and a range line should be marked 600' in front of and parallel to the foul line (see Figure A). These two lines should be the same length as the target lines or, where only one or two targets are installed on a range, should be of sufficient length to be visible to the pilot from a position directly over them.
- c. **Targets:**—The targets must be of sufficient size to provide a 6' x 6' scoring area. Targets must be placed a minimum of 100' apart. The number of targets on the range will vary, therefore, according to the space available.
- d. **Safety of Range Personnel:**—Safety of range personnel can be accomplished with the use of pits or bulletproof shelters, varying in number from one per range to one per target. A rotating safety panel—one side red and one side white—will be provided to indicate to pilots whether the range is open or closed. Figure A describes a standard range layout which can be varied as to the number of targets and number of pits. A desirable target pit, described in Figure B, facilitates marking and scoring of the target without closing the range.
- e. **Communications:**—A communication system will be installed between the ranges and the landing field so that pilots may learn the results of their missions as soon as possible. Radio communication from range to aircraft is highly desirable.

*See also  
2-8-2*

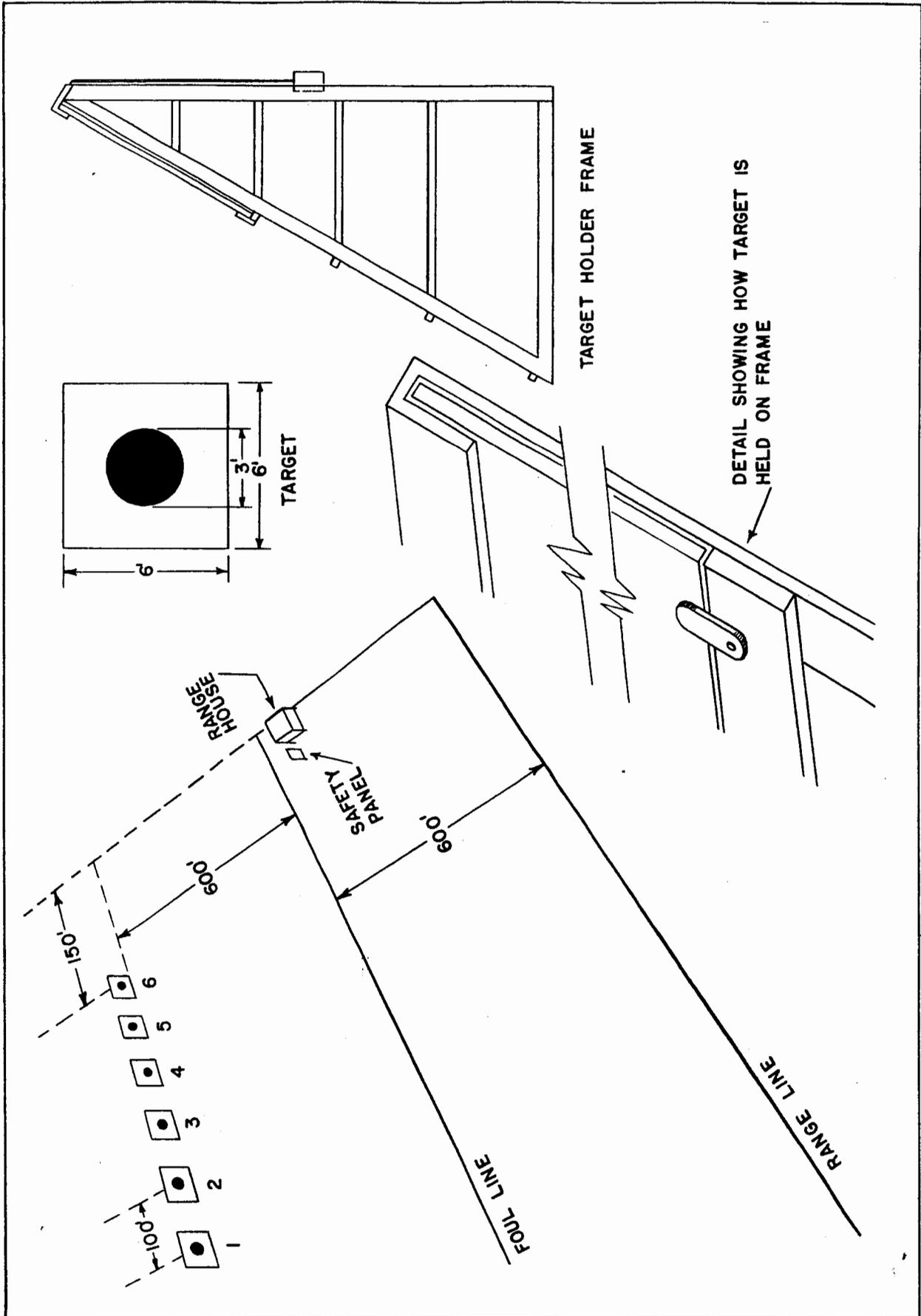


Figure A. Air-to-Ground Range and Target for Fixed Gunnery

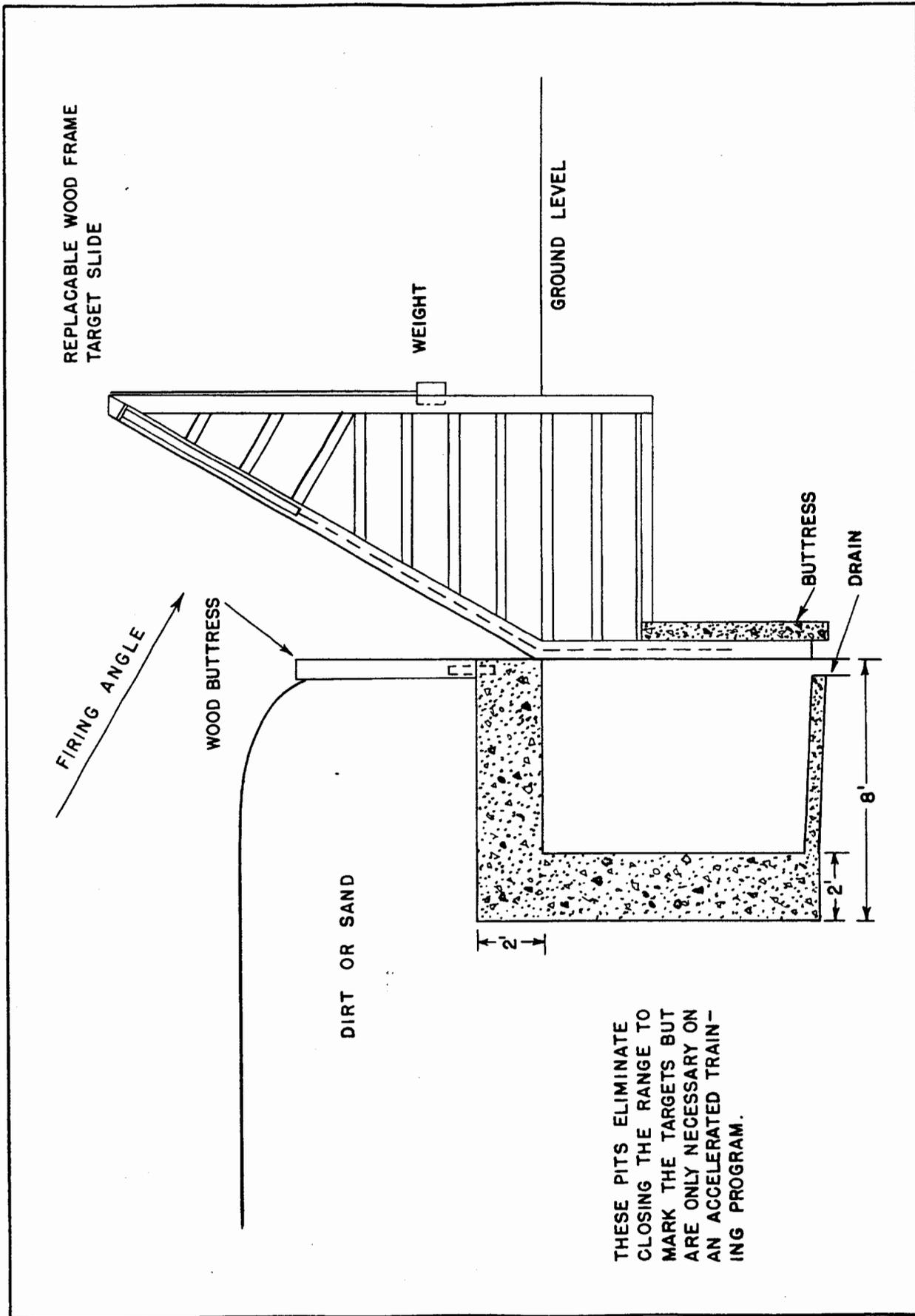


Figure B. Individual Target Pit

### 3. ROCKET AND BOMBING PRACTICE RANGE

a. **Selection of Range Site:**—In selecting a site for a rocket and bombing practice range, a maximum safety limit must be determined in order to protect personnel and equipment. The site must be free from obstructions and should be isolated from all other installations by a minimum distance of two miles. If possible, the surface upon which the range is to be constructed should be sufficiently soft to prevent ricochet of the fired projectiles.

b. **Layout of Range:**—The range shown in Figure A is a typical installation which makes use of two targets. Constructing ranges in this manner makes possible the running of two consecutive patterns, thereby allowing for greater use of available space. This type range has, however, the disadvantage of limiting the approach to the target to two directions. A range having a single target is ideal since it makes possible all directions of approach. The space available will determine the type range constructed.

c. **Target:**—The target (see Figure B) is a circle 150' in diameter. A circular target aids in pilot recognition of the firing area and provides a basis for the assessment of gun camera film. Targets of other sizes and shapes may be used, however, provided they are distinguishable from the air and prove to be a satisfactory basis for the assessment of film.

The target circle is constructed of lattice framework which is elevated to prevent its being obscured by blowing dirt or sand. The lattice frames are made in sections approximately 10' long and 3' wide to facilitate repair of damage that might result from a direct hit on the target circle. The frames are painted contrasting colors (black and white) to aid pilot recognition of the target and to permit better definition for the assessment of gun camera film.

The target bull's-eye, a pyramid with an 8' x 8' base and approximately 8' high, is constructed of 2" x 4" lumber and covered with target cloth.

d. **Coordinate Stakes:**—The target has two lines of numbered stakes placed at 15' intervals. The numbers should be at least 18" in height and 4' above the ground. To permit the greatest accuracy and ease of observation, the line of stakes should run through the center of the target and perpendicular to a line from the tower to the center of the target (see Figures A and B).

e. **Control Tower:**—The control tower should be at least 30' high

and in a position to facilitate observation of targets. The tower should contain:

- (1) Radio equipment to contact pilots flying the mission.
- (2) Wide vision binoculars, alidades, or some means of spotting hits in the target area.
- (3) Telephone (field) communication with the spotting towers.
- (4) A plotting board or coordinate sheets to record the results.

**f. Spotting Towers:**—The spotting towers, constructed of any suitable material, should be of sufficient height to permit observation of hits in the target area and should contain:

- (1) Spotting instruments similar to those in the control tower.
- (2) Telephones (field) for communication with the control tower.



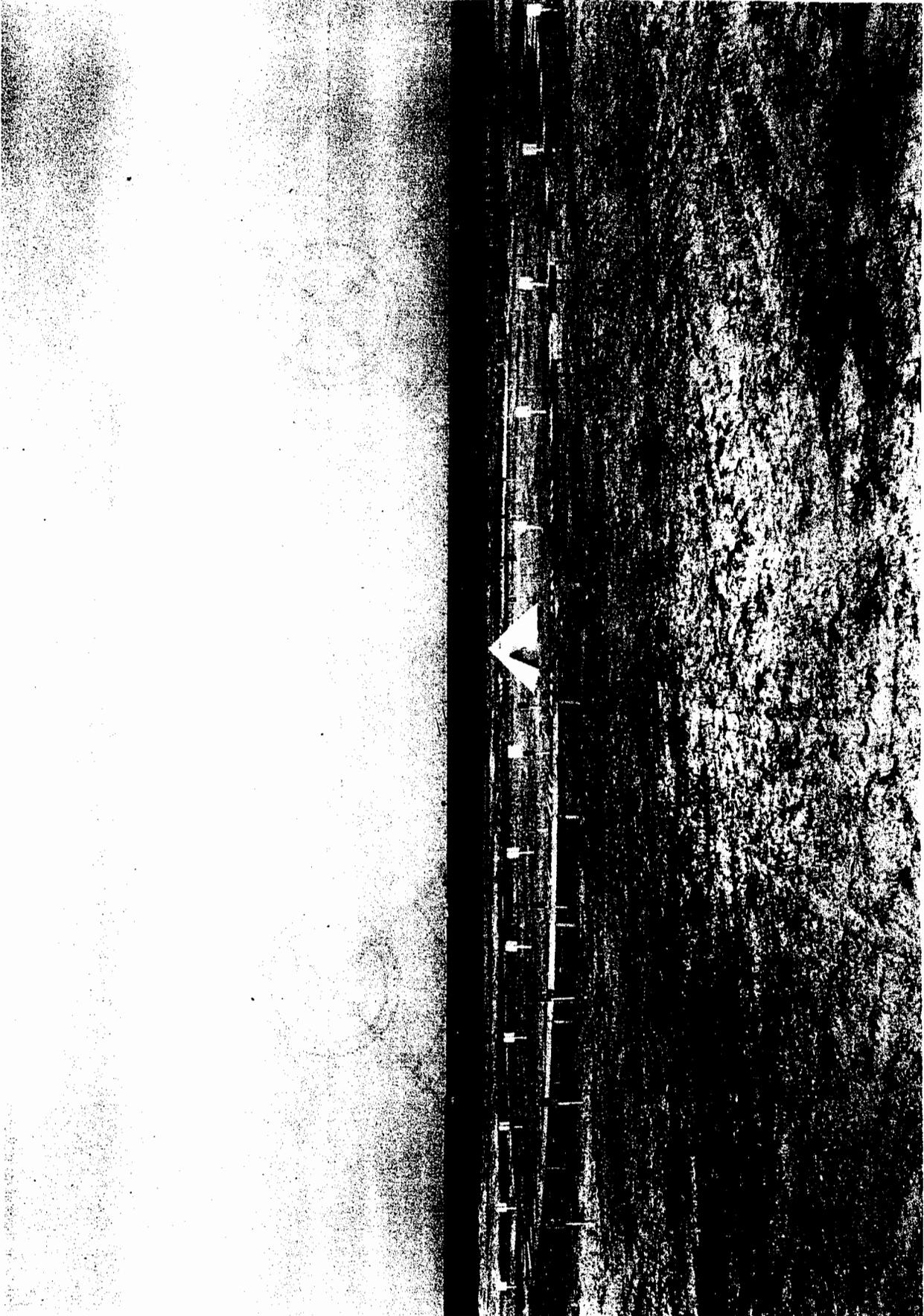


Figure B. Rocket and Bomb Practice Range Target

## Section II

# FLEXIBLE GUNNERY RANGES

### INTRODUCTION

*In establishing all ranges, danger areas must be designated in accordance with regulations governing the caliber ammunition used.*

*On ranges mounting cal. .50 (or cal. .30) aerial machine guns, it is suggested that students practice preventive maintenance, facilities for which should be provided in buildings convenient to the firing lines.*

*Details for the Poorman Flexible Gunnery Trainers are being prepared for distribution under separate cover. At present, plans for the Poorman Trainers may be obtained from the Office of the Chief of Engineers, Washington.*

### 1. BASIC DEFLECTION RANGE

- a. **Purpose:**—The purpose of the basic deflection range is twofold: to familiarize the student with basic rad deflections as taught in position firing, and to familiarize the student with the use of the iron ring and post sight or the K-13 Compensating Sight.
- b. **General:**—The basic deflection range, using hand-held shotguns, is a modification of the standard skeet range. It has replaced the skeet range (see Figure A) to implement more effectively the theories of position firing.
- c. **The Range:**—The specifications and characteristics of the basic deflection range are indicated in Figures B, C, D, and E.
- d. **Firing Stations:**—The firing station consists of any stable mount adapted to swivel the hand-held 12 ga. shotgun (see Figures F and G). It will be noted in Figure B that firing stations number from one through six only.
- e. **The Hand-Held Shotgun:**—The gun is a standard 12 ga. shotgun, skeet bore, with wooden stock removed and mounted in a modified C-16 cal. .30 machine gun adapter (see Figure H).

- f. The Sight:**—The sight may be either the three ring iron ring and post sight, shown in Figures J and K, or the K-13 Compensating Sight. The K-7 mount and modifications of the adapter for use with the K-13 sight are shown in Figures L and M. Information concerning the modification kit is available at Training Aids Division, No. 1 Park Avenue, New York City.
- g. Position Markers:**—An angle-off position marker (see Figure N) is placed at each firing station to indicate the use of the one, two, or three rad deflection required at that station to hit the target. The marker consists of a model fighter plane attacking a model bomber at the angle-off corresponding to the basic rad deflection peculiar to that particular station.

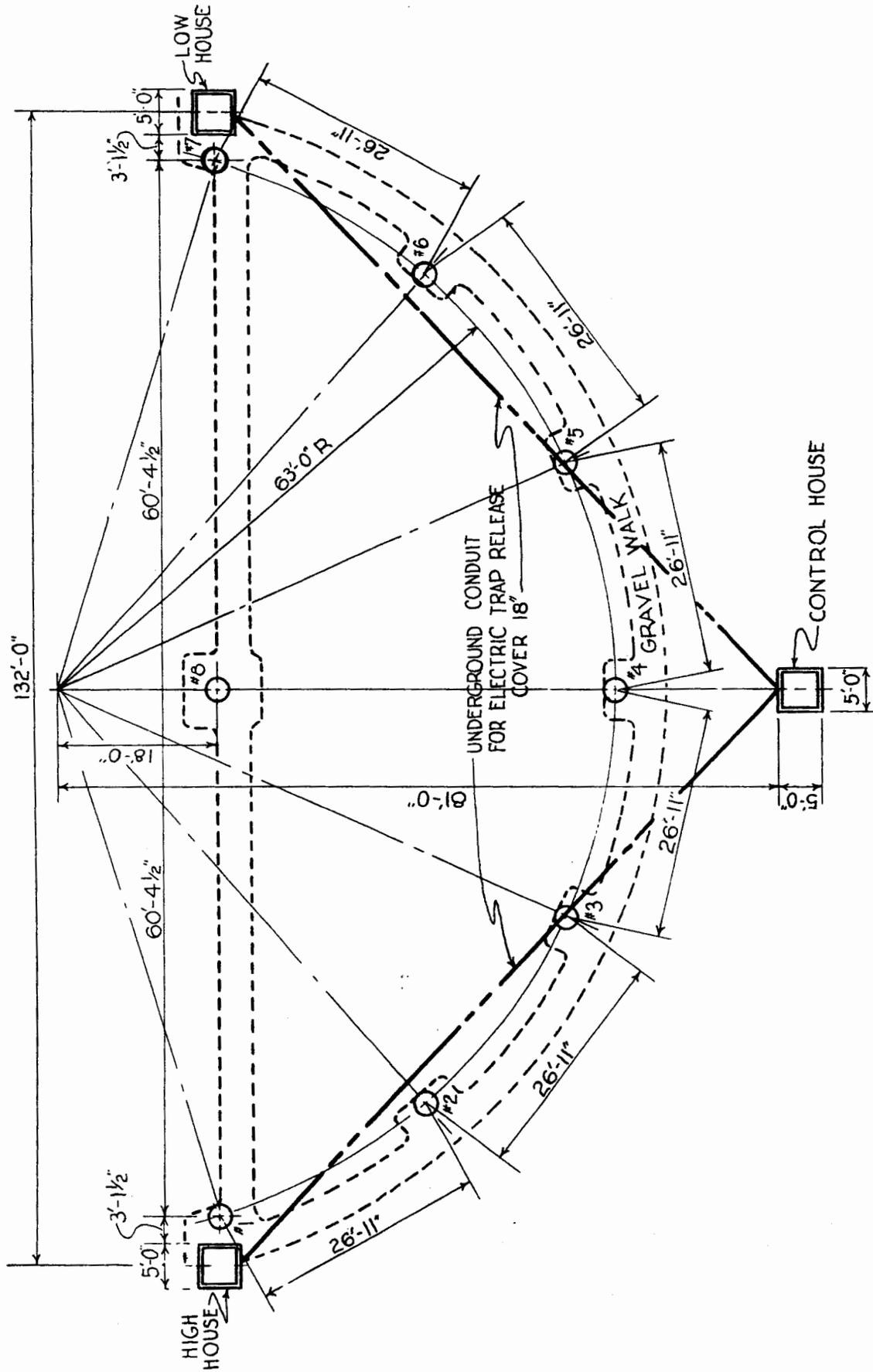
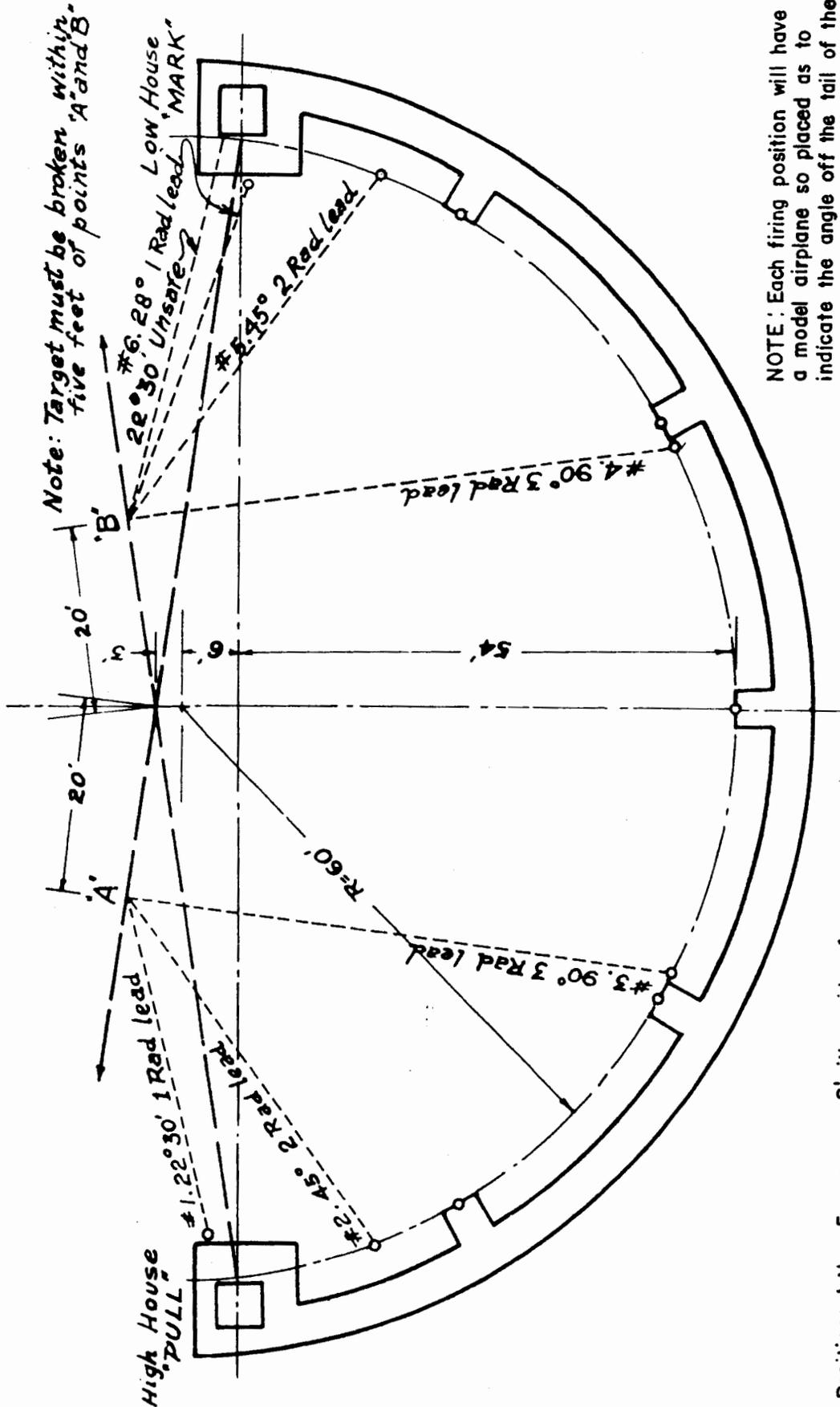


Figure A. Layout of Skeet Field



NOTE: Each firing position will have a model airplane so placed as to indicate the angle off the tail of the approaching target.

Positions 1 thru 5 can vary 2' either side of point as shown without affecting leads  
Position 6 must not be moved.

Figure B. Conversion of Standard Skeet Range to Basic Deflection Range

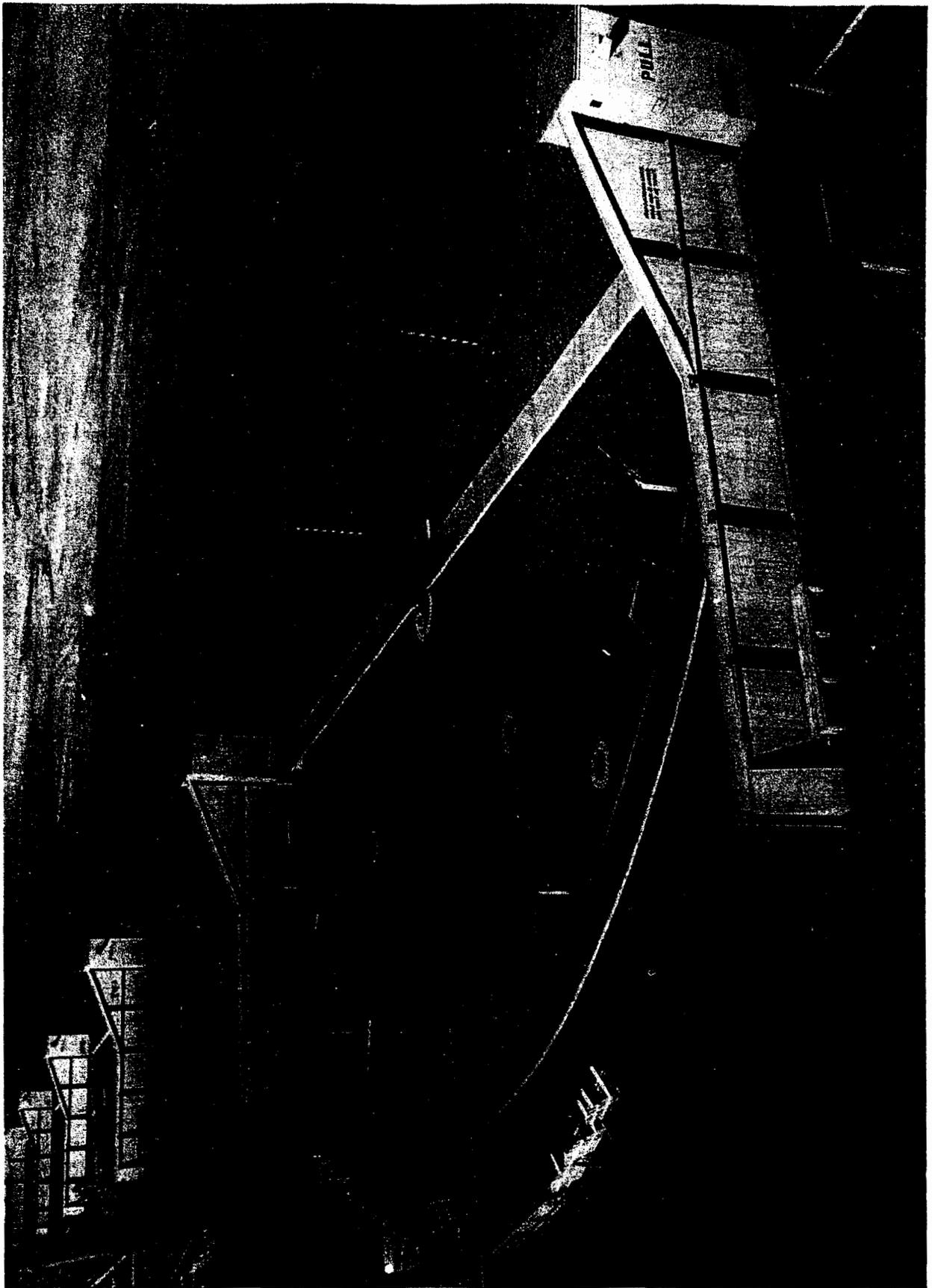


Figure C. Series of Basic Deflection Ranges



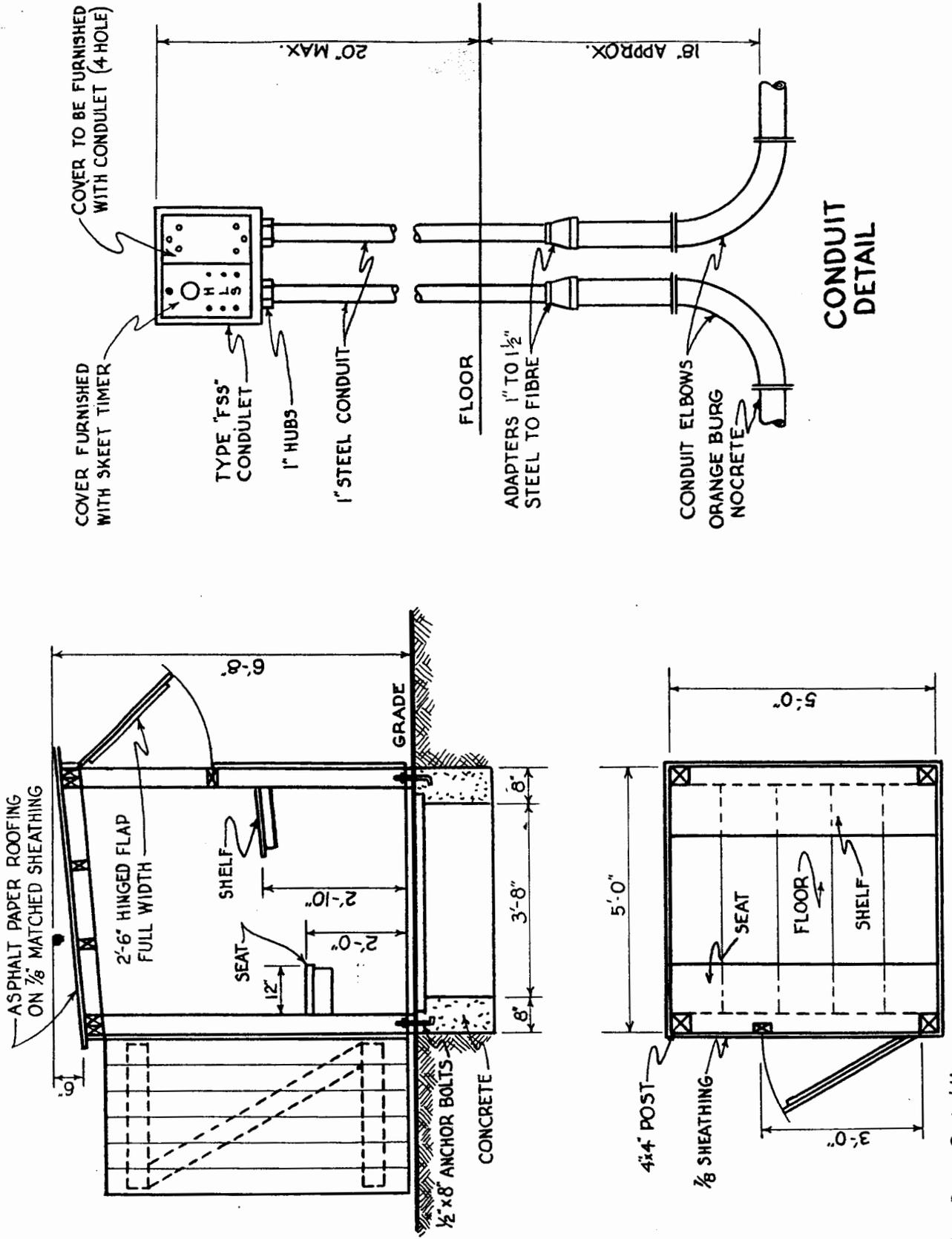


Figure E. Skeet Range Control House

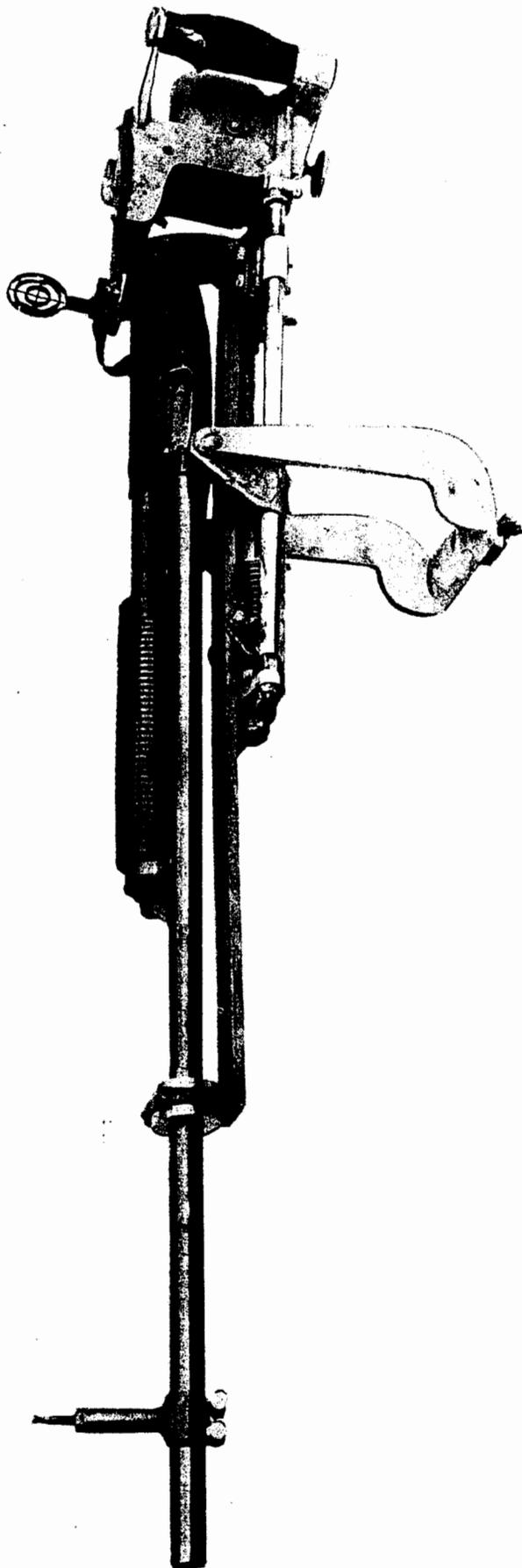


Figure F. Shotgun Mount

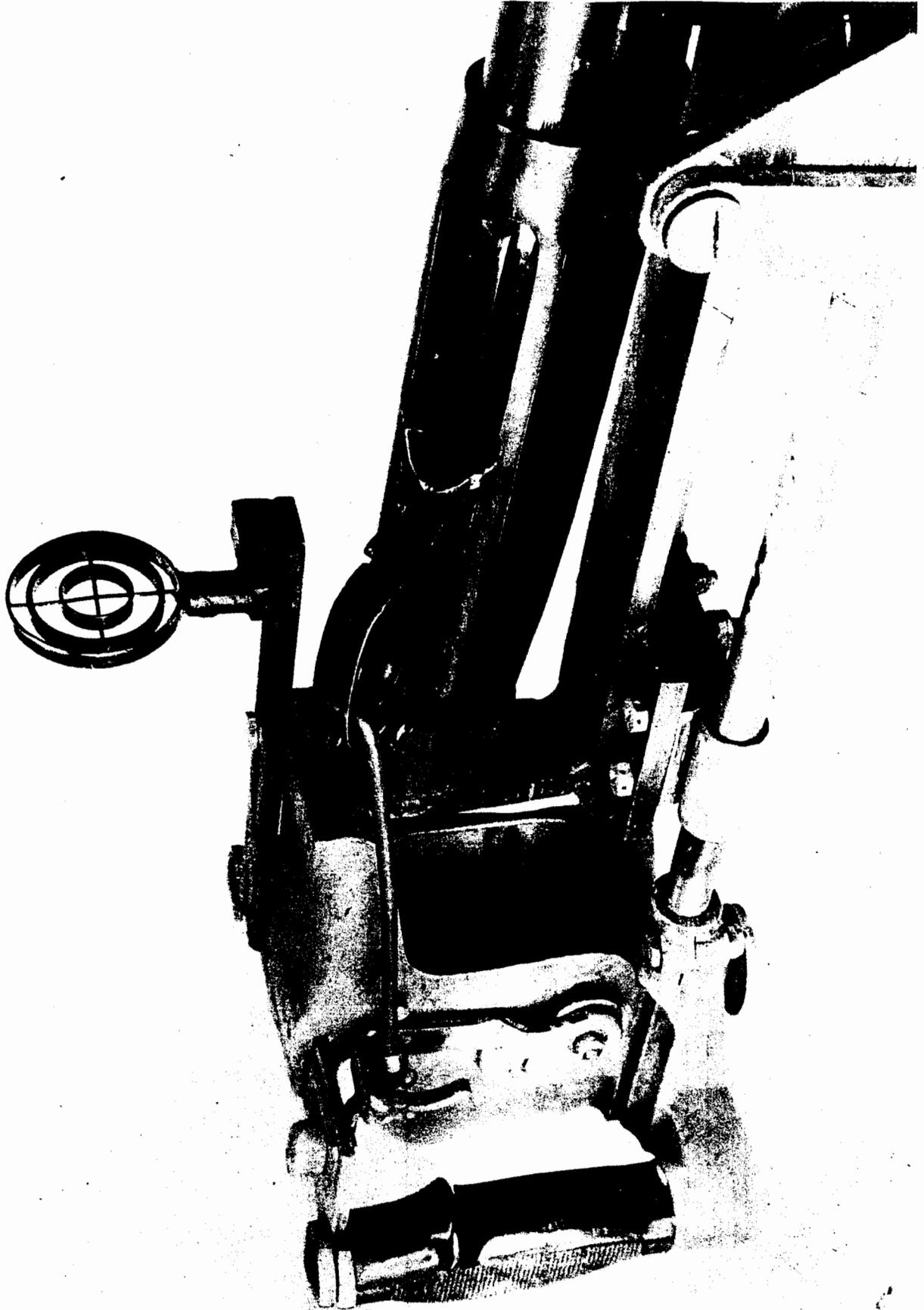


Figure G. Shotgun Mount

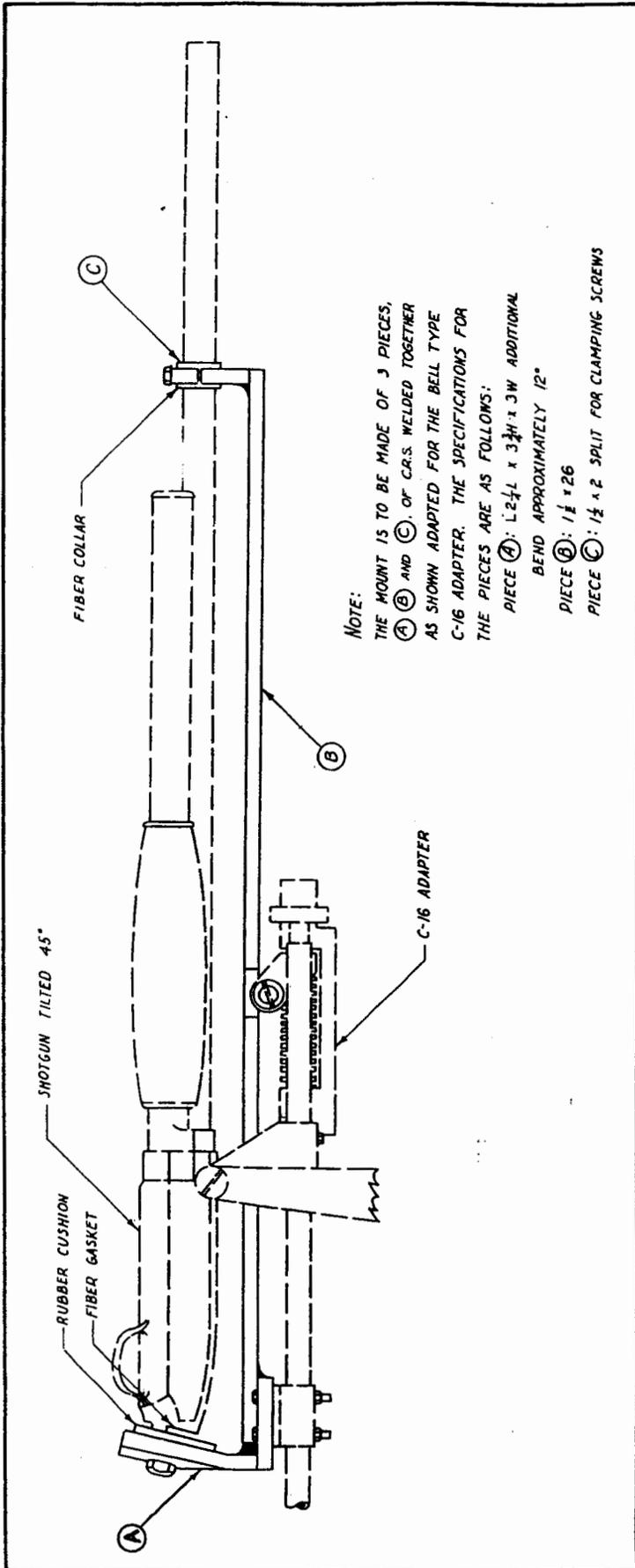


Figure H. Modified C-16 Adapter for Shotgun

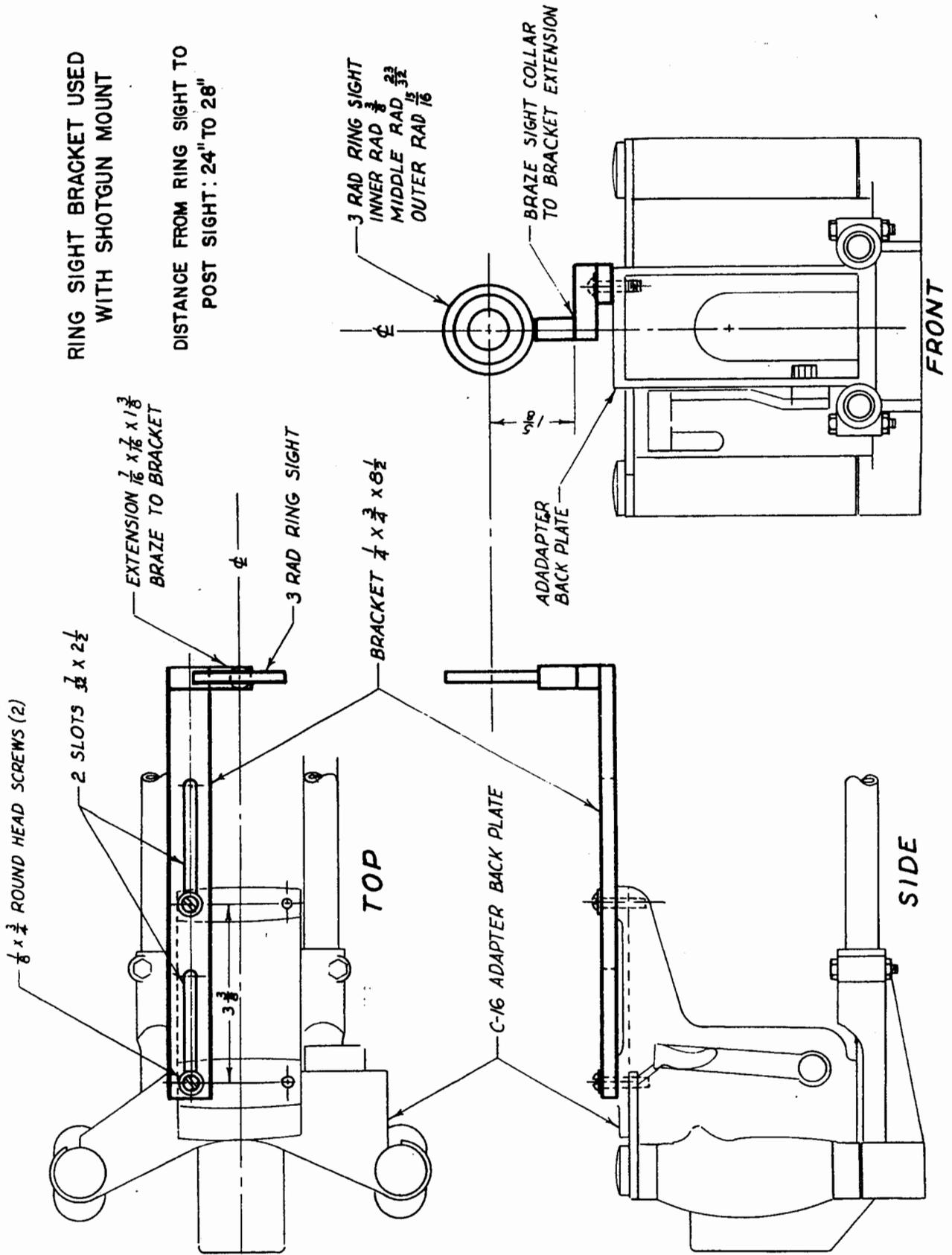
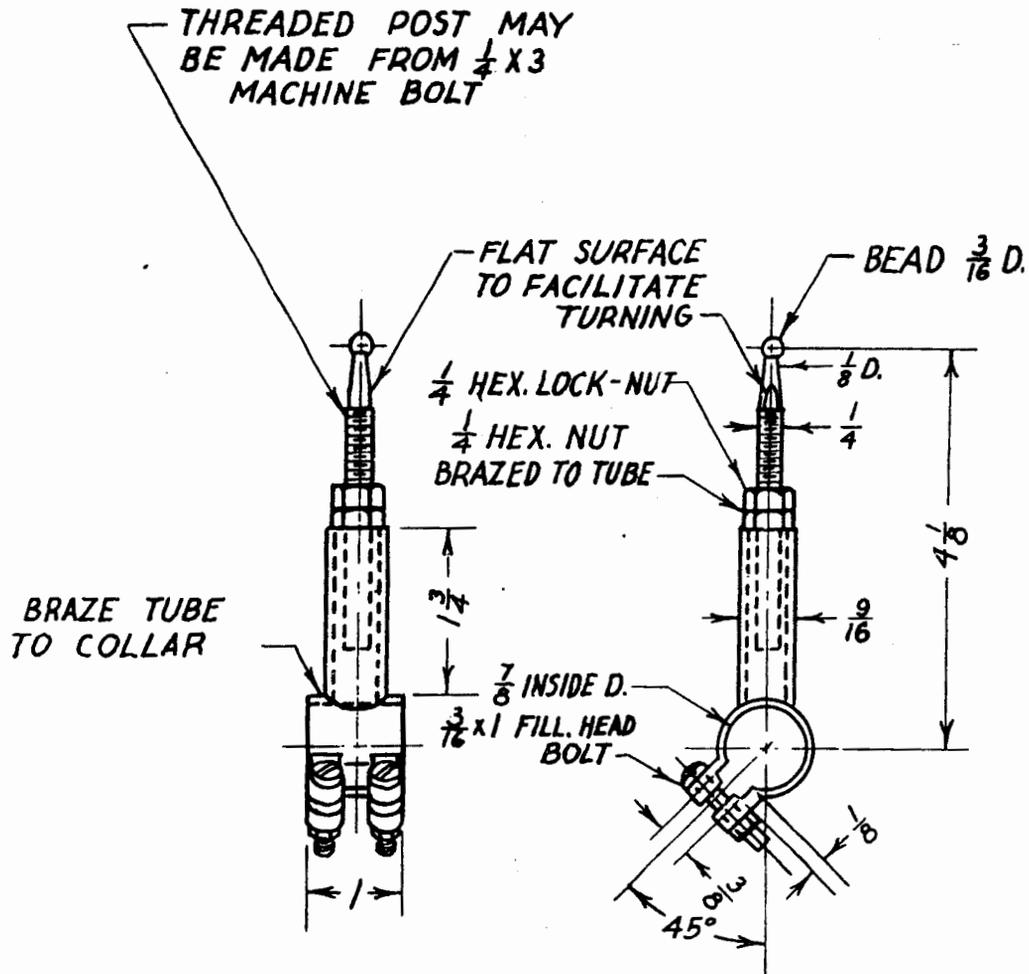


Figure J. Three-Ring Iron Ring and Post Sight for Hand-Held Shotgun



## POST SIGHT ASSEMBLY

Figure K. Three-Ring Iron Post and Sight for Hand-held Shotgun

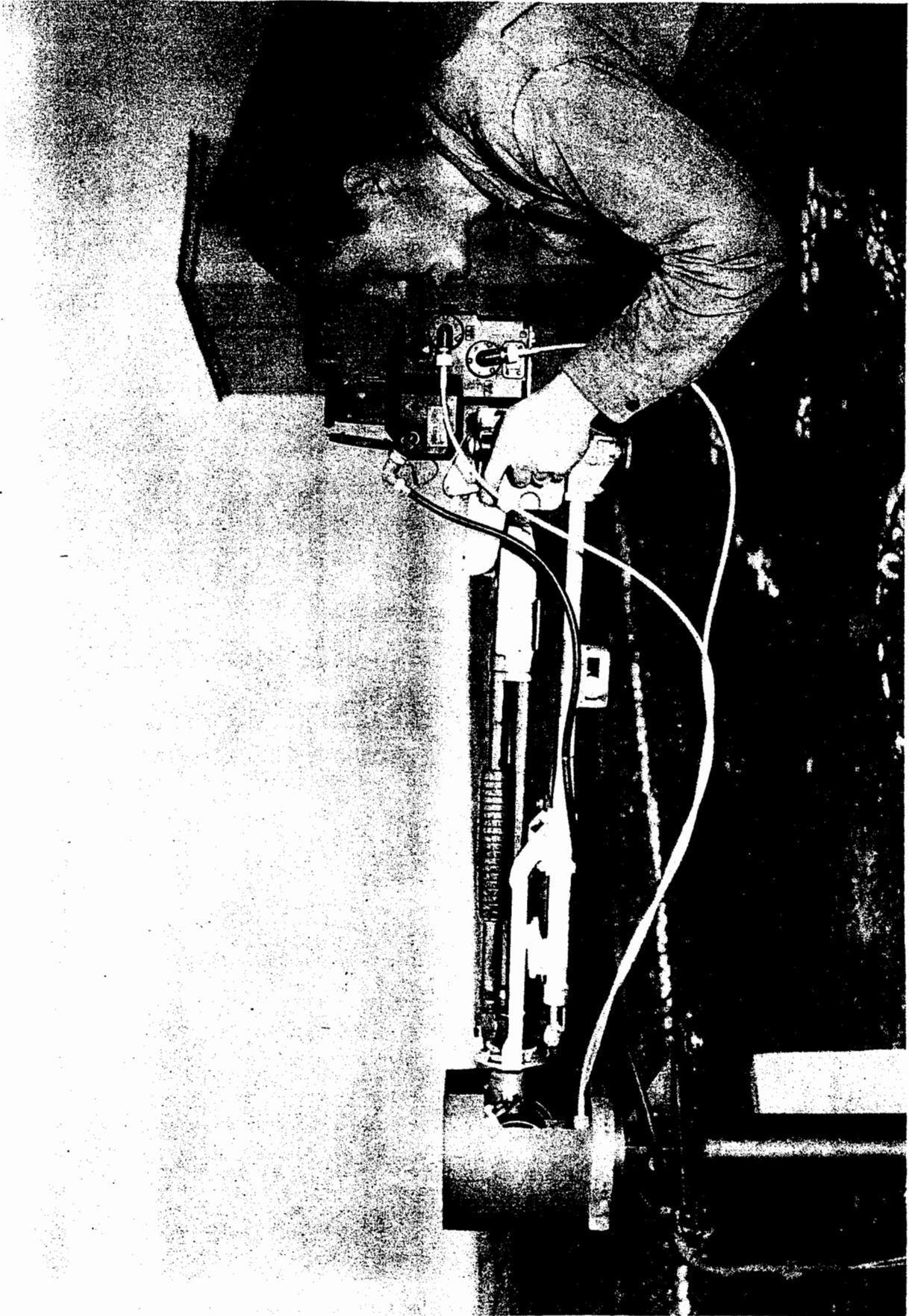


Figure L. K-13 Shotgun Mount



*Figure M. K-13 Shotgun Mount Showing Azimuth Limit Stop*



Figure N. 45° Angle-off Position Marker and Gun Mount

## 2. MOVING BASE RANGE

- a. **Purpose:**—The purpose of the moving base range is to familiarize the student with problems involved in firing from a moving mount. When the iron ring and post sight is used, the range will provide advanced training in the application of the basic rad deflections of position firing. When the K-13 Compensating Sight is employed, the range will provide practice in the use of this type sight.
- b. **The Range:**—The range consists of a smooth, hard-surfaced roadway, approximately one mile in length, which encloses an area at least 100 yards in width at all points. The area may be circular, rectangular, or irregular, depending upon local terrain. Figure A, illustrating a rectangular range under ideal terrain conditions, indicates the essential features of a moving base range.
- c. **Trap Houses:**—Trap houses, equipped with conventional clay target traps, are placed along the outer circumference of the roadway. To simulate various elevations of attack, the range is equipped with high and low trap houses (see Figure B and refer to Figure D in Basic Deflection Range for Flexible Gunnery for construction details of trap houses). The position of the trap houses along the roadway is determined by the desired angle of approach of the clay target ( $90^\circ$ ,  $45^\circ$ , or  $22\frac{1}{2}^\circ$ ). (See Figure A for an ideal spacing and arrangement of trap houses for position firing.)
- d. **Targets:**—There are two types of targets: the standard clay pigeon and the stationary target. The stationary target consists of a 12" metal disk suspended by hinge from a wooden frame and placed in front of an earth embankment in line between the firing point and the trap house (see Figure C).
- e. **The Firing Points:**—The firing point is that point on the roadway, indicated by a stake or other suitable marker, which forms the desired angle of attack (see Figure A). To permit the moving mount to arrive at the firing point at the same time the clay target reaches the desired point of impact, the target must be released before the moving mount arrives at the firing point. Therefore, points of release must be determined and indicated on the roadway for each trap house on the range. In order to utilize both nose cone and tail cone attacks, it will be necessary to

determine and indicate on the roadway two points of release for each trap house. One point of release will be used when the mount travels clockwise around the roadway, simulating nose cone attacks, and the other point of release will be used when the mount moves counter clockwise around the range, simulating tail cone attacks. To determine the points of release, such variables as speed of target, speed of the moving mount, and distance from house to roadway must be considered.

To eliminate the factor of human error, the automatic trap release system should be installed whenever possible. Information concerning the automatic trap release may be obtained from Training Aids Division, No. 1 Park Avenue, New York City. If the automatic release device is used, it will be necessary to place two trips across the roadway for each trap house. Only one of the trips will be connected, depending upon whether the mount is moving clockwise or counter clockwise around the roadway, simulating either nose cone or tail cone attacks. Only that trip which will cause the target to be released before the moving mount reaches the firing point will be connected.

- f. Moving Mount:**—The moving mount consists of a platform on a truck or other suitable vehicle upon which a hand-held shotgun is swivel-mounted. To assure the best firing and safety conditions, the vehicle should maintain an average speed of 25 mph. Figures D, E, and F illustrate the improved metal shock absorber gun mount.
- g. The Hand-Held Shotgun:**—The gun is the same as that used on the basic deflection range (see Figures G and H in Basic Deflection Range for Flexible Gunnery). For firing at clay targets, the all-purpose tube is used. For firing at stationary targets, the full-choke tube is used. The conversion from skeet-bore to full-choke may be facilitated by the use of a Cutt's Compensator.
- h. The Sight:**—The sight may be either the three ring iron ring and post sight or the K-13 Compensating Sight as shown in Figures J, K, L, and M in Basic Deflection Range for Flexible Gunnery.

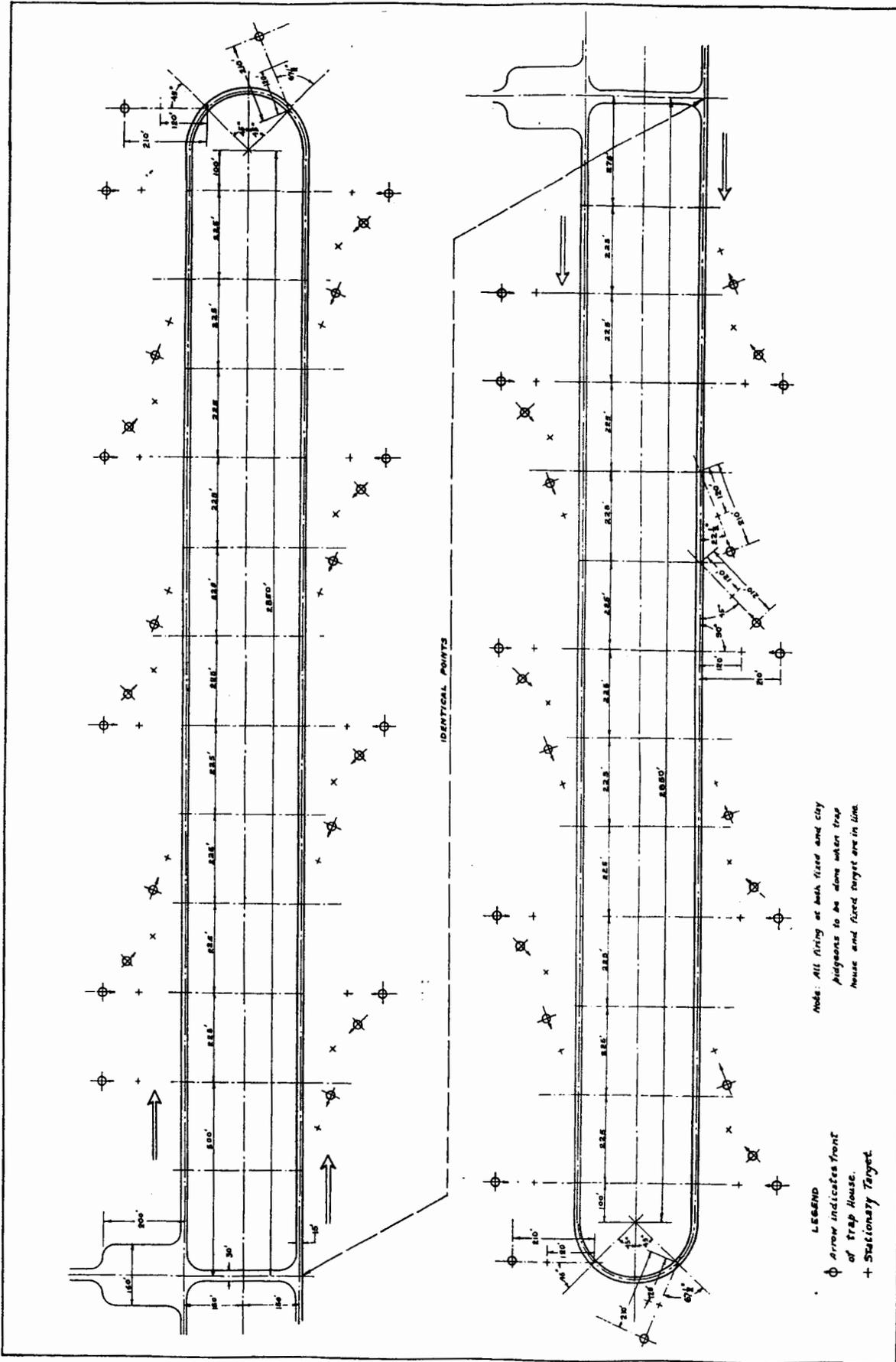


Figure A. Moving Base Range

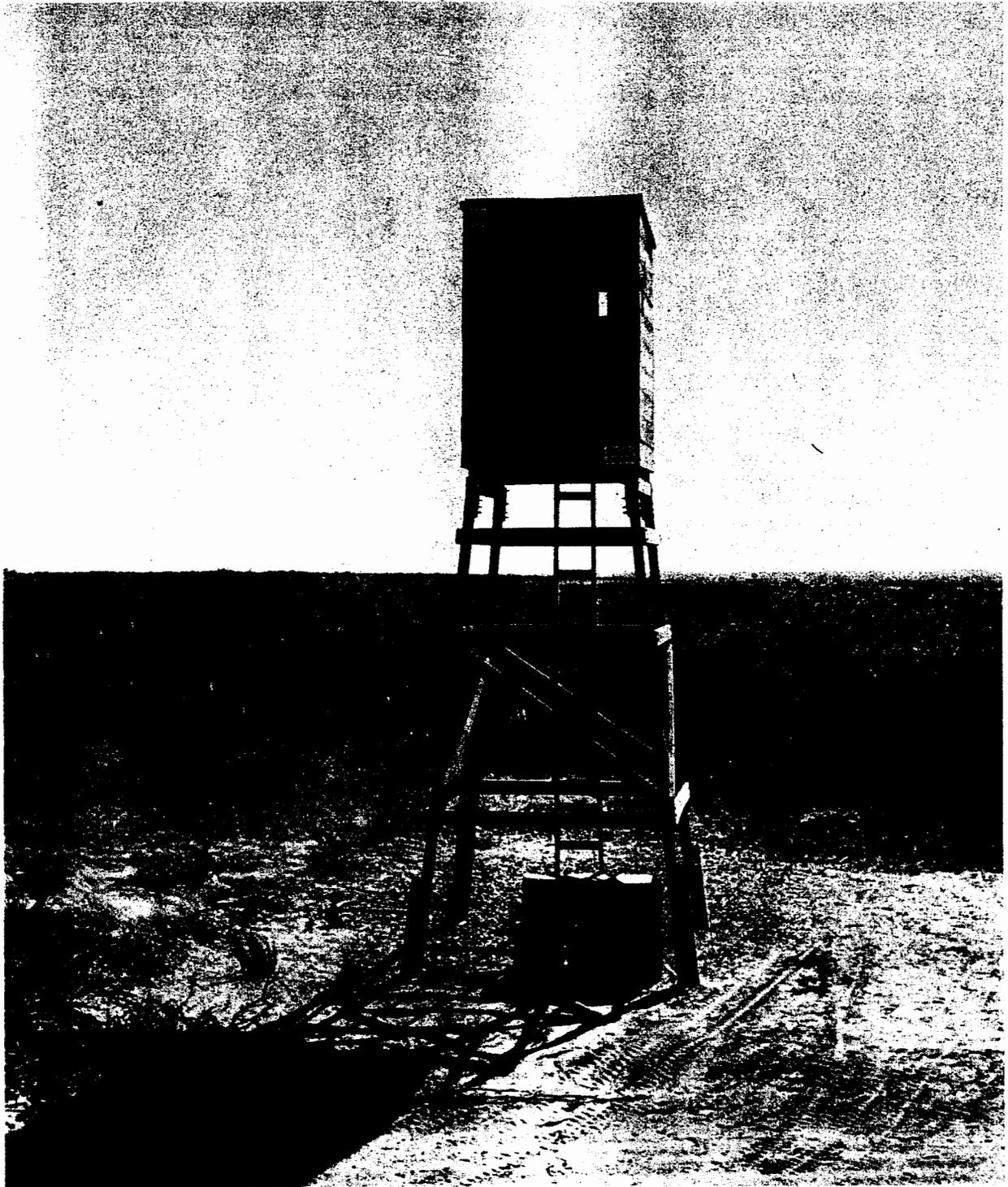


Figure B. High Trap House



Figure C. Stationary Target



Figure D. Metal Shock Absorbing Mount

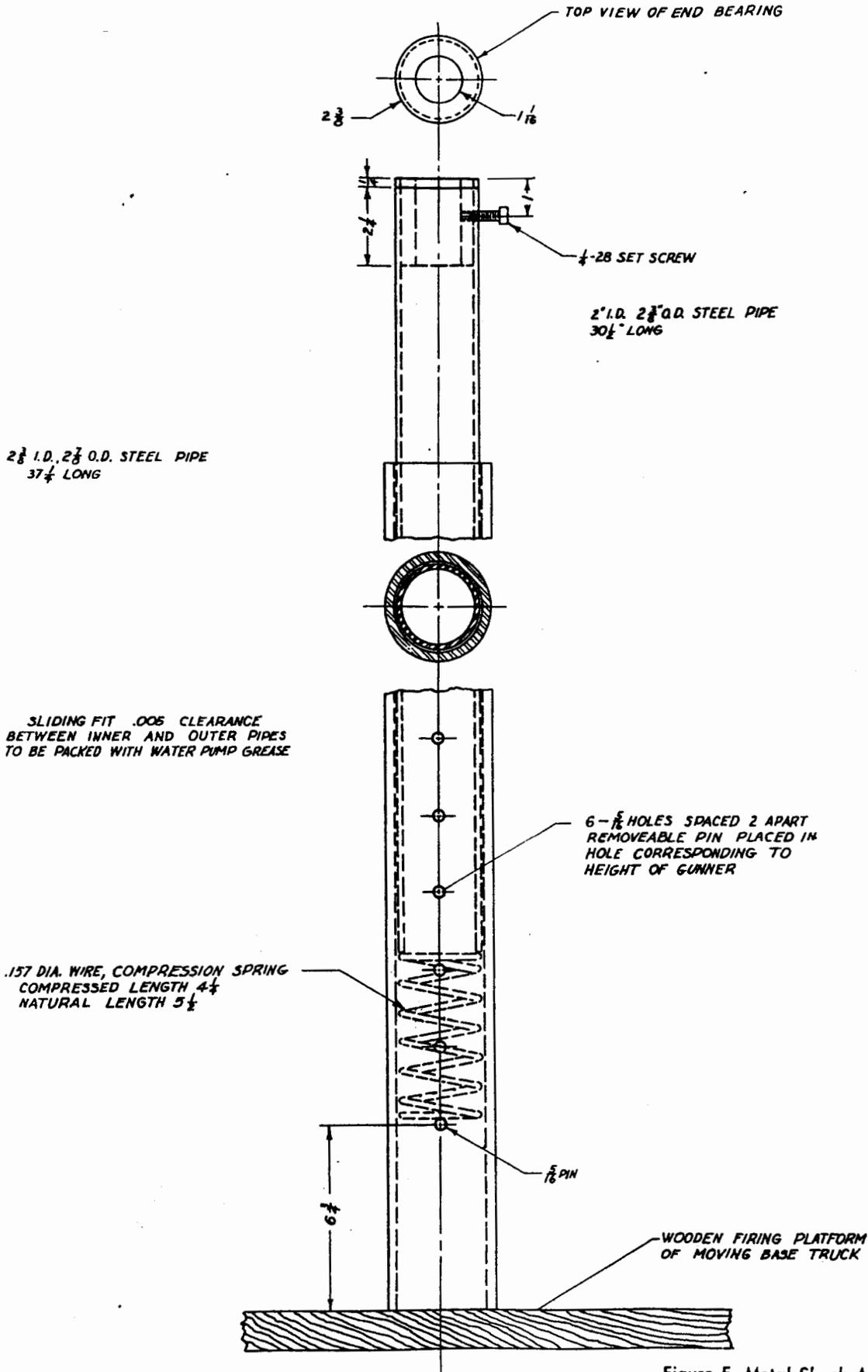


Figure E. Metal Shock Absorbing Mount

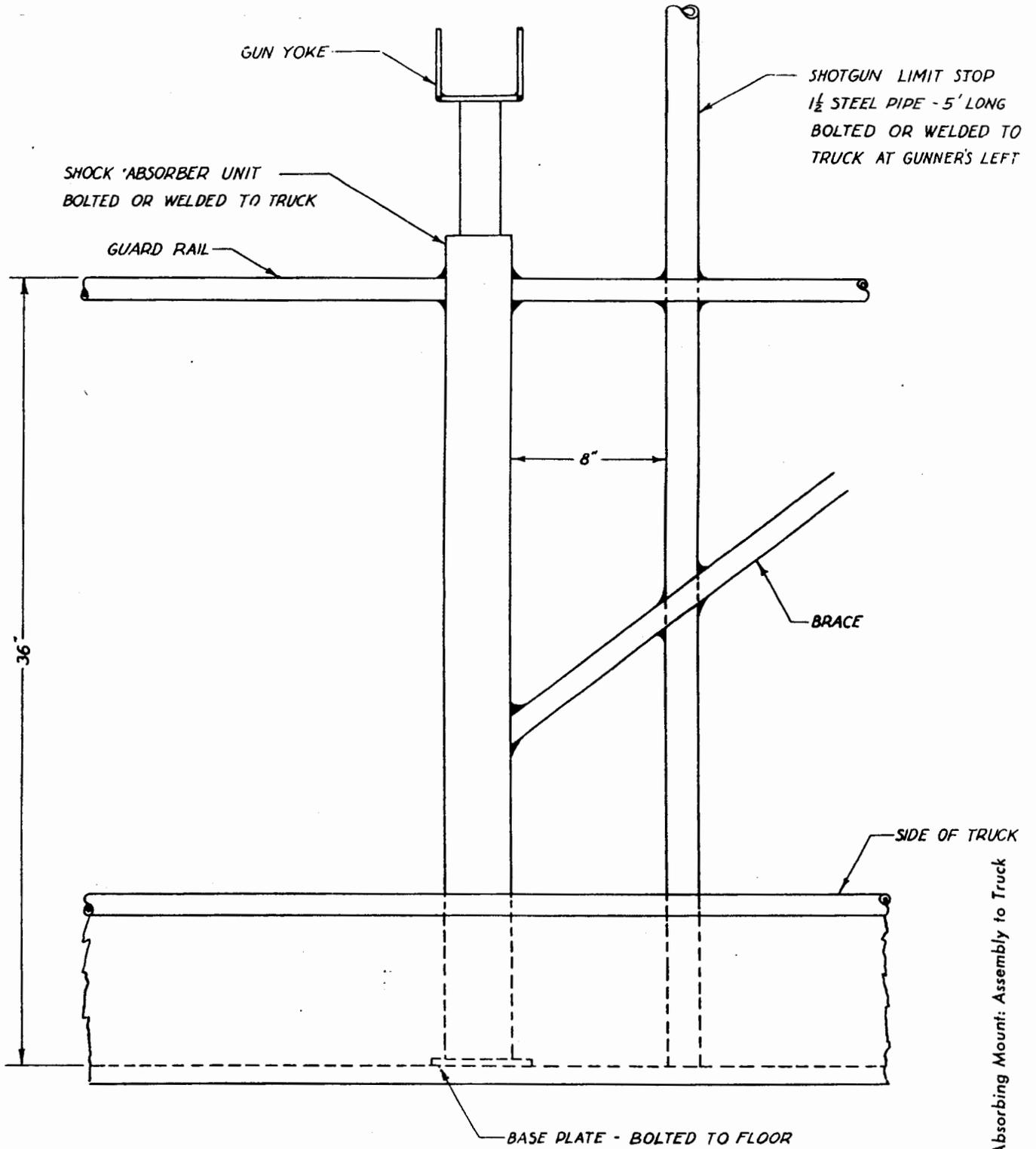
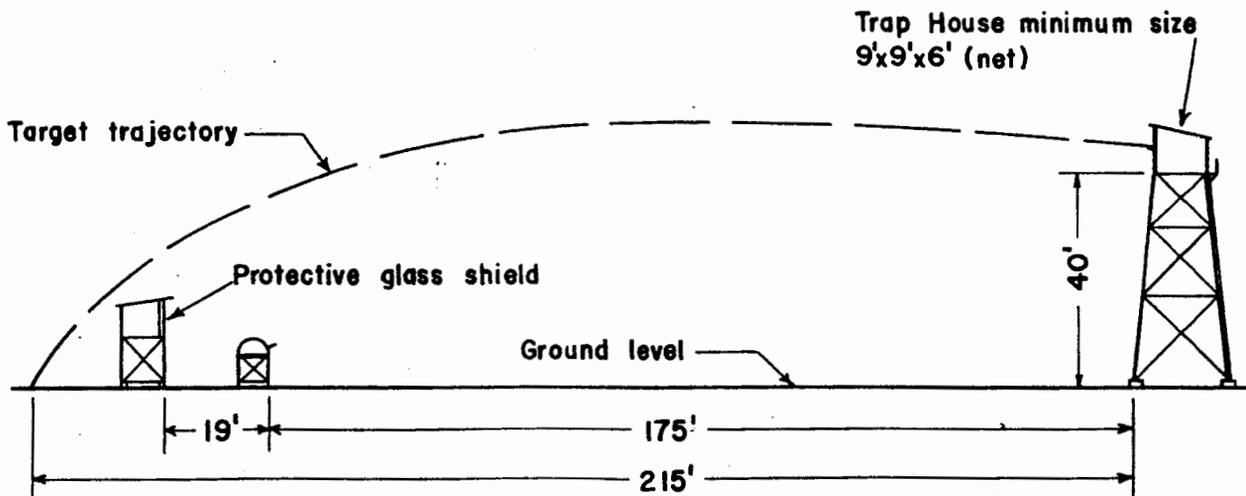
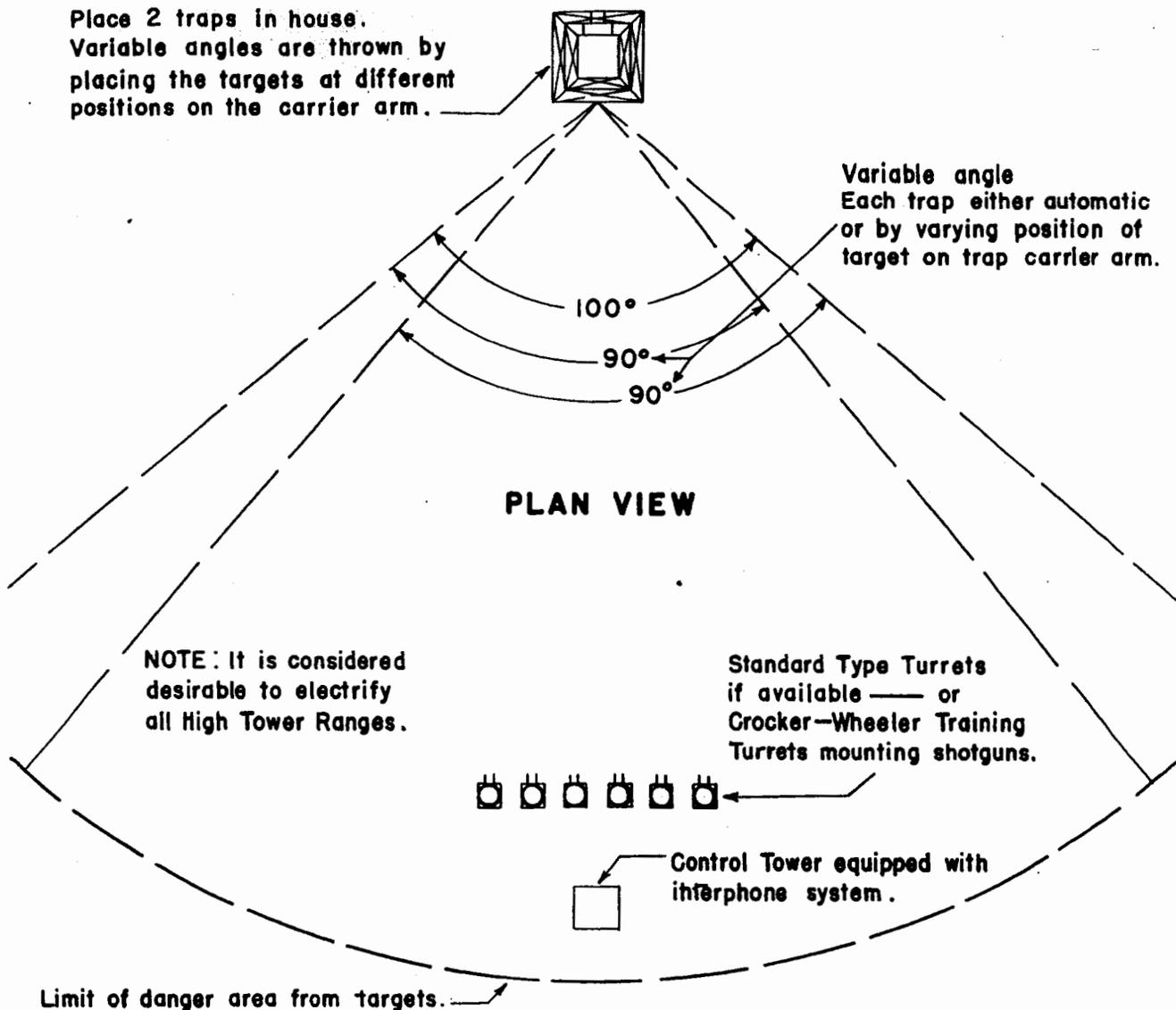


Figure F. Metal Shock Absorbing Mount: Assembly to Truck

### 3. HIGH TOWER RANGE

- a. **Purpose:**—The purpose of the high tower range is to provide practice in turret manipulation.
- b. **Dimensions:**—The range, including danger zones, is an area of approximately 500' x 500' (see Figure A).
- c. **The Tower:**—The tower trap house, mounted on a base 40' high, is designed to hold two conventional type clay target traps. Construction details of the trap house, described in Figure D in Basic Deflection Range for Flexible Gunnery, must be modified to fit specifications indicated in Figure A.
- d. **Turret Battery:**—The turret battery, placed approximately 175' from the tower, consists of six standard Martin or Sperry combat turrets, each mounting one shotgun. Figure B illustrates a battery of turrets on the range; (the Crocker-Wheeler Training Turrets in Figure B are now obsolete). The turret-mounting stand may be constructed either of wood or of metal.
- e. **The Gun:** — The gun, a standard 12 ga. shotgun — pump action or semi-automatic—with stock removed, is mounted in either the Martin or the Sperry turret by means of an adapter. Figures C and D illustrate pump action shotgun adapter and shotgun mounted in the Martin turret. For construction details of the pump action shotgun adapter for Martin turret, see Figures E, F, G, and H.
- f. **The Control Tower:**—To facilitate range operation, a control tower should be constructed behind the turret battery as indicated in Figure A.
- g. **Intercommunication:**—It is recommended that an interphone system be installed between the control tower and each of the turrets and between the control tower and the tower house.



**PROFILE VIEW**

Figure A. Schematic Diagram: Turret-Mounted High Tower Shotgun Range

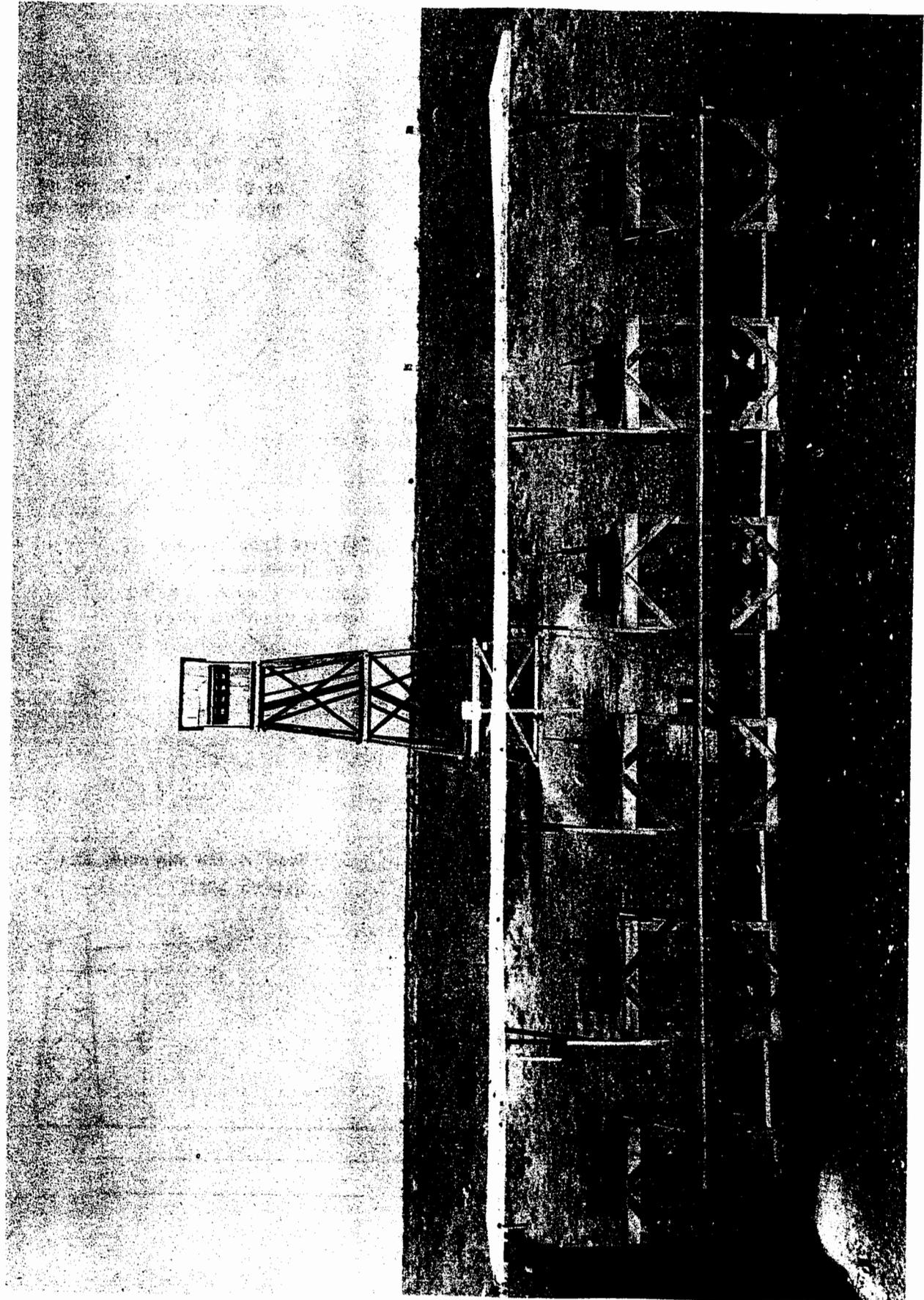


Figure B. Turret Battery and Tower

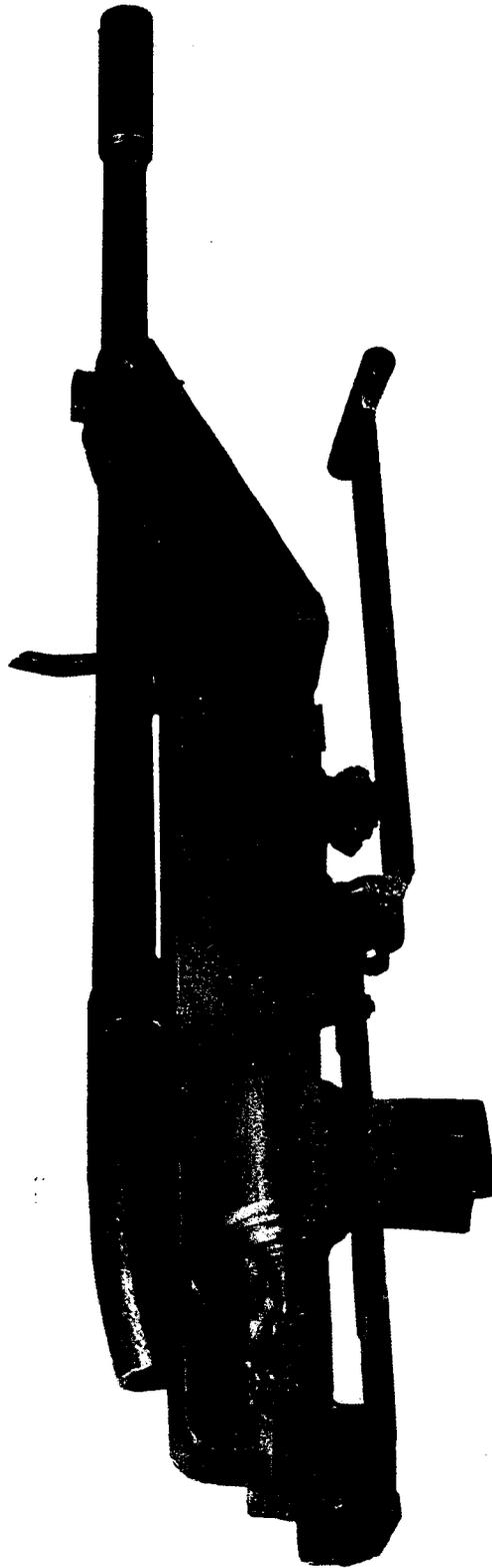


Figure C. Shotgun Adapter for Martin Turret

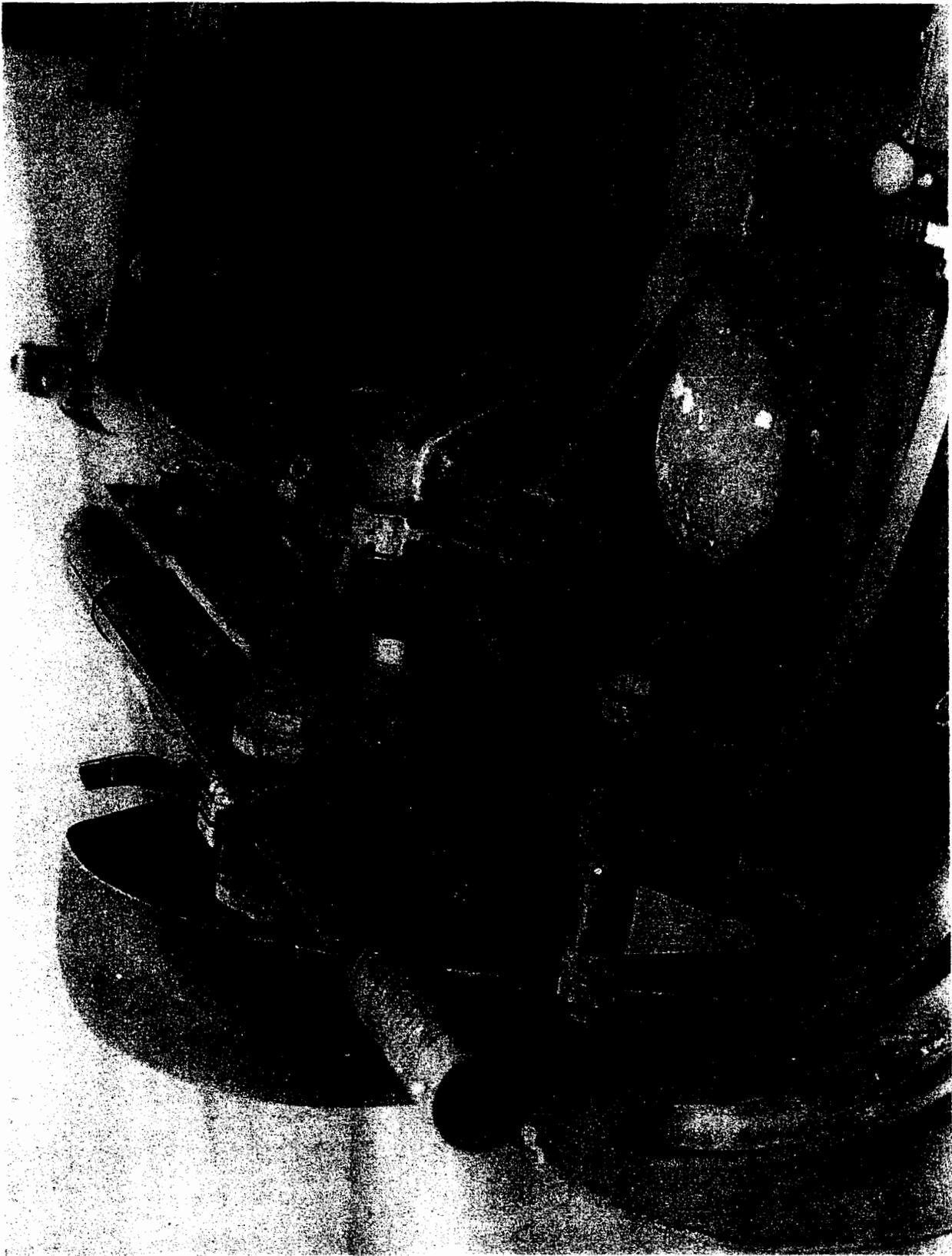


Figure D. Shotgun Mounted in Martin Turret





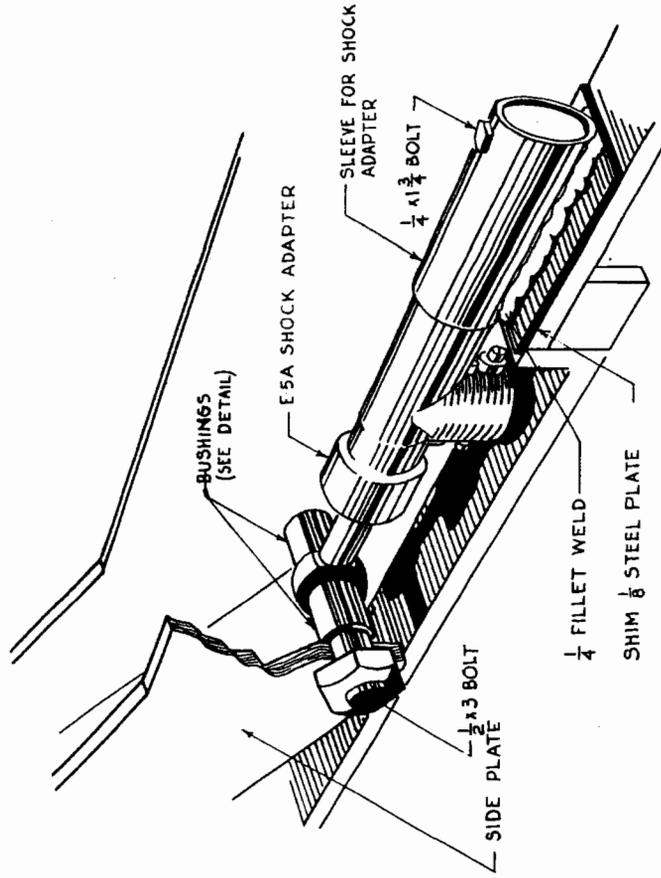
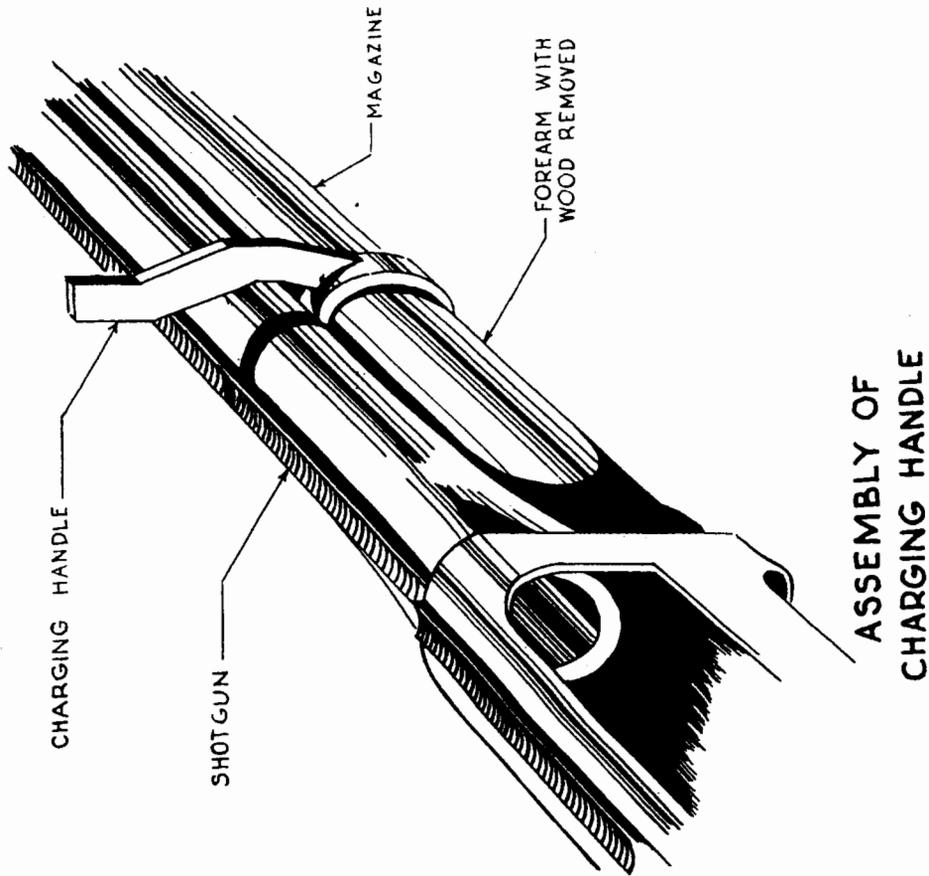
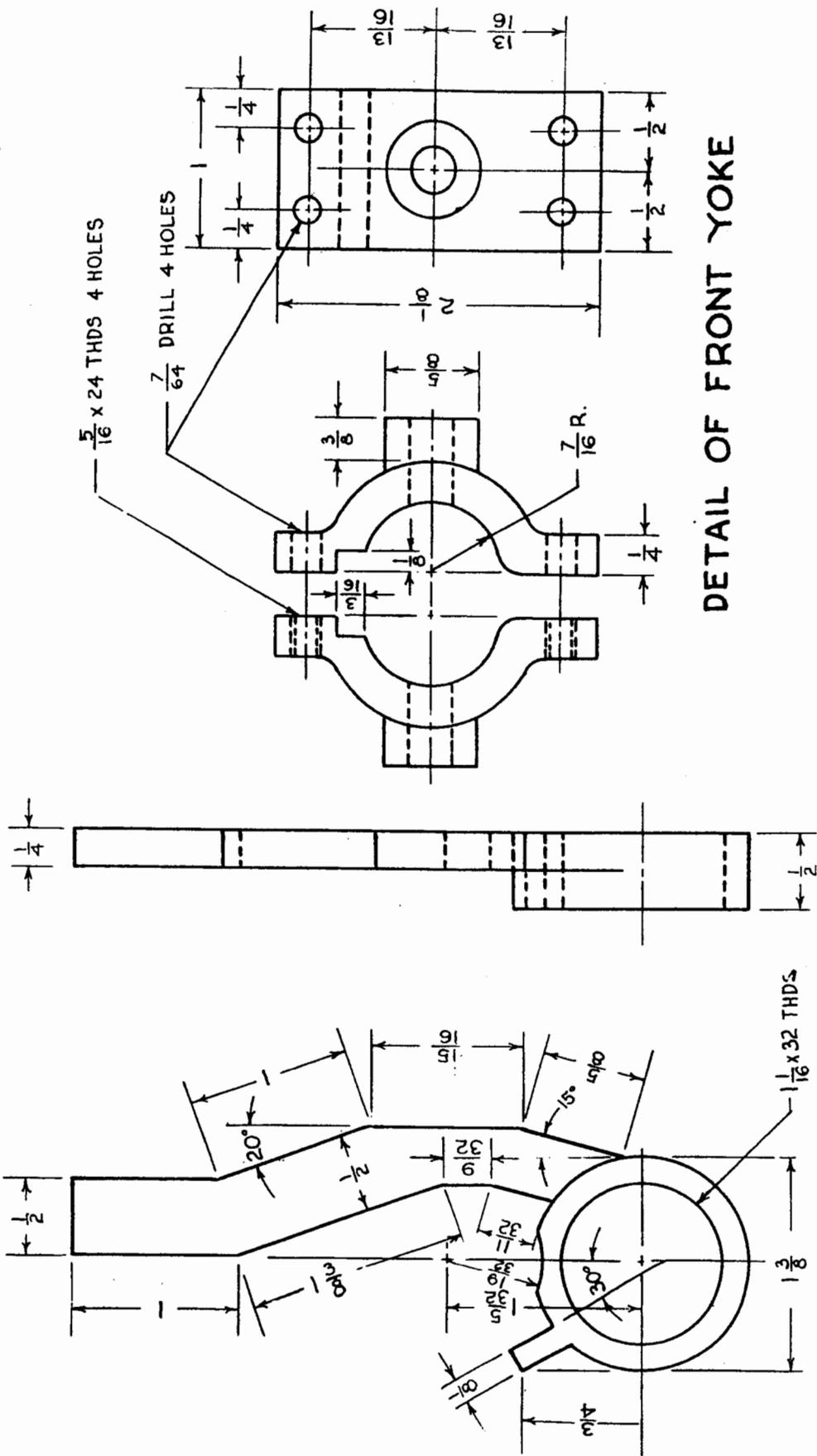


Figure G. Pump Action Shotgun Adapter for Martin Turret



DETAIL OF FRONT YOKE

DETAIL OF CHARGING HANDLE

Figure H. Pump Action Shotgun Adapter for Martin Turret

#### 4. BURST CONTROL RANGES

- a. **Purpose:**—The purpose of burst control ranges is twofold: to familiarize the student with the firing characteristics of the cal. .50 (or .30) aerial machine gun, and to give practice in the control of aim during automatic operation of the weapon.
- b. **Types of Burst Control Ranges:**—There are two types of burst control ranges: the 1000" stationary target range, and the 1000" moving target range.

##### 1. 1000" Stationary Target Burst Control Range

- a. **The Range:**—The general characteristics of the range are indicated in Figure A.
- b. **Firing Stations:**—The firing stations, placed eight to ten feet apart, consist of any stable mount (see Figure B) adapted to swivel the cal. .50 hand-held aerial machine gun. The gun mount post is anchored in a block of concrete 3' x 3' x 4'.
- c. **Gun-Pointing Device:**—The triangular gun-pointing device, shown in Figures C and D, is attached to the gun mount to permit demonstration of the built-in dispersion of the cal. .50 aerial machine gun and to facilitate harmonization of gun and sights directly on the target.
- d. **The Gun and Sight:**—The gun is a standard cal. .50 (or .30) aerial machine gun upon which an adjustable standard ring and post sight or K-13 Compensating Sight is mounted.
- e. **The Target:**—A 3' x 3' target frame is covered with target cloth and mounted on legs four feet long. The cloth or paper target, upon which is painted the silhouette of an enemy fighter plane, is fastened or glued to the target cloth (see Figure E). If the conventional type yoke mount, as shown in Figure D, is used, the scoring area will consist of a circle ten inches in diameter described around the nose of the silhouette. If an improved mount, such as the K-6 or K-7, is used, the scoring area will be reduced to a circle approximately eight inches in diameter described around the nose of the silhouette.
- f. **The Tracks and Four-Wheel Dolly:**—The tracks and four-wheel dolly, shown in Figure E, are used to facilitate and

expedite range operation by permitting targets to be pulled to and from a firing position for scoring and changing while firing continues at other positions. As illustrated in Figure A, one dolly and a set of tracks serve two firing positions. Figure F lists ordnance property numbers of dolly and tracks. Dimensions are indicated to facilitate construction locally in case ordnance equipment is not available.

If, however, materials are not available for the construction of dolly and tracks, the target frames may be secured in the ground, and the scoring and changing of targets will be accomplished after all positions have ceased firing.

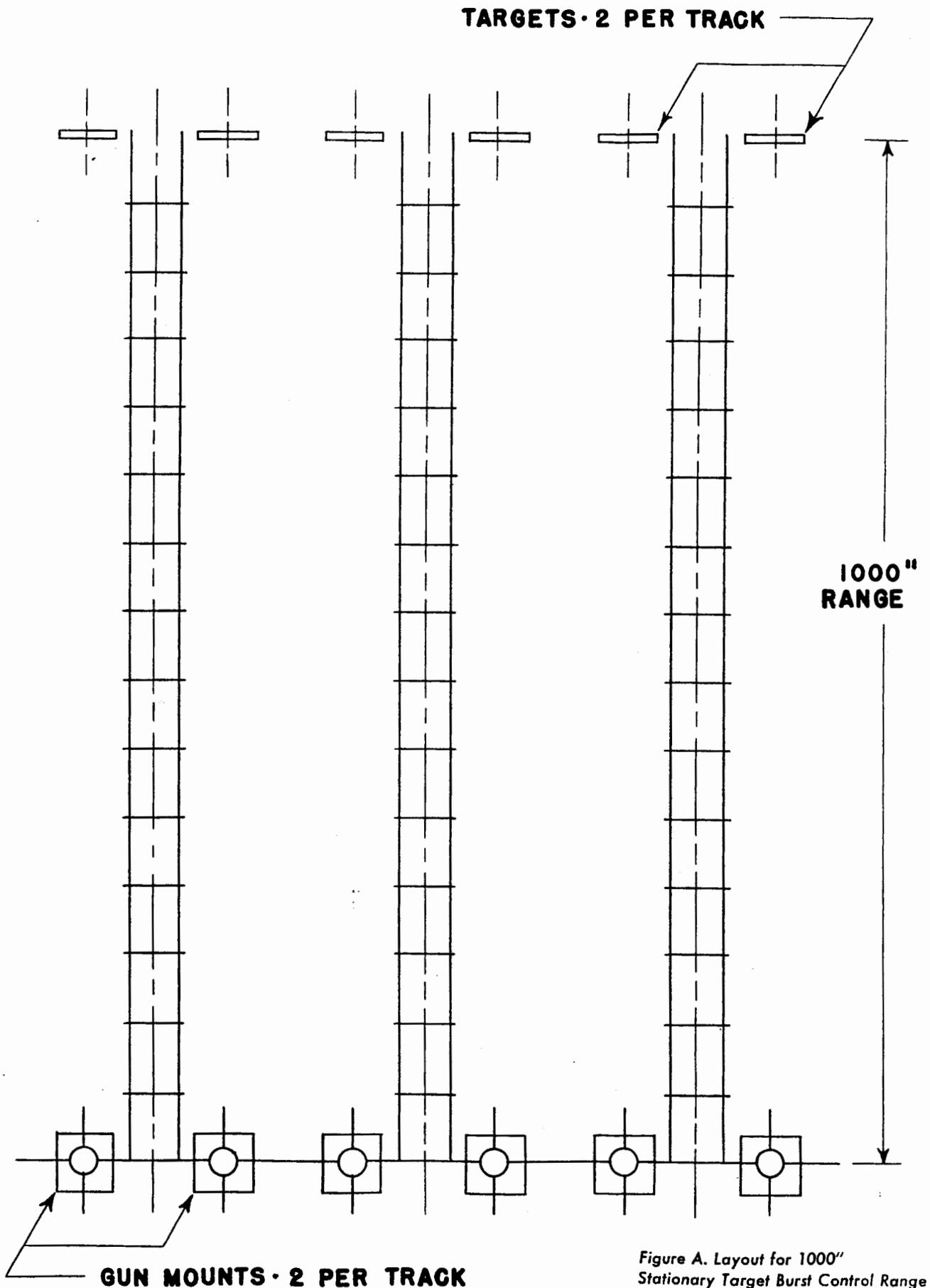


Figure A. Layout for 1000"  
Stationary Target Burst Control Range

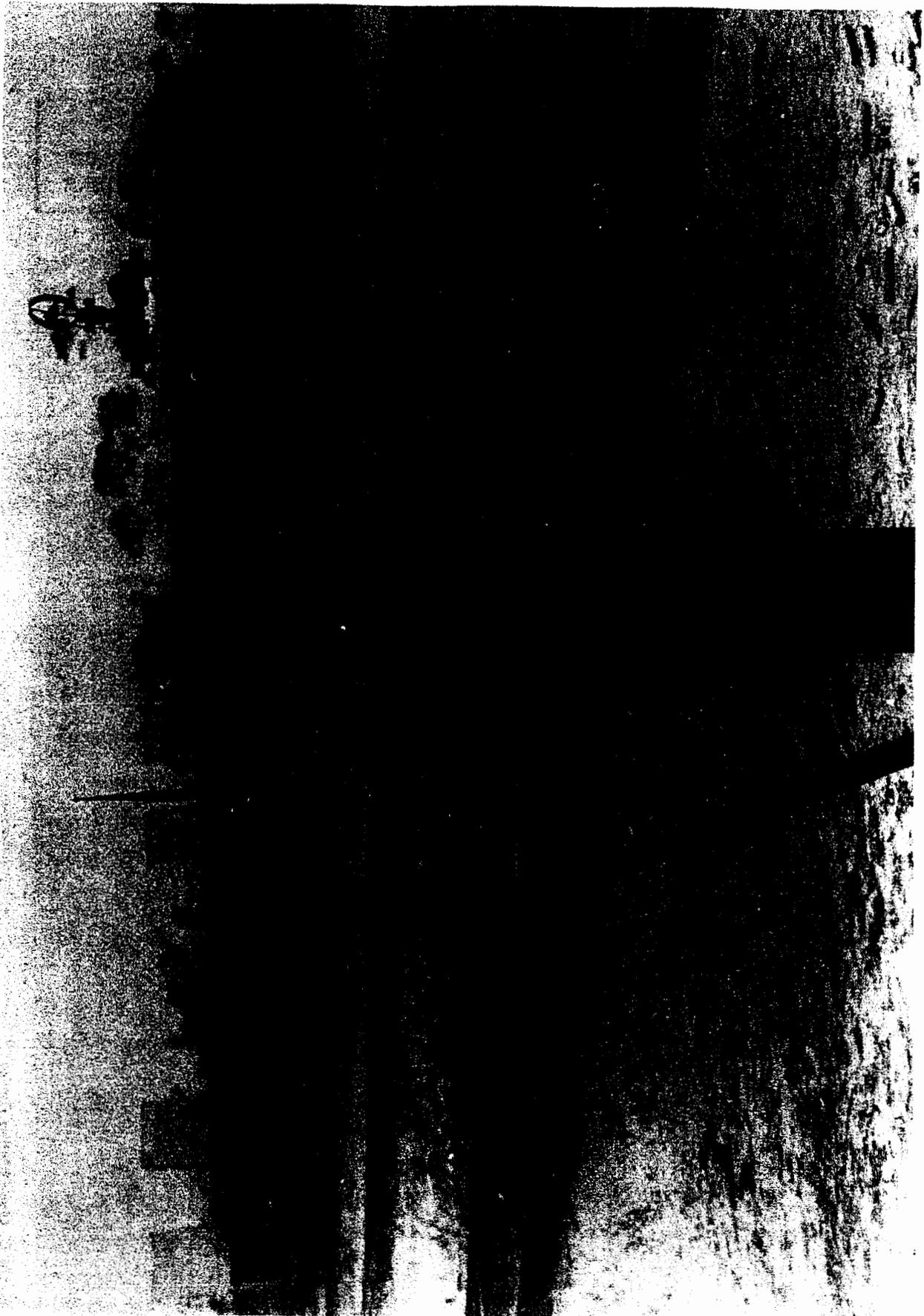


Figure C. Gun-Pointing Device

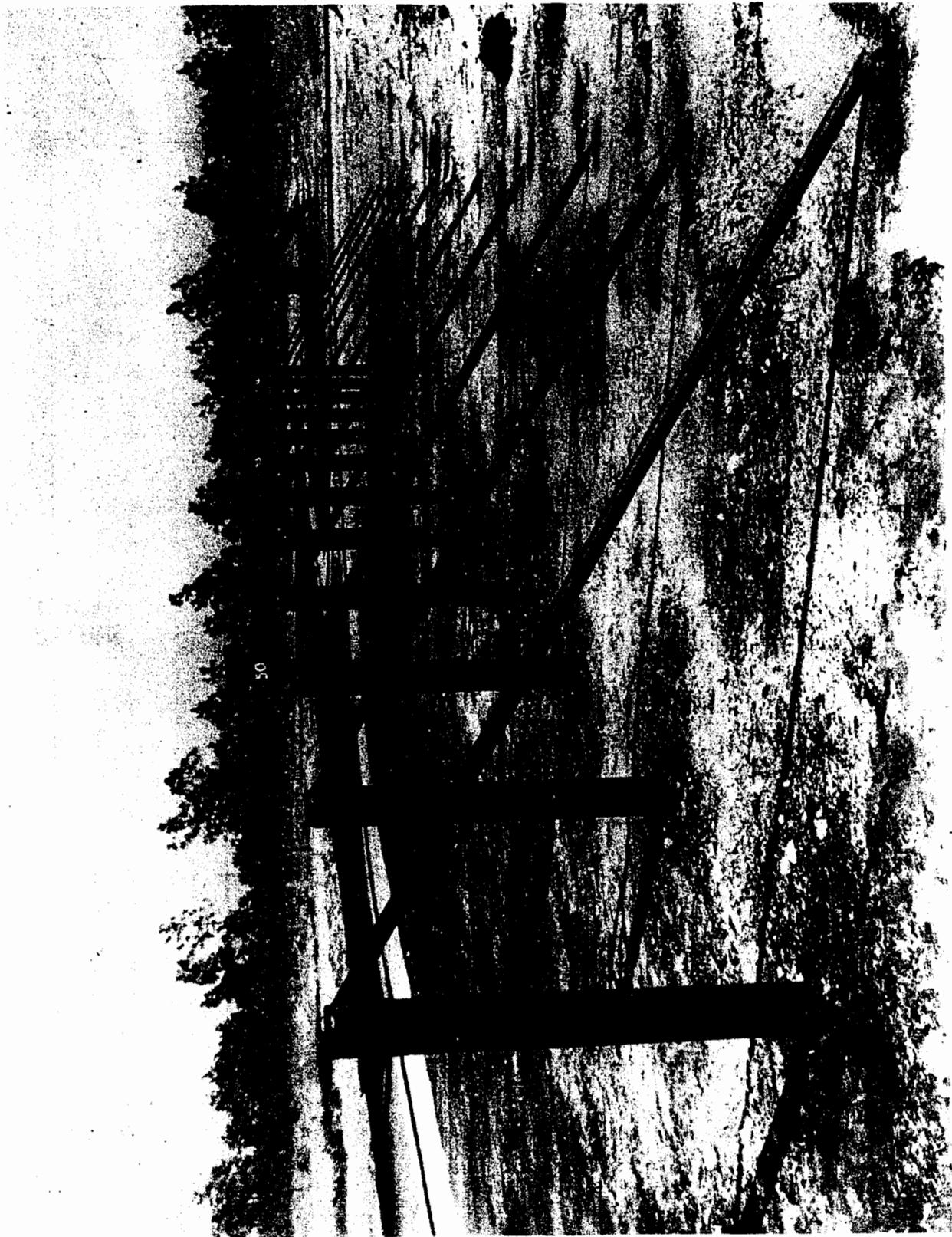


Figure B. Gun Mount Post



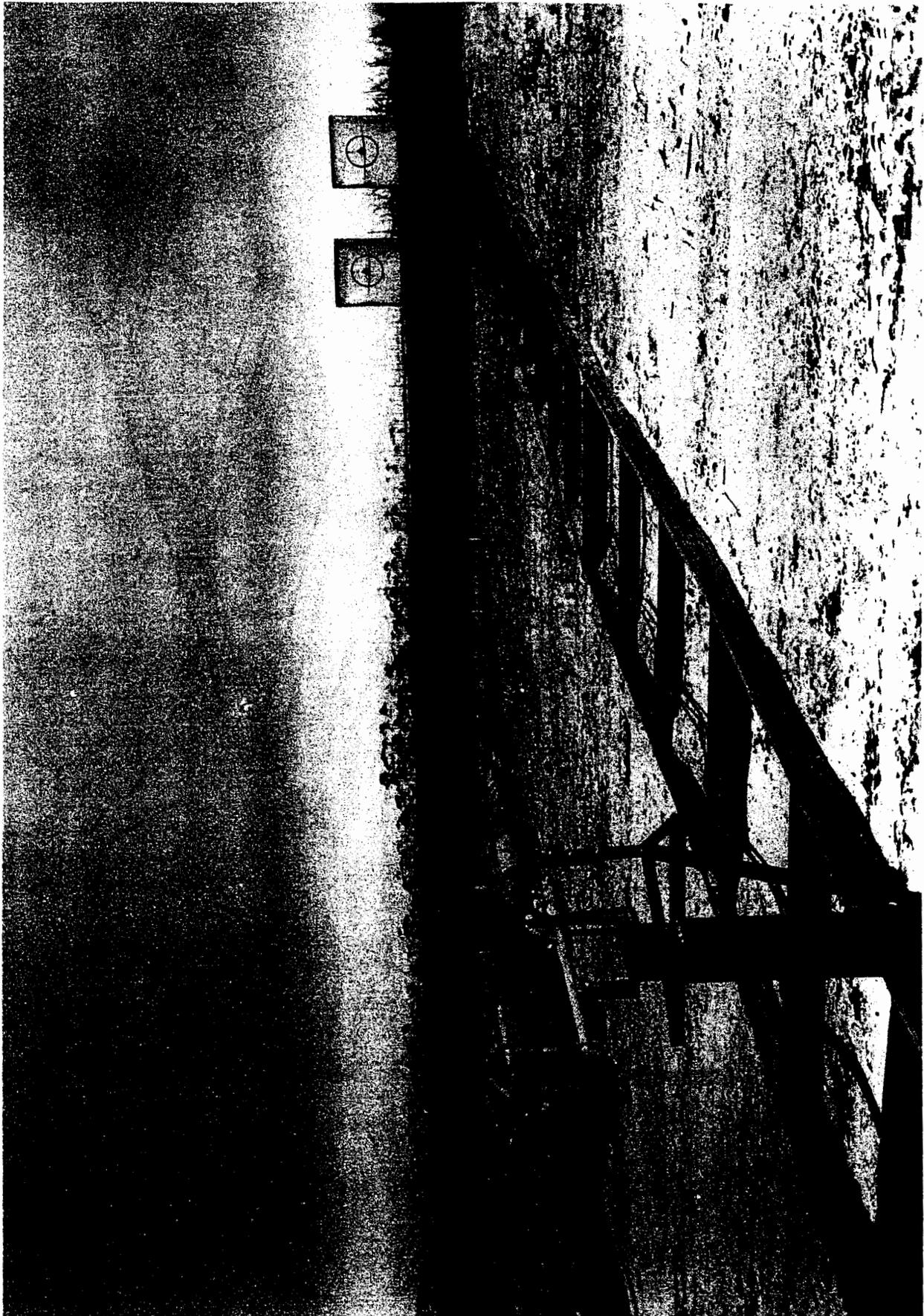


Figure E. Targets, Tracks, and Four-Wheel Dolly

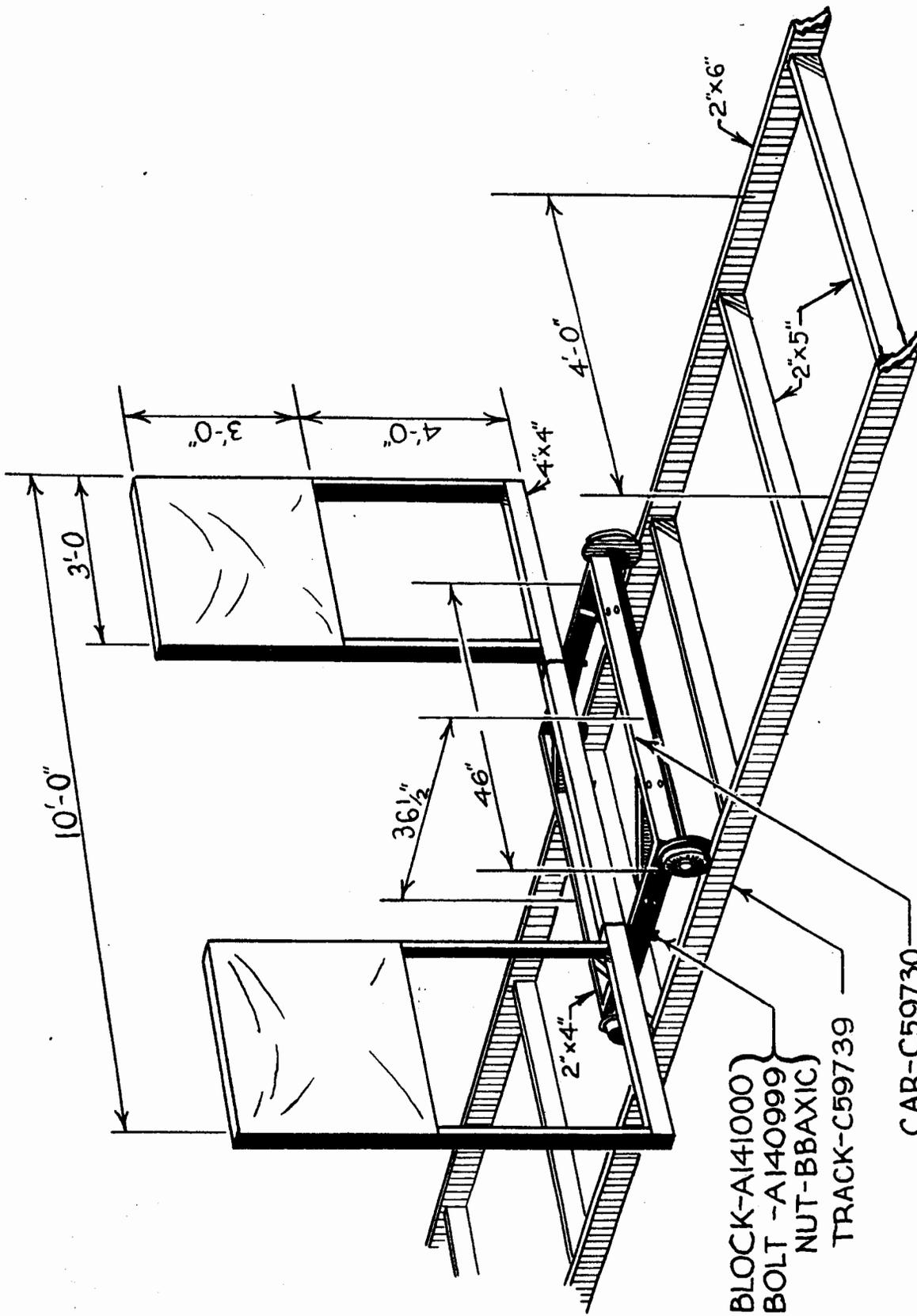
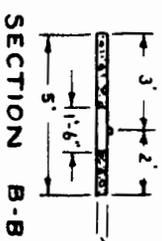
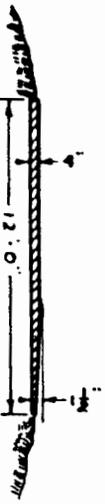
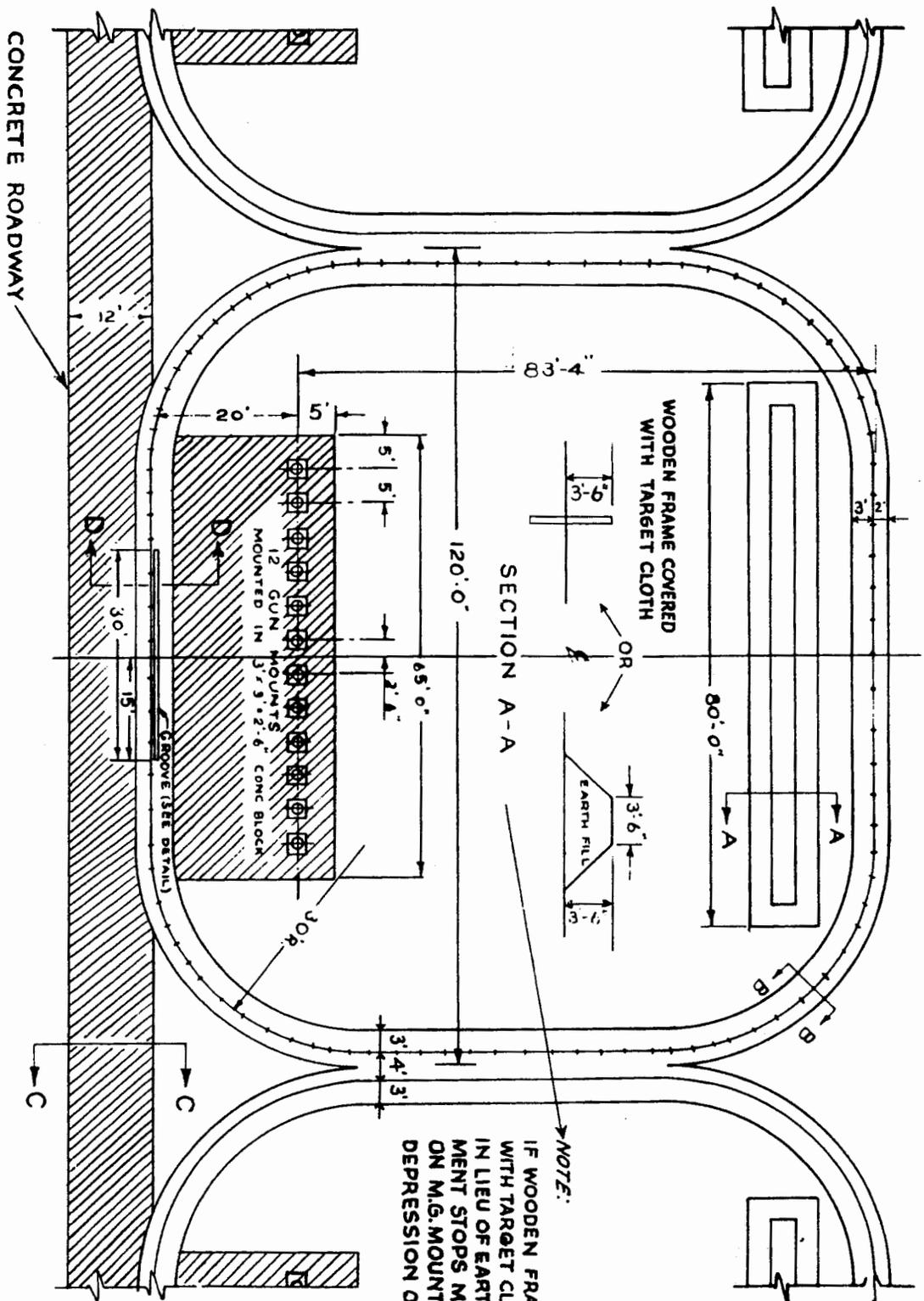


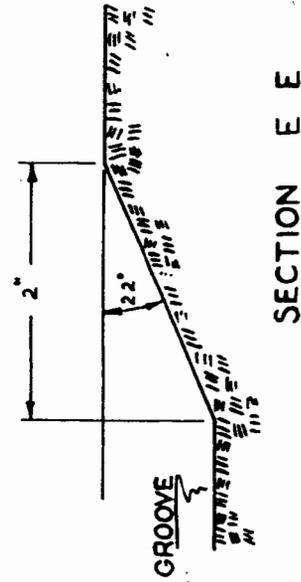
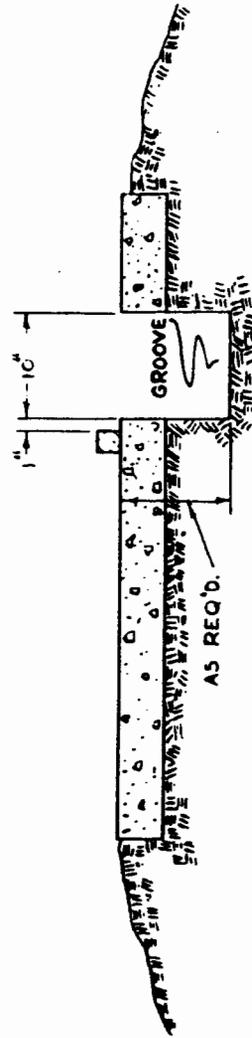
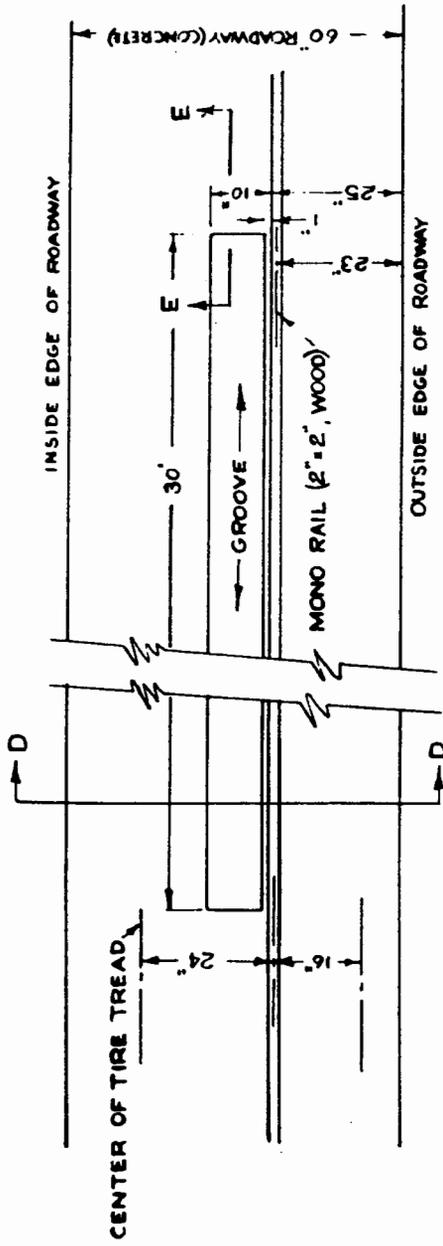
Figure F. Target, Rolling, Machine Gun, Complete C-59725

## 2. 1000'' Moving Target Burst Control Range

- a. **The Range:**—The dimensions and general characteristics of the range are indicated in Figures A and B.
- b. **The Firing Stations:**—The firing stations, spaced five feet apart, are identical to those used on the 1000'' stationary burst control range.
- c. **The Gun, Sights, and Gun-Pointing Device:**—The gun, sights, and gun-pointing device are identical to those used on the 1000'' stationary target burst control range.
- d. **Circular Track and Embankment:**—A circular track is constructed with the line of firing stations so located inside that the track passes approximately 20' behind and 1000'' in front of the firing stations (see Figure C). To protect the target carrier, an earthwork, three and one-half feet high and approximately 80' long is placed five feet inside the track. A single guide rail (2'' x 2'' wood) is secured to the track. In the arc of the track behind the firing line is located a groove 30' long and 10'' wide, designed to stop the target carrier for the purpose of changing targets.
- e. **Target Carrier:**—The target carrier, mounting targets either for point blank firing or for full deflection firing, is a three-wheel scooter, Government issue, with a guide lever and guide wheel installed to steer it around the track (counterclockwise) along the guide rail (see Figures D, E, and F). A pair of side wheels is installed on the rear of the scooter (see Figure G) to support the scooter on the track when the single rear drive wheel strikes the 30' groove. After targets have been changed, a gentle push of the scooter, bringing the drive wheel out of the groove, continues the scooter around the track.
- f. **The Target:**—A 3' x 3' target frame is covered with target cloth and mounted on legs five and one-half feet long. The cloth or paper target, upon which is painted the silhouette of an enemy fighter plane, is fastened or glued to the target cloth. If the conventional type yoke mount, as shown in Figure C in the 1000'' Stationary Target Burst Control Range for Flexible Gunnery, is used, the scoring area will consist of a circle 15'' in diameter described around the nose of the silhouette. If an improved mount, such as the K-6 or K-7, is used, the scoring area will be reduced to a circle approximately 12'' in diameter described around the nose of the silhouette. Modifications of

the target and target carrier to allow full deflection shooting with K-13 Compensating Sight or iron ring and post sight are shown in Figure H.





GROOVE IN CONCRETE ROADWAY ON BURST CONTROL RANGE (MOVING TARGET) WHICH IS USED TO STOP TARGET CARRYING SCOOTER

Figure B. 1000' Moving Target Burst Control Range



Figure C. Firing on 1000' Moving Target Burst Control Range

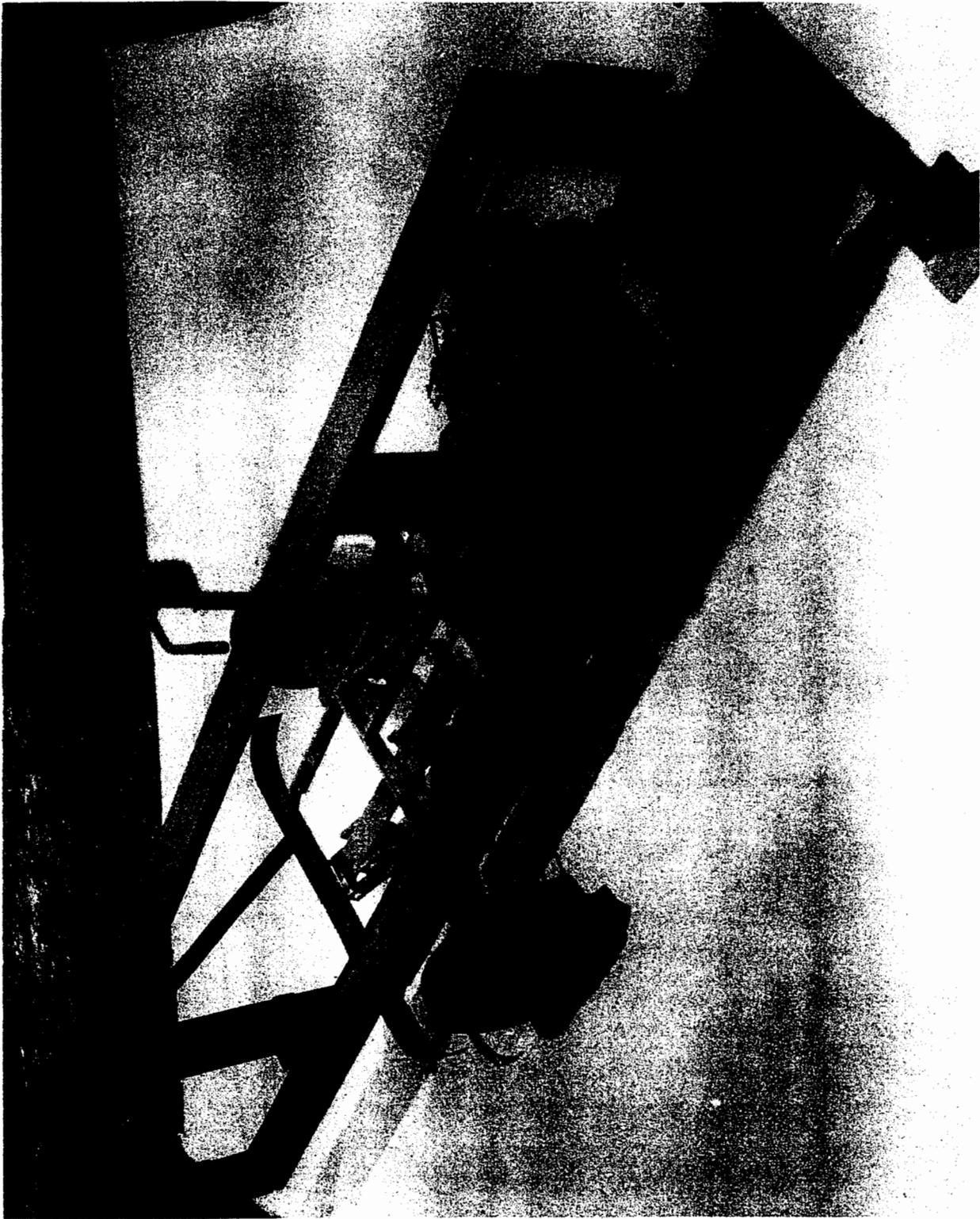


Figure D. Scooter Target Carrier



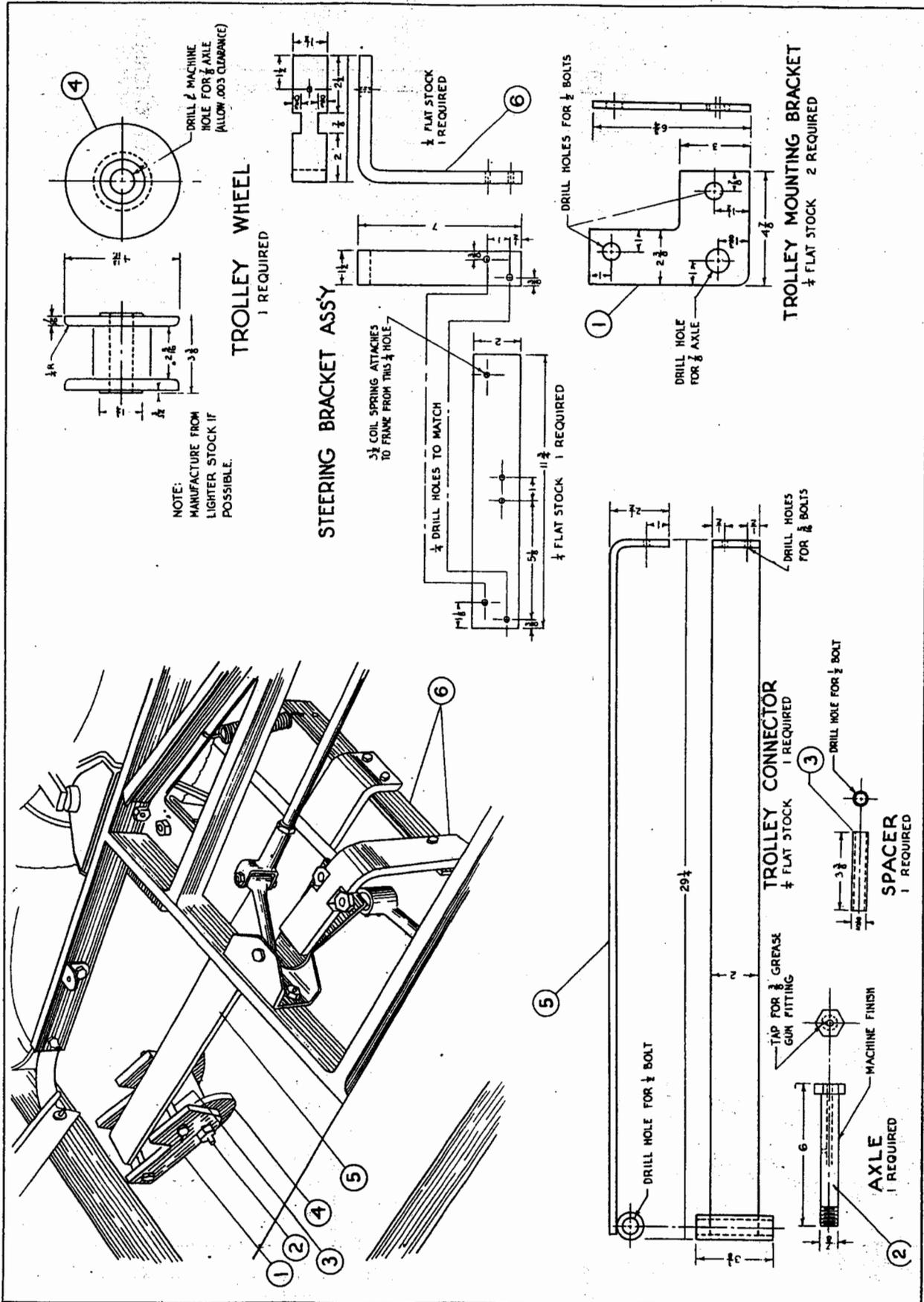


Figure F. Scooter Target Carrier Details: Scooter Trolley

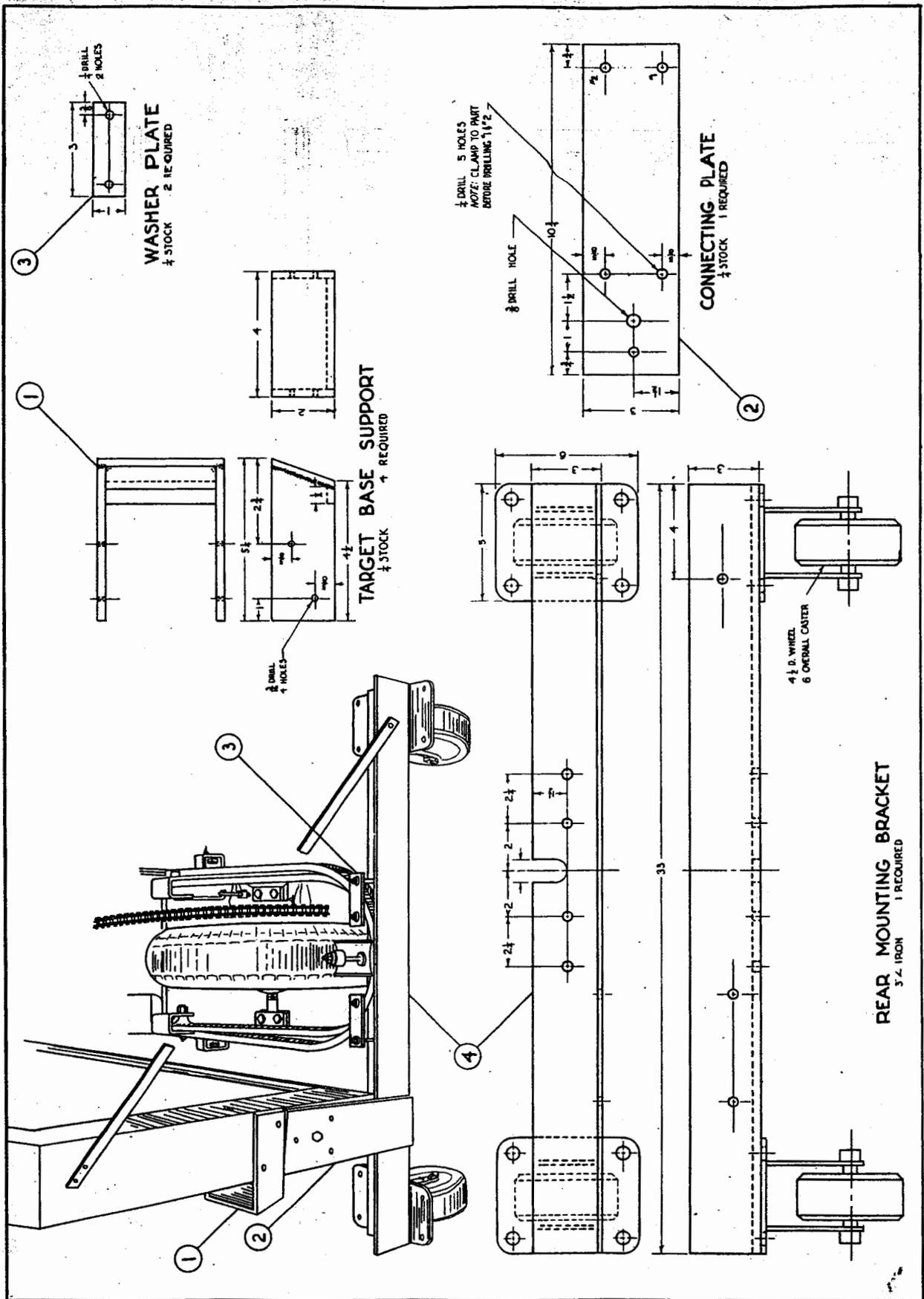


Figure G. Scooter Target Carrier Details: Rear Bracket

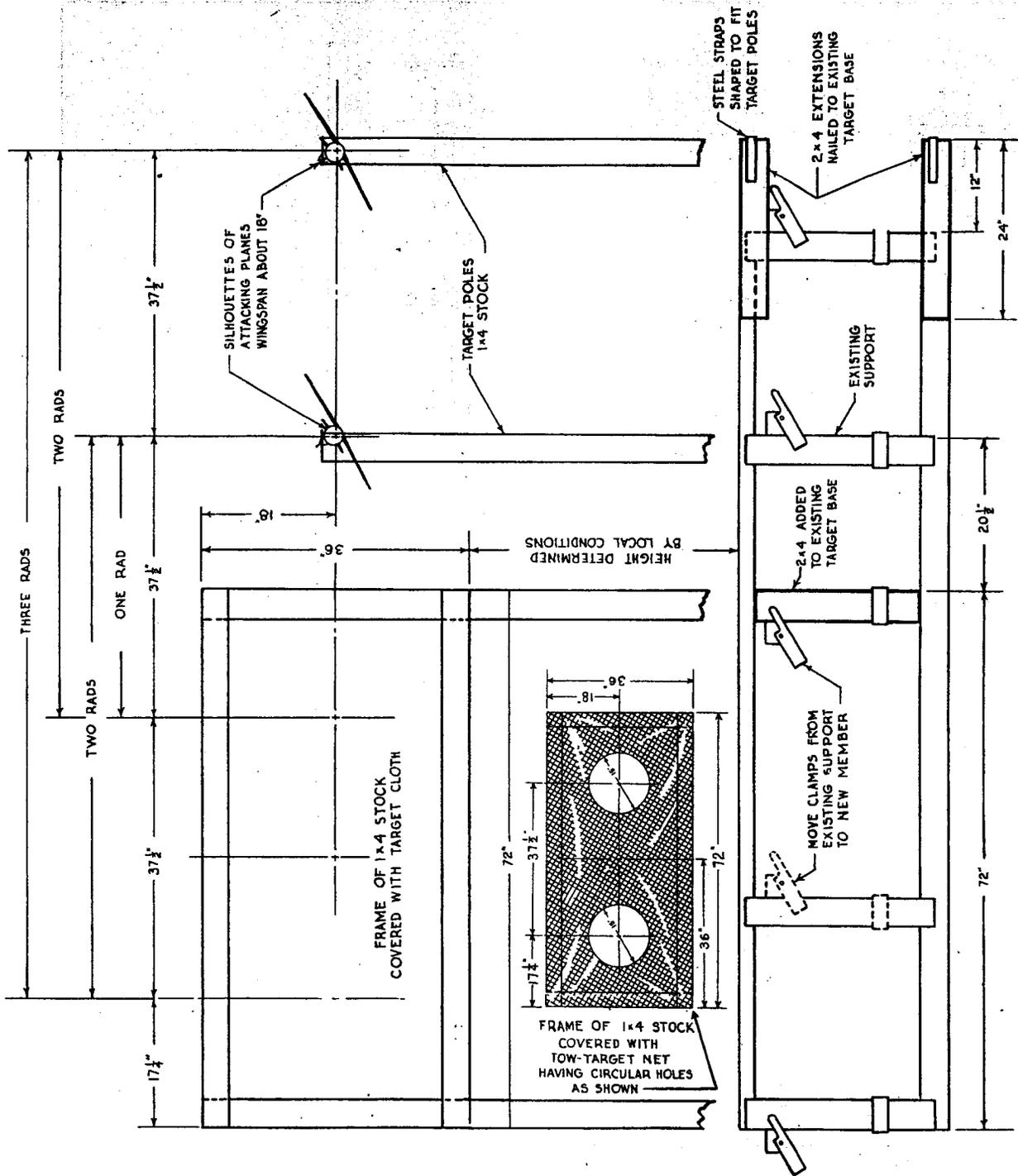


Fig. H. Modifications of target and target carrier for full deflection firing.

## 5. MOVING TARGET RANGES

- a. Purpose:**—The moving target ranges permit practice in firing either hand-held or turret-mounted cal. .50 aerial machine guns at distances approximating combat ranges.
- b. The Ranges:**—There are two types of moving target ranges: the first, illustrated in Figures A, B, and C, using modified jeep target carrier; the second, illustrated in Figures E, F, G, H, J, and K, using either the Buda or the Fairmont railway car target carrier. Each range layout may be fitted for use with either type target carrier.
- c. The Firing Stations:**—The firing station for the hand-held machine gun consists of any stable mount adapted to swivel the cal. .50 hand-held aerial machine gun (see Figure B on 1000" Stationary Target Burst Control Range for Flexible Gunnery).
- The firing station for the turret-mounted machine guns consists of cal. .50 aerial machine guns mounted in any standard type combat turret. There are two types of turret mounts: If electric current is available, turrets may be mounted in stands similar to those illustrated in Figure B in High Tower Range for Flexible Gunnery. If electric current is not available, the E-5 Trainer Mount, powered by a truck equipped with generator, relay switches, and batteries, may be used as illustrated in Figure D.
- d. The Gun and Sights:**—The gun is a standard cal. .50 (or .30) aerial machine gun. The hand-held cal. .50 gun will mount the standard ring and post or K-13 Compensating Sight adapted for ground use and designed for the cal. .50 hand-held aerial machine gun. The turret, mounting cal. .50 guns, will use the standard sight installed in the combat turret provided the sight is adapted to ground use.
- e. The Target:**—The target is a cloth banner stretched between two 12' poles (4" x 4" wood). (See Figure L.) The scoring area on the banner is generally 6' x 6'. Hits outside this area are not scored.
- f. Target Carriers:**—On the concrete range, illustrated in Figures A, B, and C, the target carrier is the ¼ ton reconnaissance 4 x 4 (standard jeep) equipped with guide lever, guide wheel, stopping device, and target post pockets (see Figures M, N, O, P, Q, R, S, and T). On the rail range, the target carrier most generally used is the Buda Model R-2 Target Car.



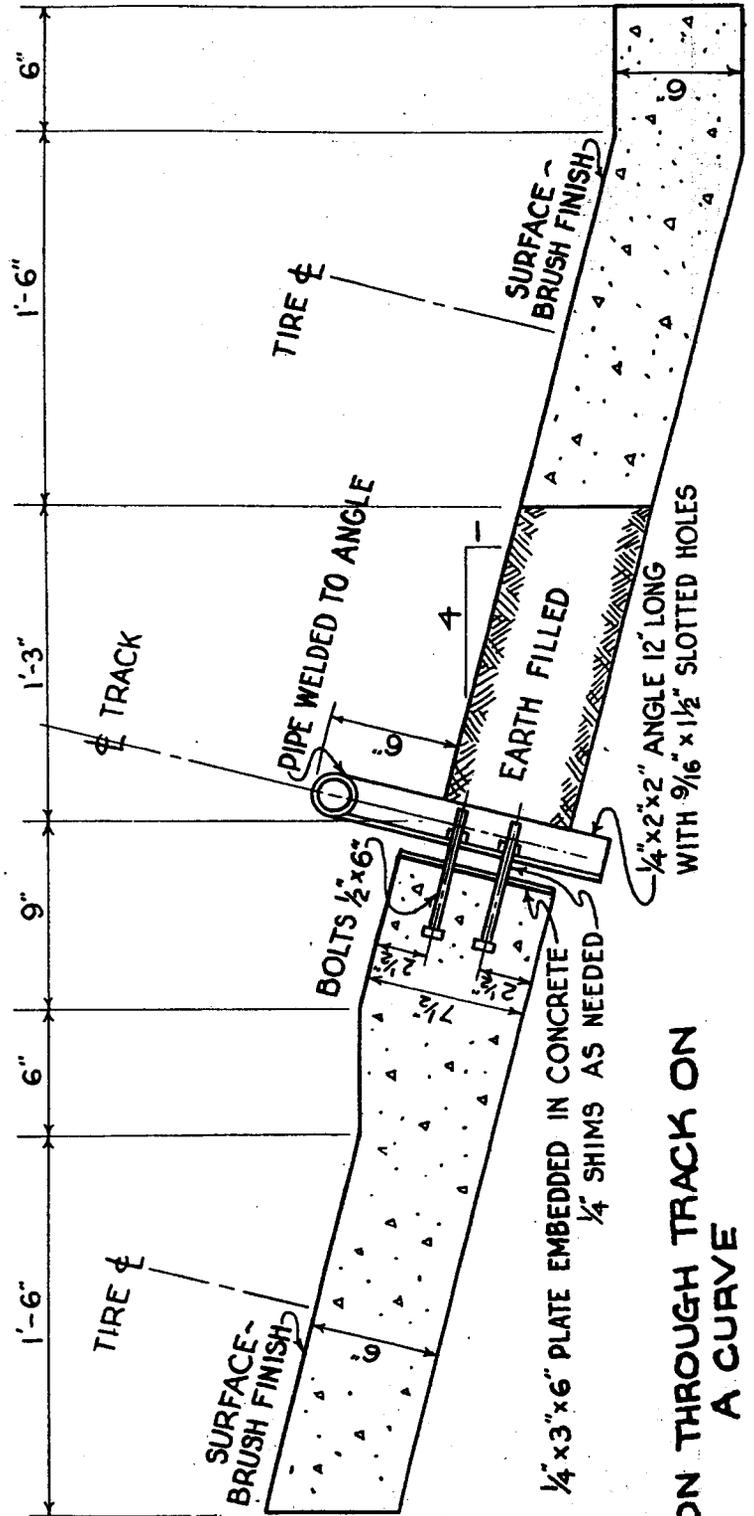
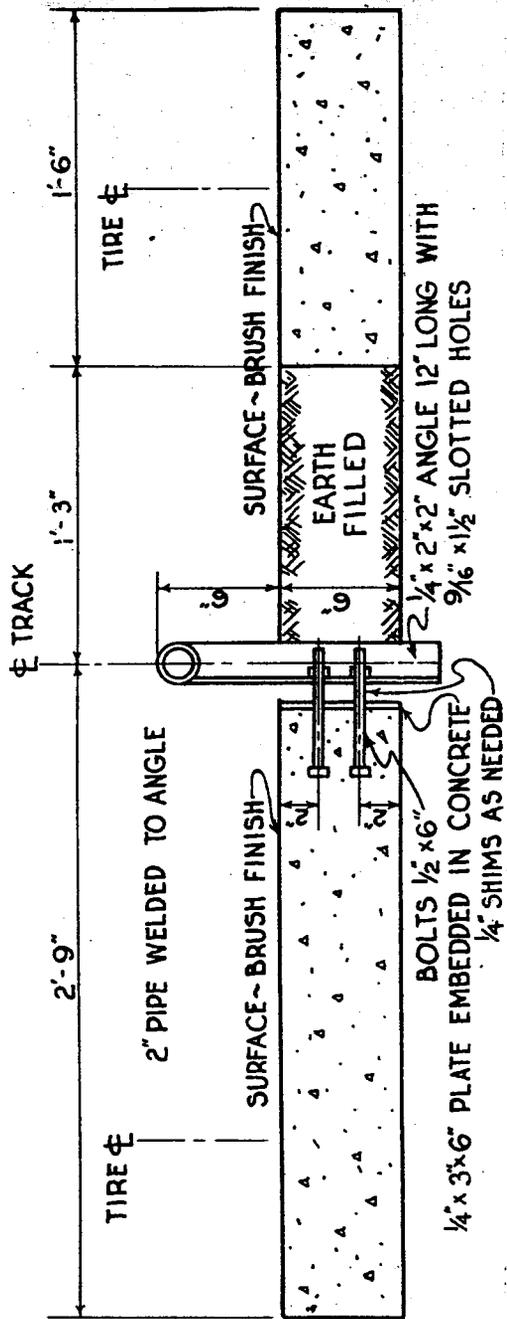


Figure B. Detail of Track for Moving Target Range

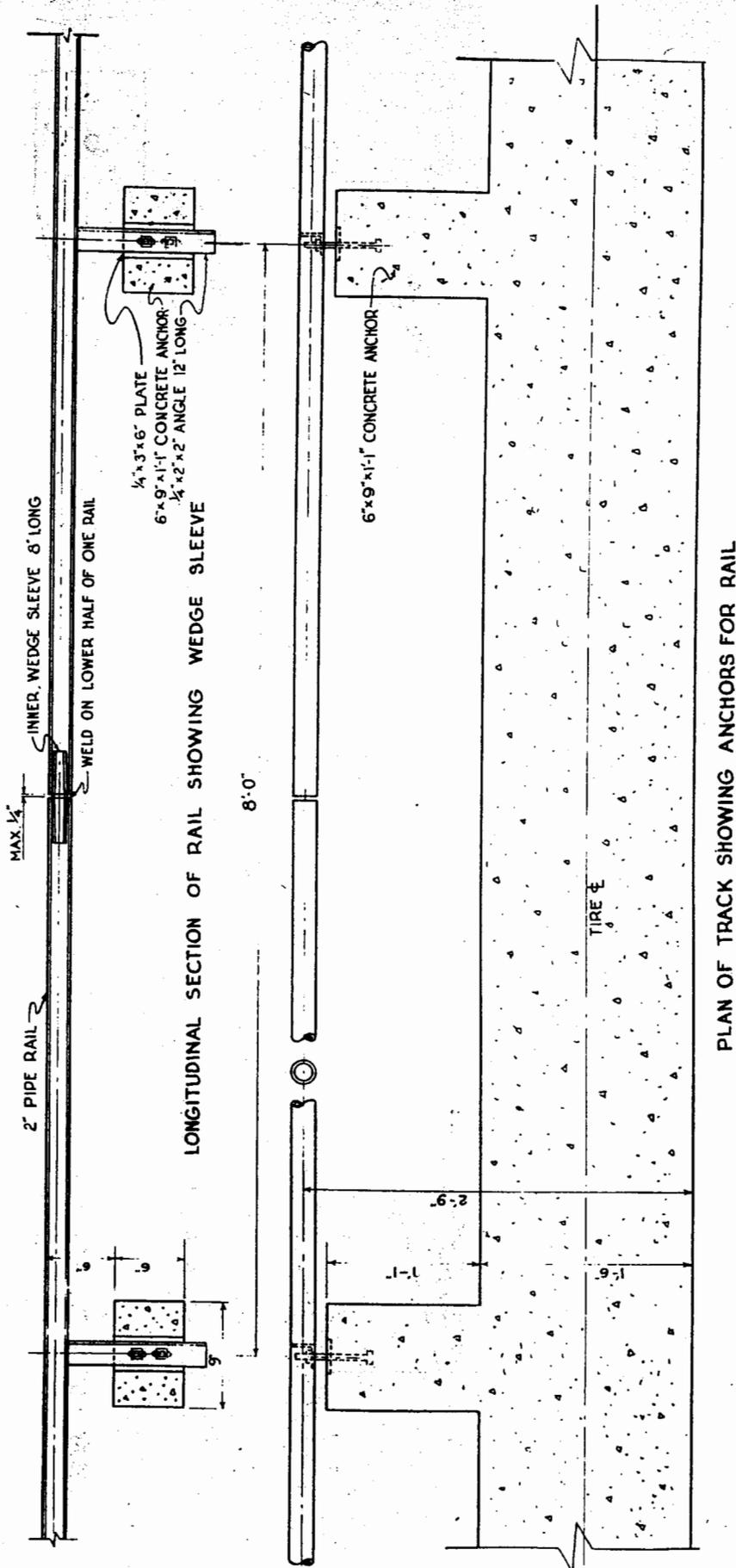


Figure C. Detail of Track for Moving Target Range

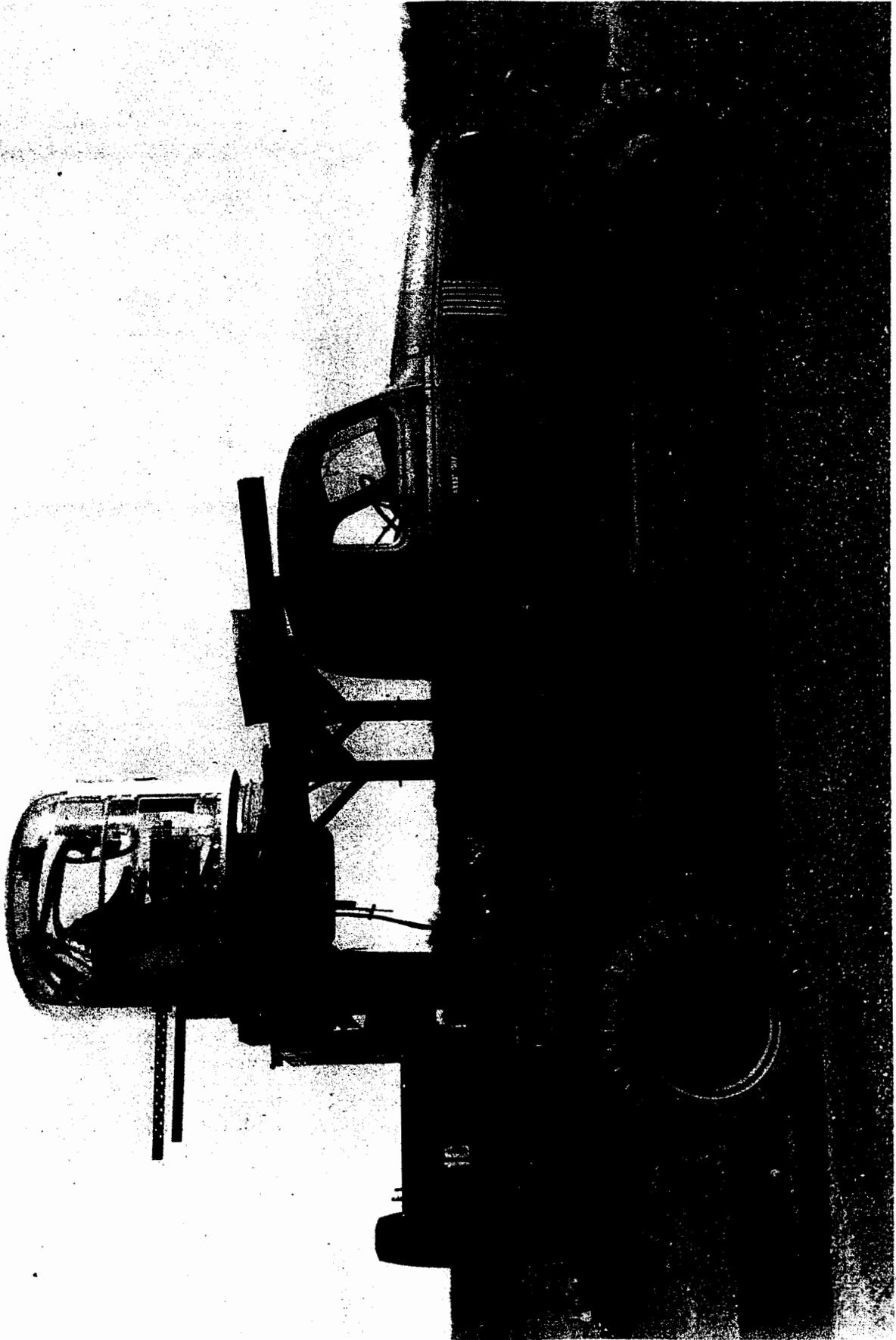
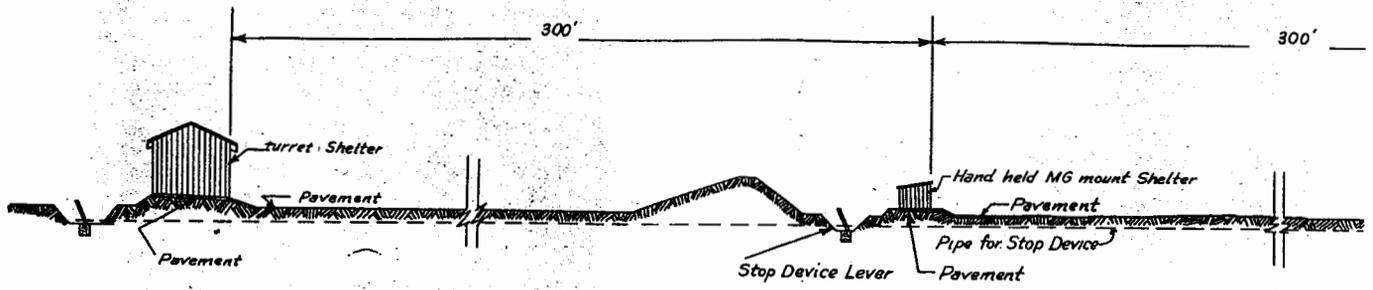
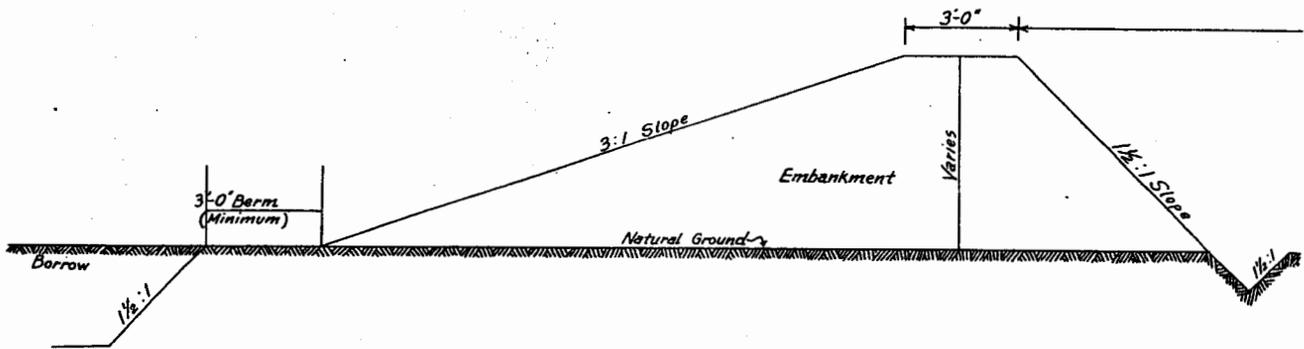


Figure D. E5 Trainer Mounting Motor Products Tail Turrets

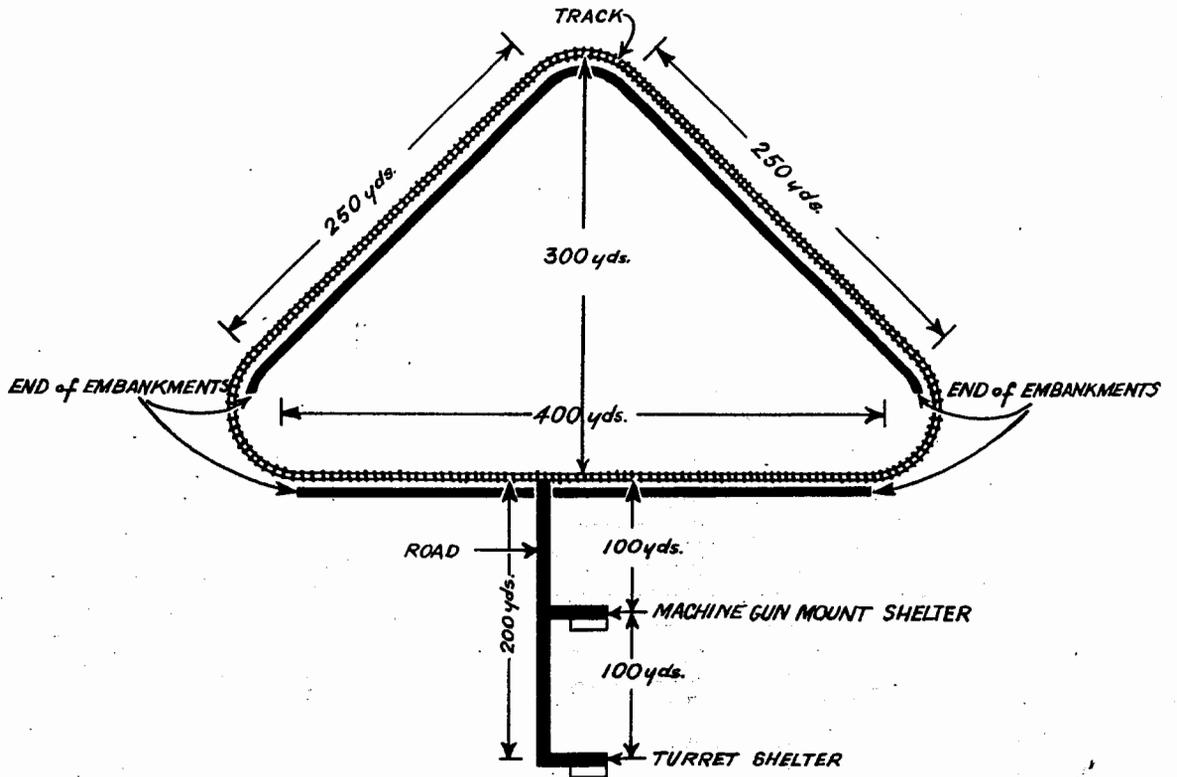
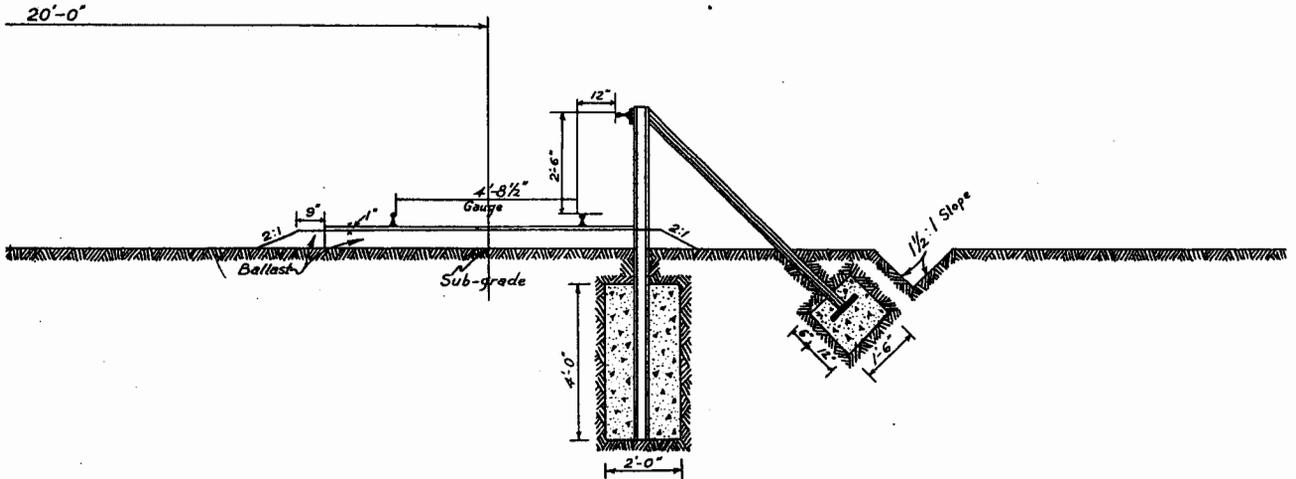
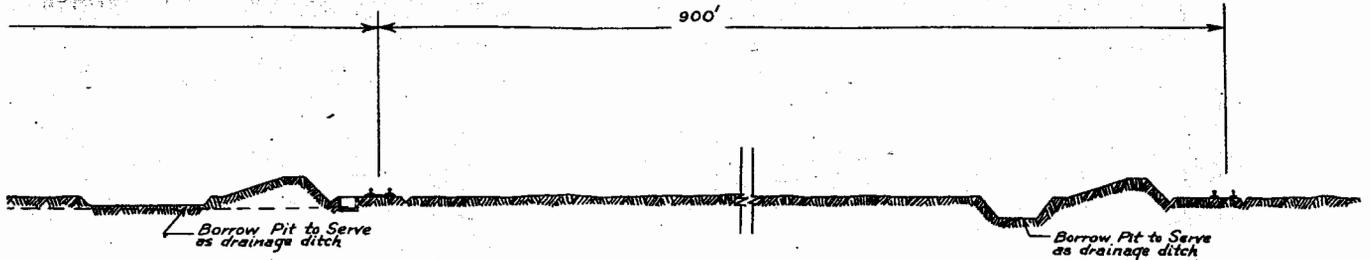


Profile of Center Line of Moving Target Range



Profile of Curve

Figure E



Layout of Moving Target Rail Range.

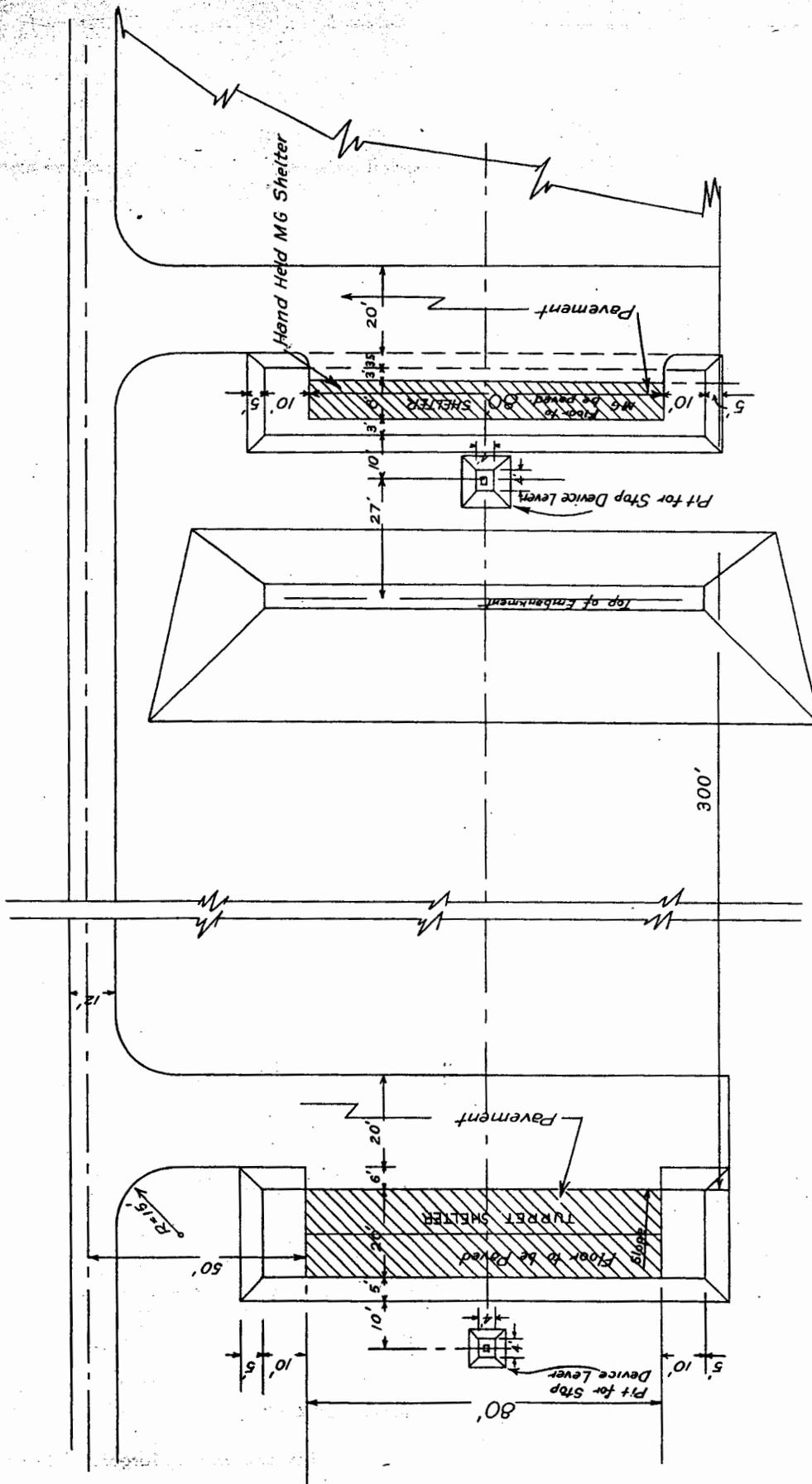


Figure F. Plan View Turret Shelter, Embankments, and Stopping Devices



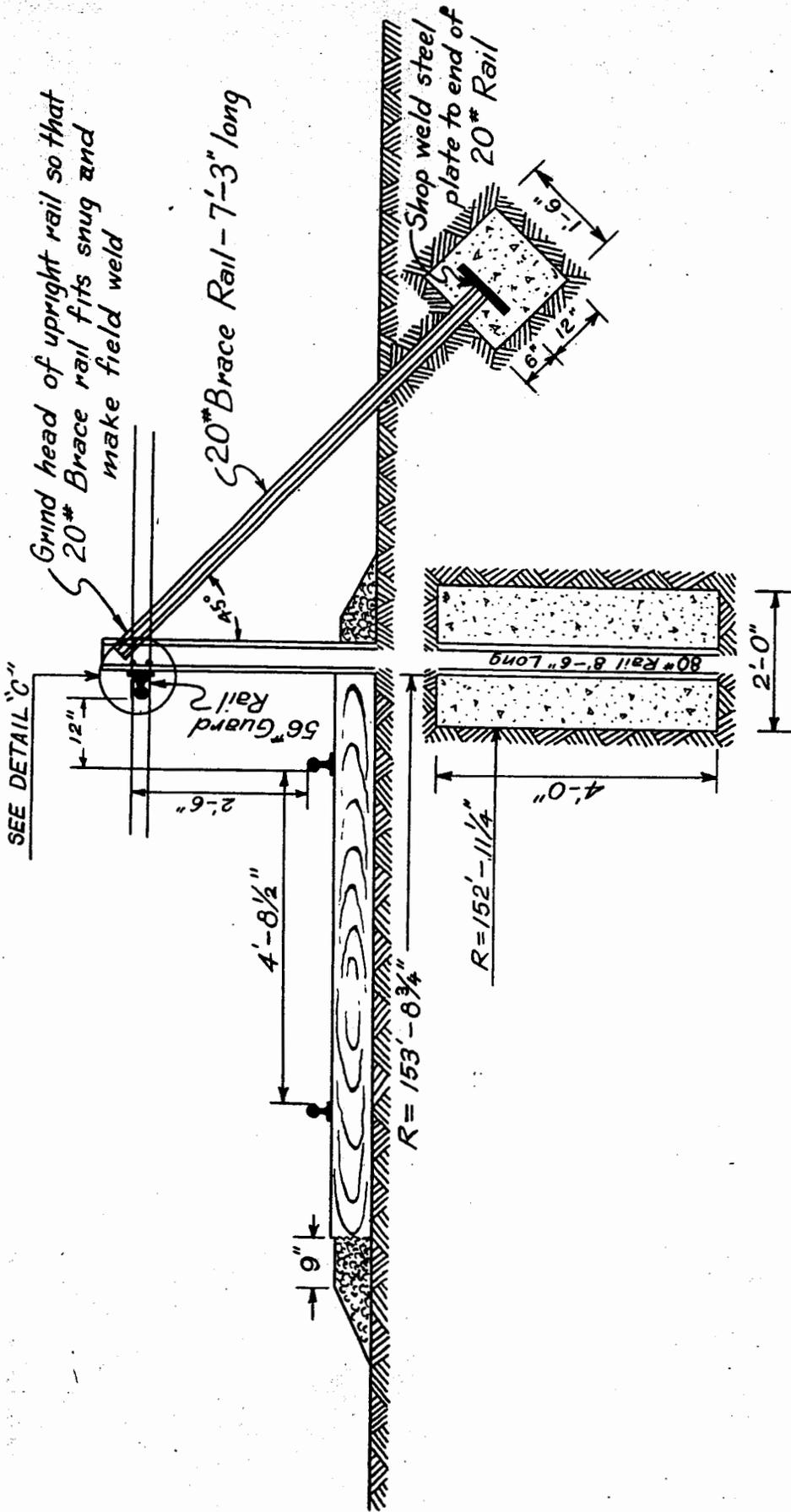
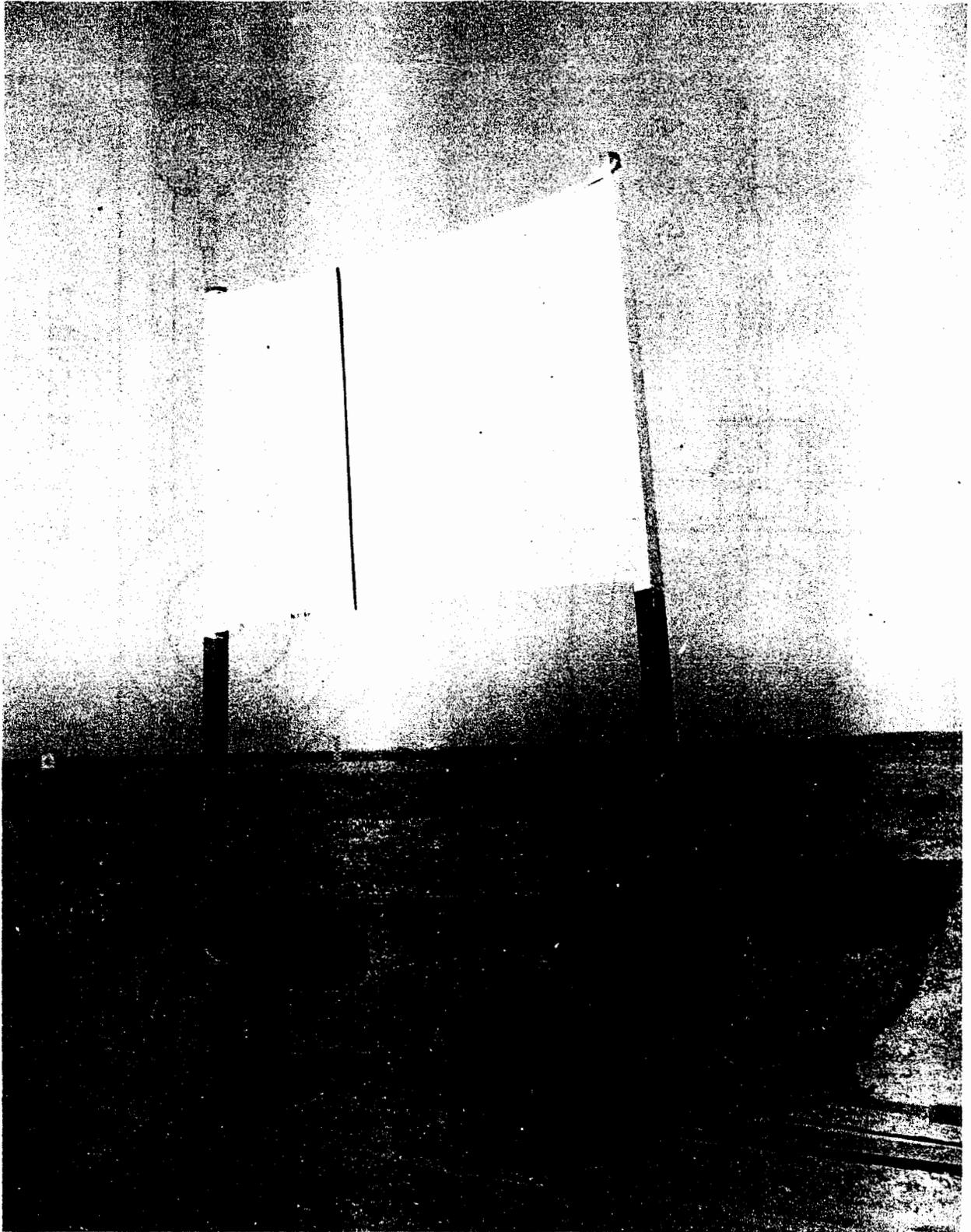


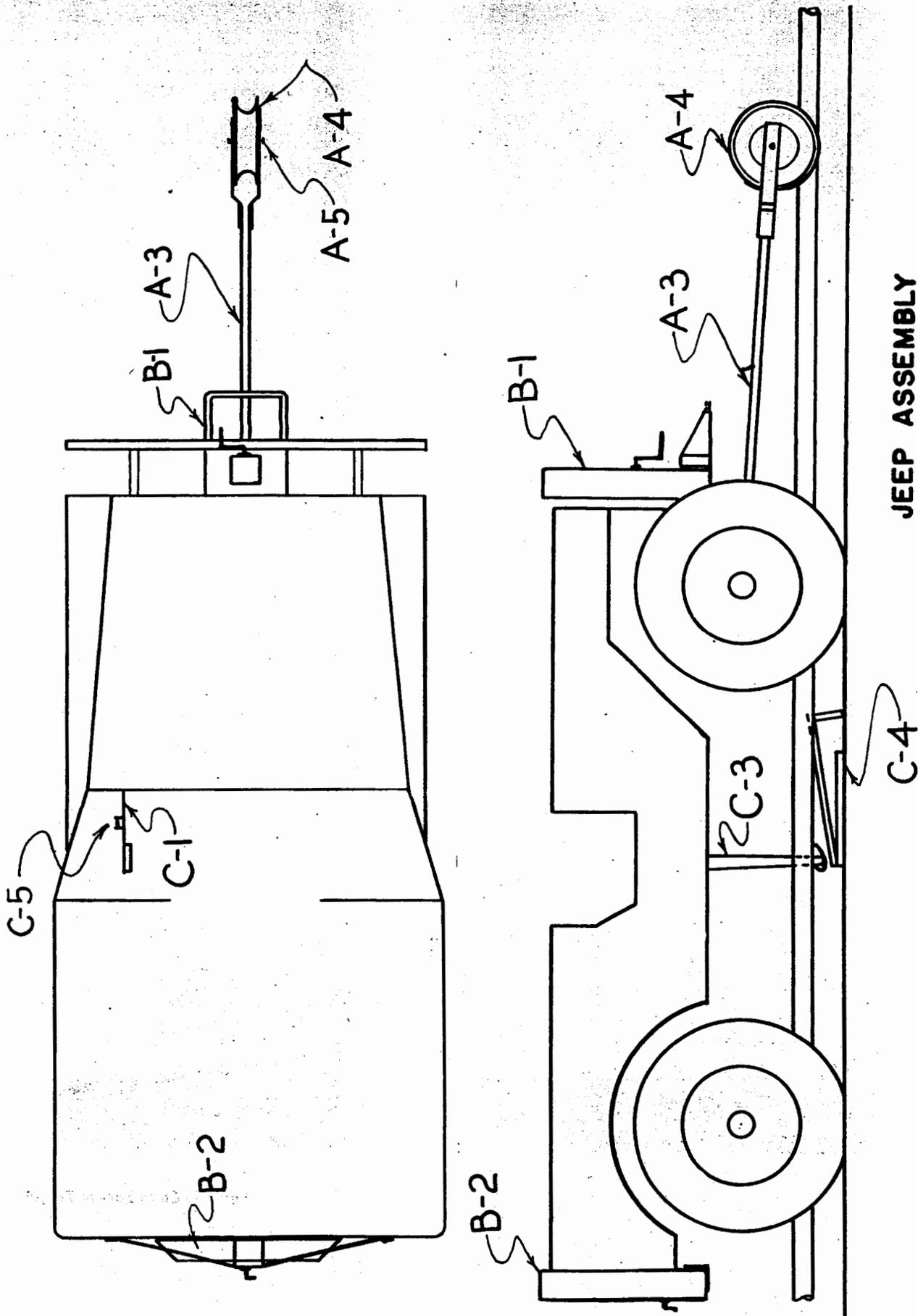
Figure H. Guard Rail Details







*Figure L. Cloth Banner Target*



JEEP ASSEMBLY

Figure M. Jeep Equipped with Guide Lever, Guide Wheel, Stopping Device, and Target Post Pockets



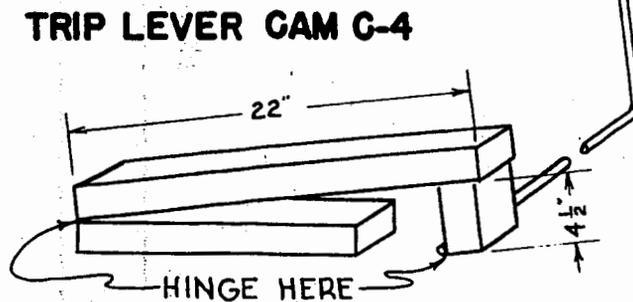
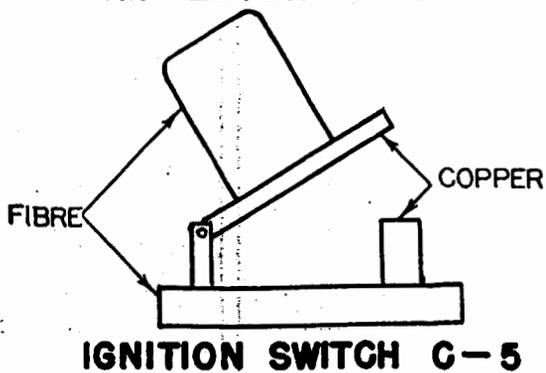
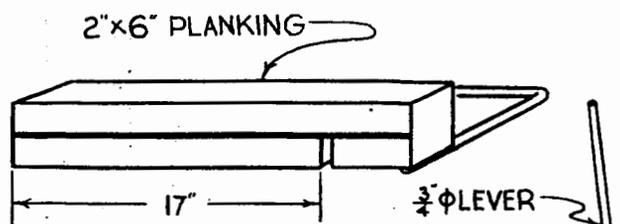
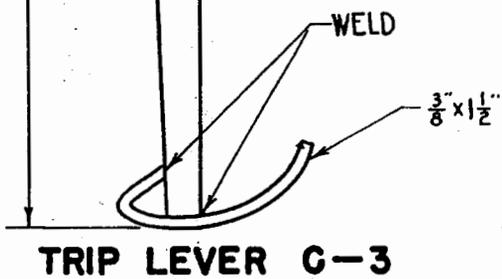
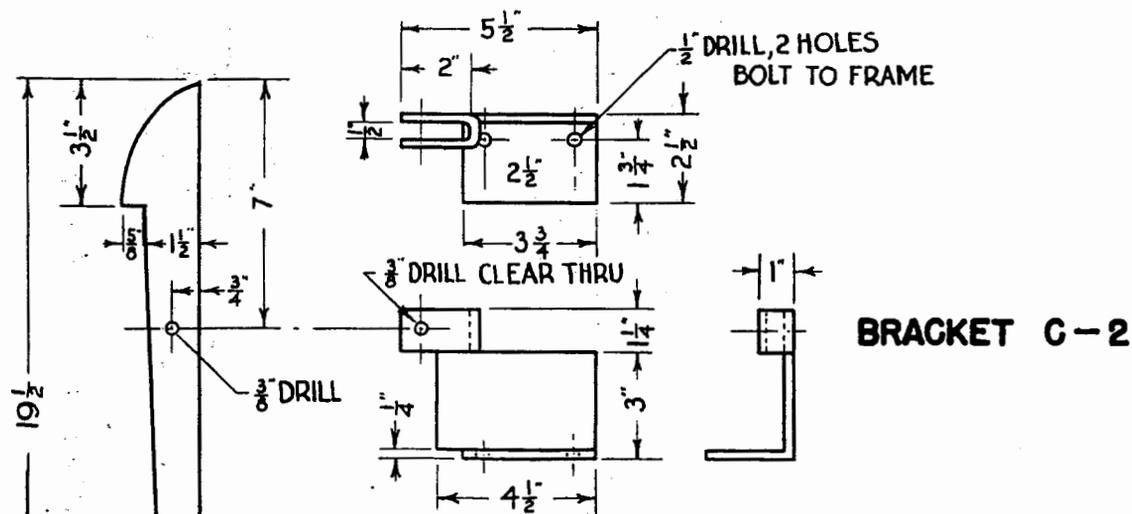
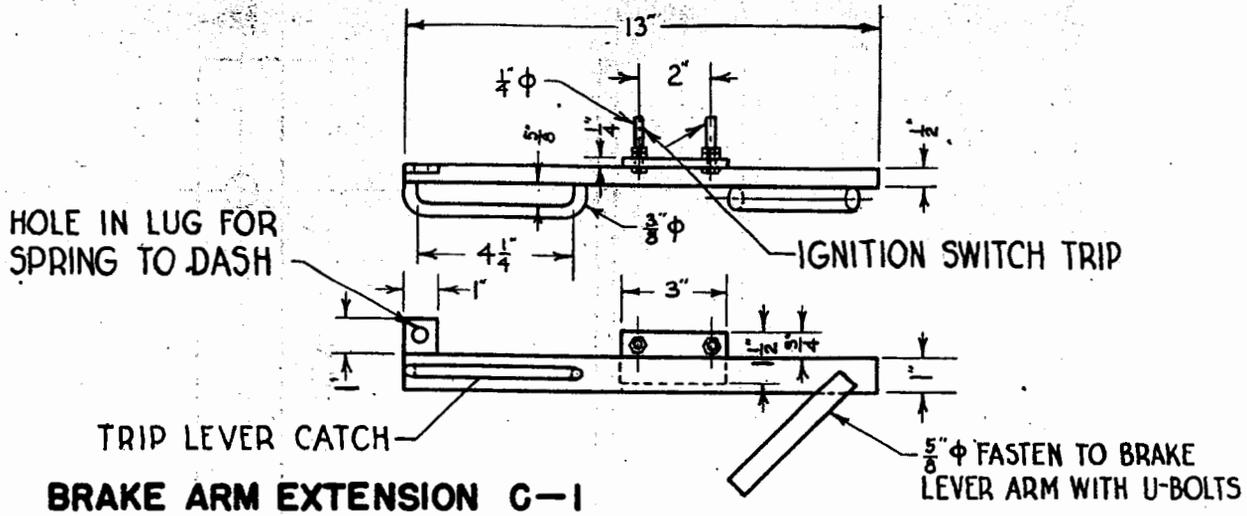
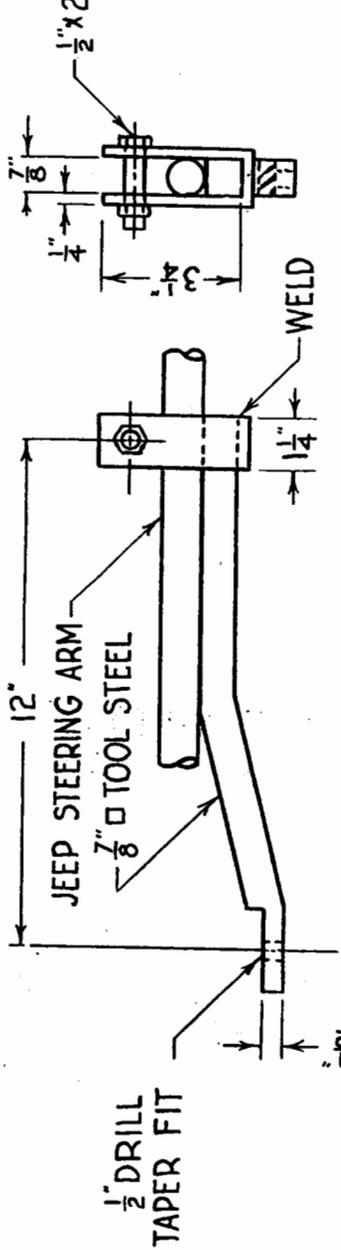
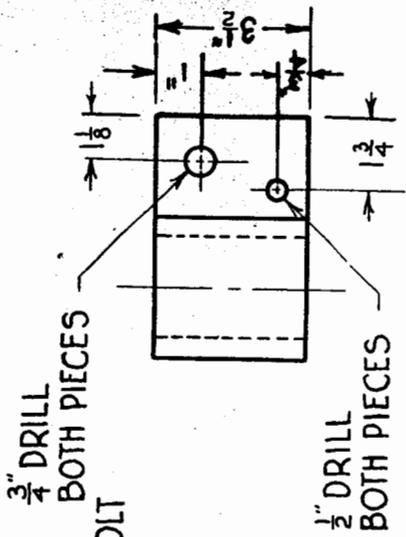
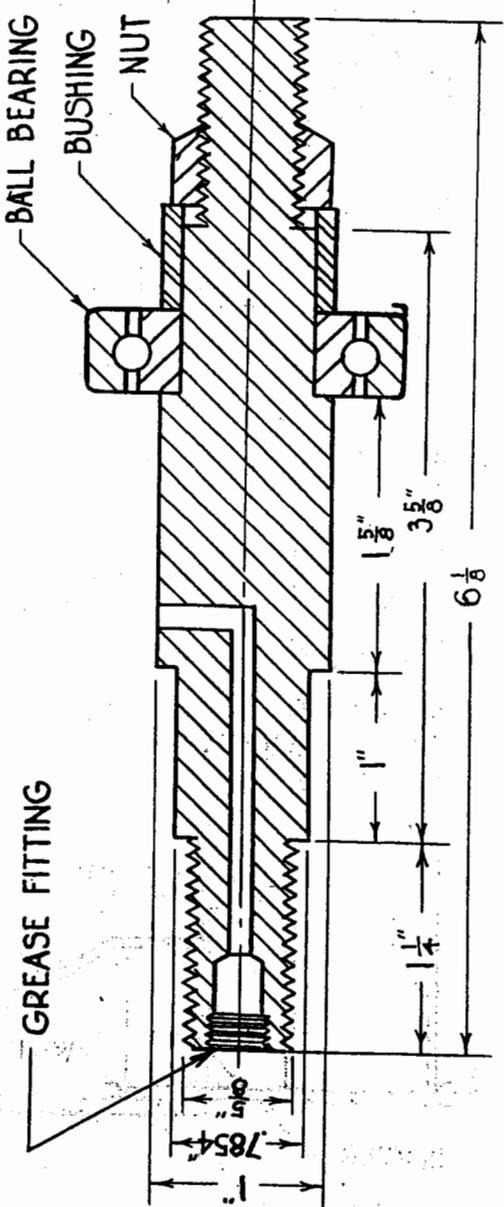


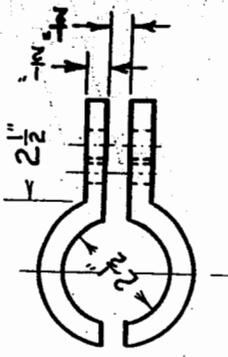
Figure O



CONNECTION TO JEEP STEERING ARM A-2



GUIDE WHEEL AXLE A-5



CONNECTION TO JEEP AXLE A-1

Figure P







Figure 5. Guide Lever, Guide Wheel, and Front Target Post Pockets

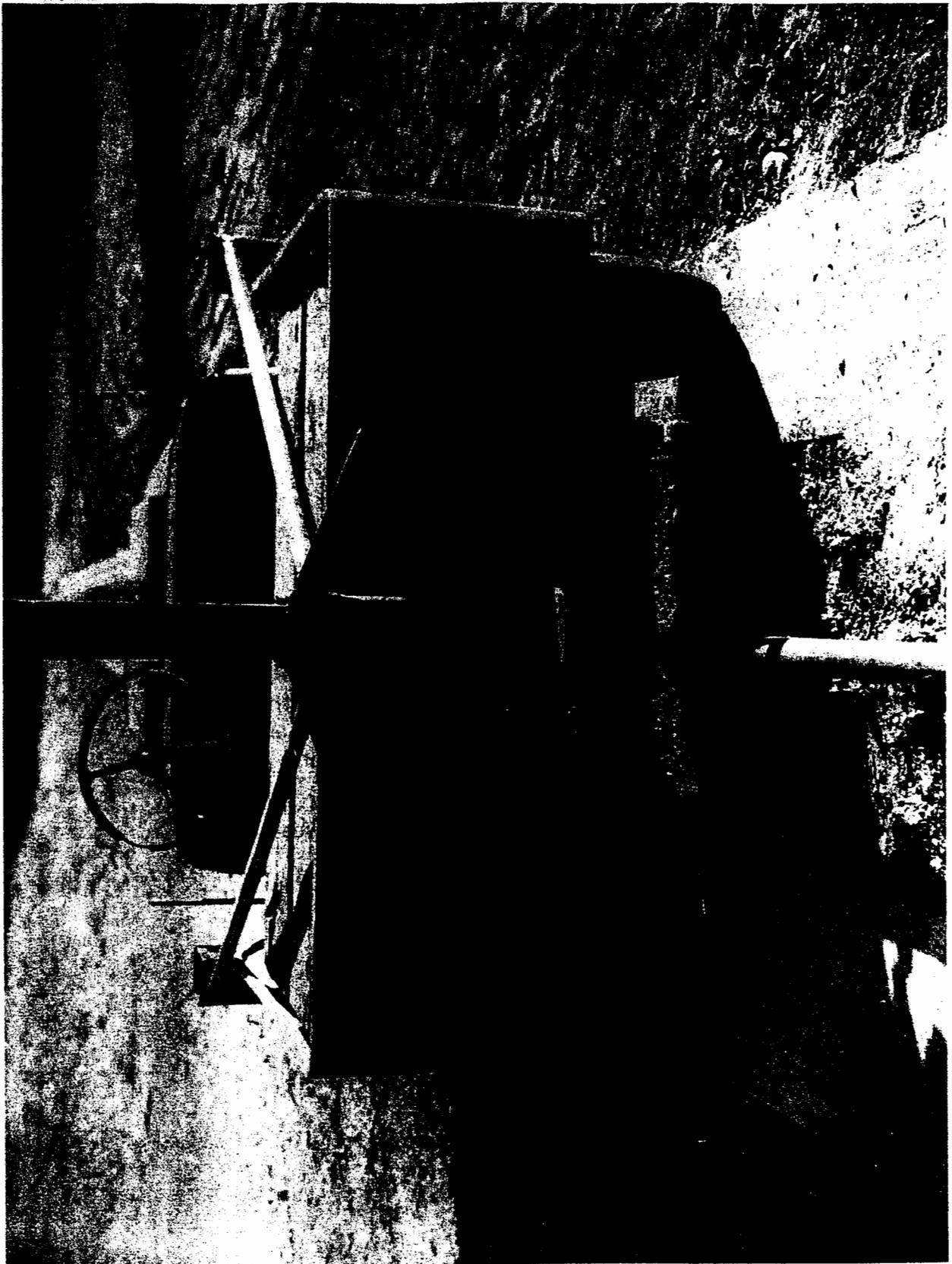


Figure T. Rear Target Post Pockets

## 6. OUTDOOR RANGE ESTIMATION RANGE

- a. **Purpose:**—The purpose of the range estimation range is to give the student practice in estimating the range of attacking aircraft.
- b. **General:**—Dimensions and characteristics of the range estimation range are indicated in Figure A. Range markers, used chiefly as a guide for attacking aircraft, may be constructed of wood as illustrated in Figure B, or they may be described on the ground with whitewashed dirt or crushed rock.
- c. **The Firing Line:**—The firing line consists of any convenient number of gun mounts toward which a single-engine aircraft can fly in simulated attack.
- d. **The Gun and Sights:**—The gun is a dummy cal. .50 machine gun or standard machine gun with barrel, bolt, and oil buffer groups removed. The sight is the standard iron ring and post or optical (noncomputing) sight.
- e. **The Gun Mount:**—The mount consists of any stable structure adapted to swivel the gun 180°.
- f. **Recording Device:**—The range is to be equipped with the Automatic Range Estimation Recorder Device, information concerning which may be obtained from Training Aids Division, No. 1 Park Avenue, New York City.
- g. **Communications:**—As a safety precaution, two-way air-to-ground communications will be established between the control house and the attacking aircraft.

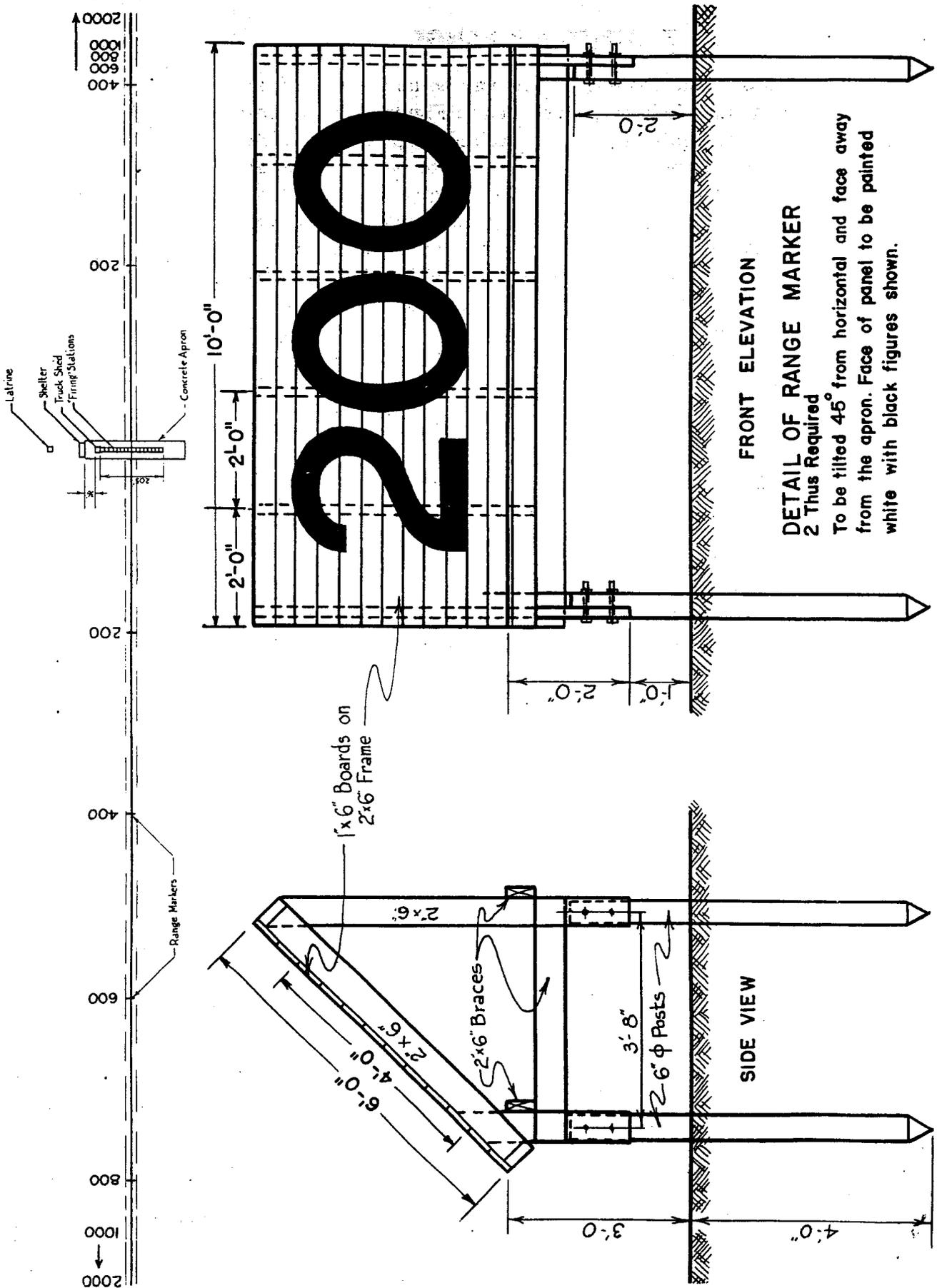


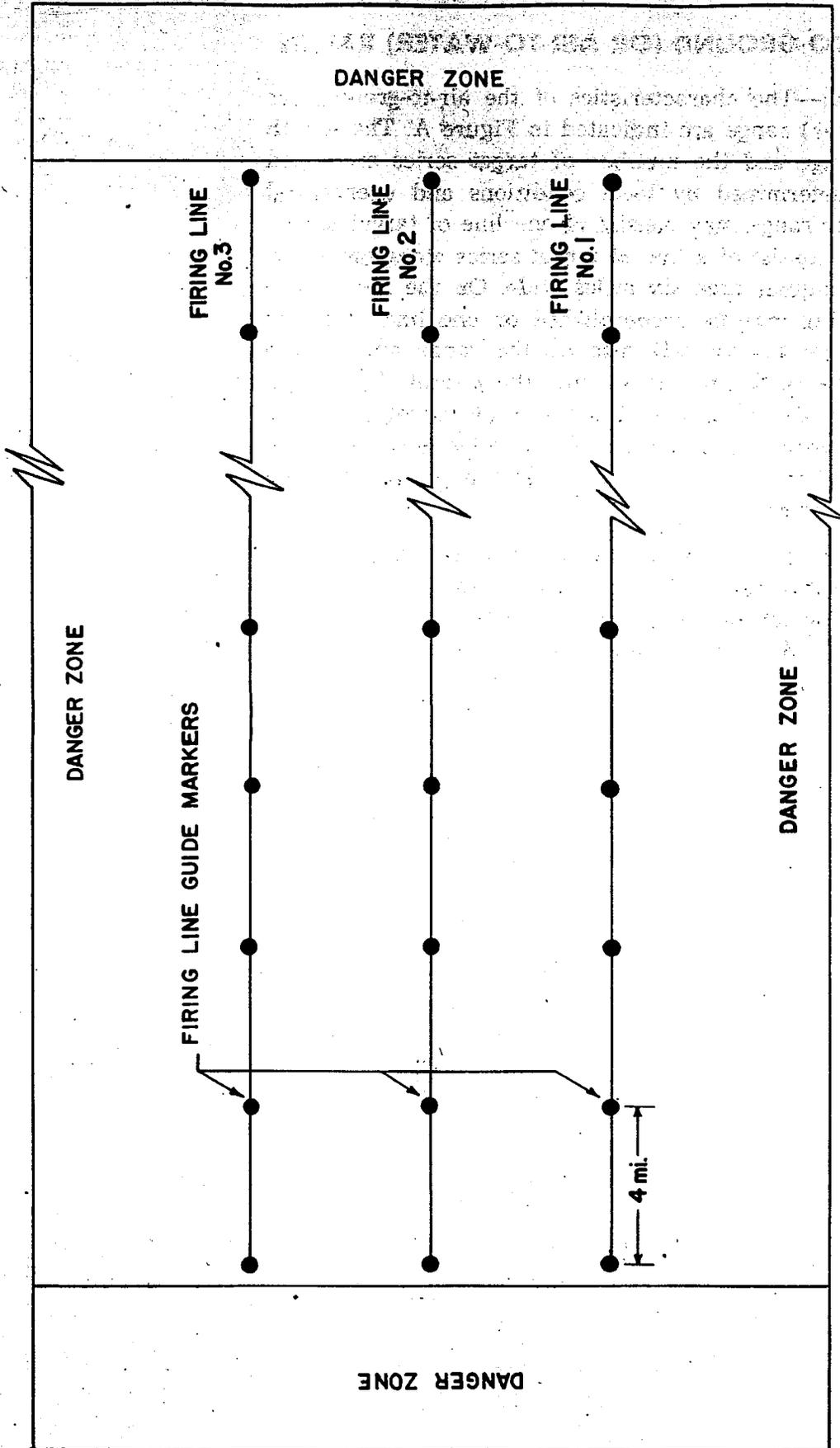
Figure A. Layout of Range Estimation Range and Detail of Range Marker

## 7. AIR-TO-AIR RANGE

- a. **The Range:**—The air-to-air range may be laid over land or water. A suitable range, illustrated in Figure A, may consist of a rectangular area of any desired length along which are indicated one or more firing lines to permit firing at a tow target from one side of the aircraft while flying up the range and firing from the other side while flying down the range. Markers to guide the towing aircraft will be constructed approximately every four miles along the firing line. Danger zones will be designated on the four sides of the range. The size of the zones will be determined by the altitude and true airspeed of the firing aircraft (see Figure B in Air-to-Air Range for Fixed Gunnery). It is not necessary to alter the layout of the air-to-air range for use with frangible bullets.
- b. **The Target:**—The target, attached to a towline, is the A-6-A or A-10 banner type, or the A-7 sleeve type target. The sleeve type target is less desirable, however, owing to its smaller scoring area and to the fact that the cloth shreds at tow speeds exceeding 150 mph. On training installations prepared to make use of frangible bullets, the tow target will be replaced by the RP-63 target ship.



*See also  
1-1-1*



TYPICAL LAYOUT OF AIR-TO-AIR RANGE  
 SIZE OF DANGER ZONES WILL BE DETERMINED BY ALTITUDE AND TRUE AIR  
 SPEED OF FIRING AIRCRAFT

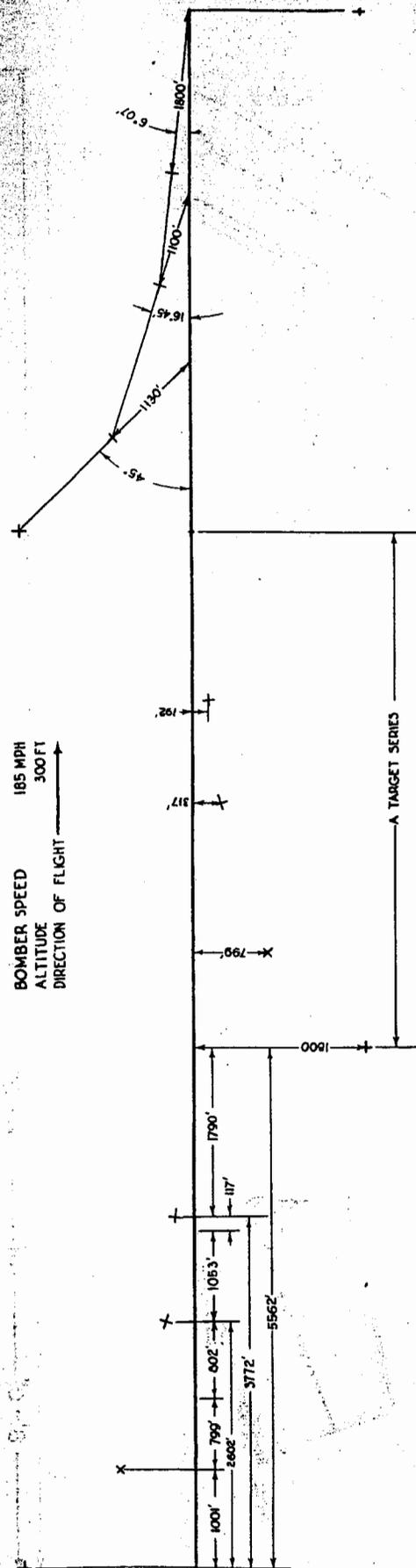
Figure A

### 8. AIR-TO-GROUND (OR AIR-TO-WATER) RANGE

- a. **The Range:**—The characteristics of the air-to-ground (or air-to-water) range are indicated in Figure A. The length of the range and the number of target series employed will be determined by local conditions and operational needs. The range may consist of one line of target series, or it may consist of a line of target series along each side of a rectangular area six miles wide. On the latter type range, firing may be accomplished on one line of target series while the aircraft flies up the range and on the second line of target series while the aircraft flies down the range. On all air-to-ground and air-to-water ranges, a danger zone of a minimum of five miles must be established beyond each firing line and at the end of each line of target series.
- b. **The Target:**—On the air-to-ground range, the double-sided, bill-board type target, illustrated in Figure B, is used. On the air-to-water range, the target, raft type constructed and anchored to withstand tides and waves, is of any desired design.

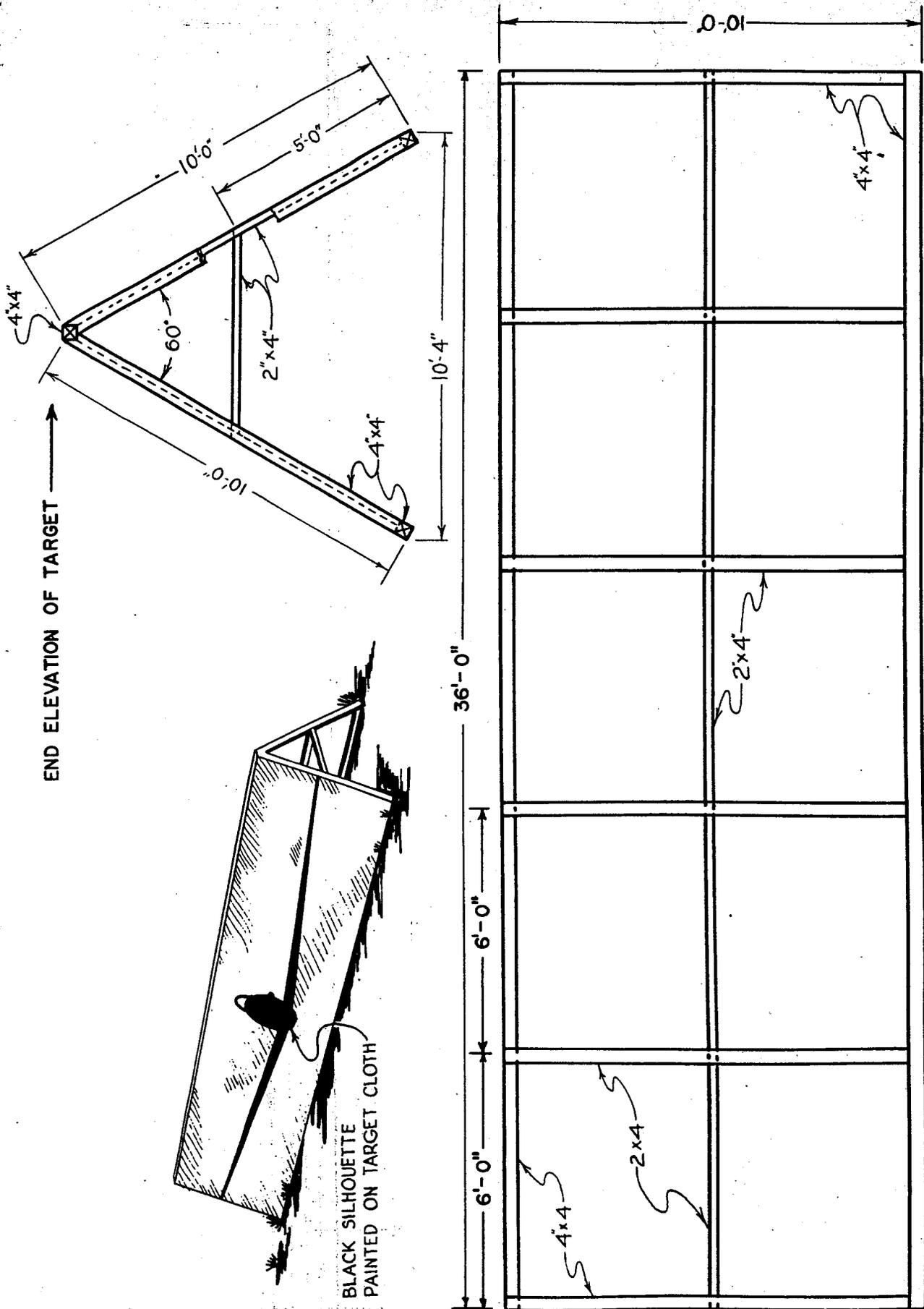
*See also  
1-2-1*

DANGER ZONE



BOMBER SPEED 185 MPH  
ALTITUDE 300 FT  
DIRECTION OF FLIGHT →

Figure A. Layout of Air-to-Ground Range



END ELEVATION OF TARGET

FRONT ELEVATION OF TARGET

BLACK SILHOUETTE  
PAINTED ON TARGET CLOTH

Figure B. Double-Sided, Billboard Type Target

## Section III

# HORIZONTAL BOMBING RANGES

### INTRODUCTION

- a. **THE RANGES:**—There are three types of horizontal bombing ranges:
1. A range for radar bombing.
  2. Two ranges for horizontal visual bombing:
    - (a) A range for use with practice type bombs
    - (b) A range for use with tactical type bombs(Combat target ranges have been found to have little training value and to be excessively expensive to construct and to maintain.)
- b. **GENERAL:**—The following factors should be considered in the selection and construction of each of the two types of horizontal bombing ranges:
1. Bombing ranges should be so located that populated centers will be avoided in the line of flight to and from the target as well as around the target area.
  2. Depending upon the types and quantity of bombs to be used, the range site should be selected and fenced to prevent injury to adjoining property and livestock, thus minimizing liability of injunction by property owners.
  3. In the selection of a range site, the availability of land for future expansion of range facilities and for future expansion of populated areas should be taken into consideration.
  4. The range site should be located on terrain which will afford maximum visibility and facilitate bomb salvage and maintenance.
  5. The range site should be so located that all the range series, while conveniently accessible for maintenance, will not be so located with respect to one another as to be confusing to air personnel.
  6. The terrain should be sufficiently well drained to permit heavy traffic, and the soil should be, whenever possible, of such color that contrasting colors may be used in describing target lines and circles.
  7. Two-way radio communications should be established in the range area either by fixed radio transmitting and receiving stations or by adequate portable equipment. Adjacent telephone lines may be used as a secondary means of communication.

8. The procurement of privately owned land for training purposes will comply with AR 100-61.

c. SAFETY PRECAUTIONS —

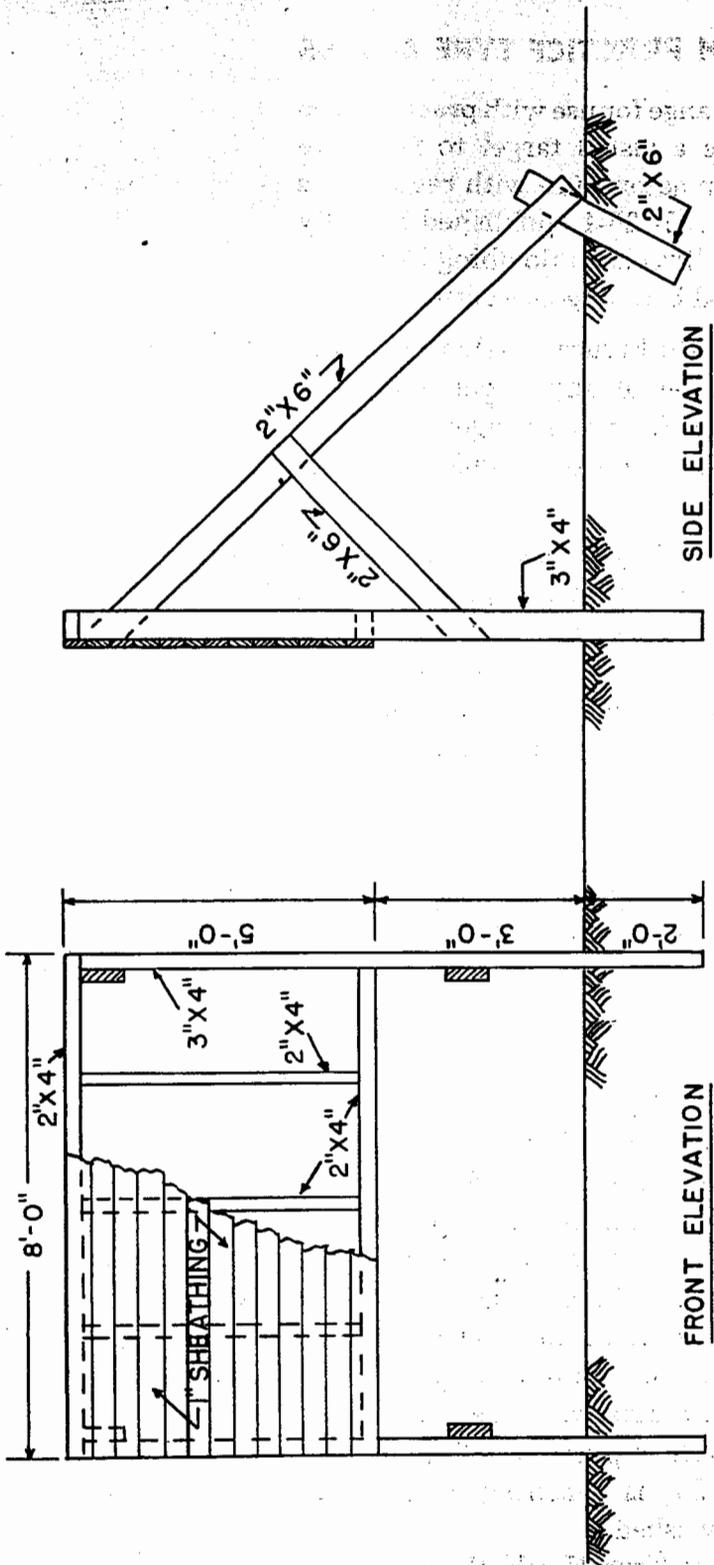
1. General safety precautions to be followed on ranges for use with practice and tactical bombs are outlined in AR 750-10.

2. A target fence, adequate to prevent livestock and trespassers from entering the target area, will be constructed.

3. To reduce fire hazards, fire guards 30' wide, coinciding with the circumference of the range area, will be cleared of vegetation. Adequate fire-fighting facilities will be located centrally among the range series.

4. Range warning markers, illustrated in Figure A, will be placed at one-half mile intervals around the circumference of the range and outside the 30' fire guards.

5. Provisions for marking a closed target are outlined in AAF Letter 62-5, dated 19 January 1945.



**DANGER KEEP OUT** → 9" Red  
 U. S. ARMY AIR FORCE BOMBING RANGE → 5" Black  
 Do Not Proceed Beyond This Point  
 Bombing Operations in Progress Day & Night → 4" Caps & 3" Lens case

**WARNING** → 8" Red  
 Picking Up Bombs or Ammunition Parts is → 4" Caps & 3" Lens case

**EXTREMELY DANGEROUS** → 5 1/2" Red  
 And is Prohibited By Law → 4" Caps & 3" Lens case

Figure A. Range Marker and Detail of Warning Signs

## 1. RANGE FOR USE WITH PRACTICE TYPE BOMBS

- a. **Purpose:**—The purpose of the range for use with practice type bombs is twofold: to provide a visual target to facilitate qualification of bombardiers in accordance with regulations outlined in AAF Manual No. 125-126-4 (published initially as Air Forces Manual No. 62) "Precision Bombing Practice" and to develop skills in tactical bombing procedures.
- b. **The Range:**—The range area (see Figure A) should be sufficiently large so that the center of any target placed on it will be a minimum of 2500' from the range boundary. (For bombing from 25,000' and above, a 5000' radius is advisable.)
- c. **Range Series:**—A range series may consist of from two to twelve single-target ranges dispersed in a pattern which best facilitates maintenance and training (see Figure B). The most practical distance between ranges in a series is from 12 to 15 miles; however, such factors as the speed of the aircraft used in training and the availability of land will alter the distances within a range series. It is important that the altitude variance within a particular range series be kept to a minimum and that it not exceed 50'. There should be no peaks or high plateaus within a range series, and each target should be readily visible from the bombing approach heading.
- d. **The Target:**—The target design described in Figure C is in wide use. The legs indicate N/S and E/W in True directions. Four reference squares are placed along each leg at 100' intervals to facilitate scoring. While the 100' circle is an essential feature of the target, the 200' and 500' circles should be described, wherever possible, to facilitate scoring. For bombing above 15,000', it is recommended that only the 200' and the 500' circles be described. The legs and circles of the target are constructed of crushed rock or dirt sprayed with white paint, whitewash, or with a contrasting color to the surrounding soil (see Figure D). In the center of the target circle, a pyramid, 12' high with a base approximately 30' x 30', is constructed of native earth, or wood, and is whitewashed.
- For the purpose of indicating True North, the north leg is extended within the 100' circle toward the target center a distance of 40'. At the extreme end of the north leg, a numeral (either Arabic or Roman) of whitewashed dirt or crushed rock (see Figure D) is set with its base toward the target center. For altitudes below 15,000', a 75' numeral

is adequate; for greater altitudes, a 150' numeral should be constructed.

**e. Night Illumination of Targets and Numerals:—**

1. The Source of Power:—The source of power for night target and numeral illumination, regardless of the type scoring device used, is a 5KVA generator (Koehler), or adequate substitute, which is placed a minimum of 1000' from the center of the target.

2. Target Lighting:—Lighting must be so controlled as to make targets visible to training aircraft and to prevent excessive illumination which will blot out the bomb-sight cross-hairs. When the photographic scoring device is used, target lighting must be of sufficient intensity to be photographed from a maximum altitude. Light bulbs will be mounted on posts eight feet long at intervals of  $22\frac{1}{2}^{\circ}$  around the circle (see Figures D and E). For altitudes up to 15,000, 75 watt bulbs on the circle are adequate. A 150 watt bulb is placed at the four intersections of the 100' circle with the N/S and E/W legs.

3. Numeral Lighting:—The target numeral is illuminated with regular transparent (not colored) 25 watt bulbs spaced five feet apart (see Figure F). A flasher system (three seconds on, one second off) on the illuminated numerals is recommended and can be accomplished by placing a flasher type switch in the power line to the numeral.

**f. Scoring Devices:—**

1. Photographic Scoring Device:—The only ground construction problem involved in the photographic scoring device is the marking of the legs and circles of the target with colors which contrast the surrounding soil.

2. Sonic Scoring Device:—The sonic scoring device is readily adapted to the targets described above. Owing to the bulk of details available on sonic scoring, it has been considered advisable to describe the construction and the operation of this device in a separate publication. Information concerning sonic scoring and the proposed publication may be obtained from Air Technical Service Command, Wright Field, Dayton, Ohio.

**g. Range Facility Buildings:—**

1. Generator House:—Details for the building used to house the power plant, fire-fighting equipment, tools, and target miscellany are shown in Figure G. (In hot climates, more ventilators in the generator house will be required

than are indicated in the drawing.)

2. Range Fire Station:—A building adequate to house fire truck, fire personnel, and radio range equipment should be located centrally among the range series.

Information regarding the location of the range series and the location of the Range Fire Station should be obtained from the Range Management Plan. The Range Management Plan should be reviewed to determine the location of the Range Fire Station and the location of the Range Series. The Range Management Plan should be reviewed to determine the location of the Range Fire Station and the location of the Range Series.

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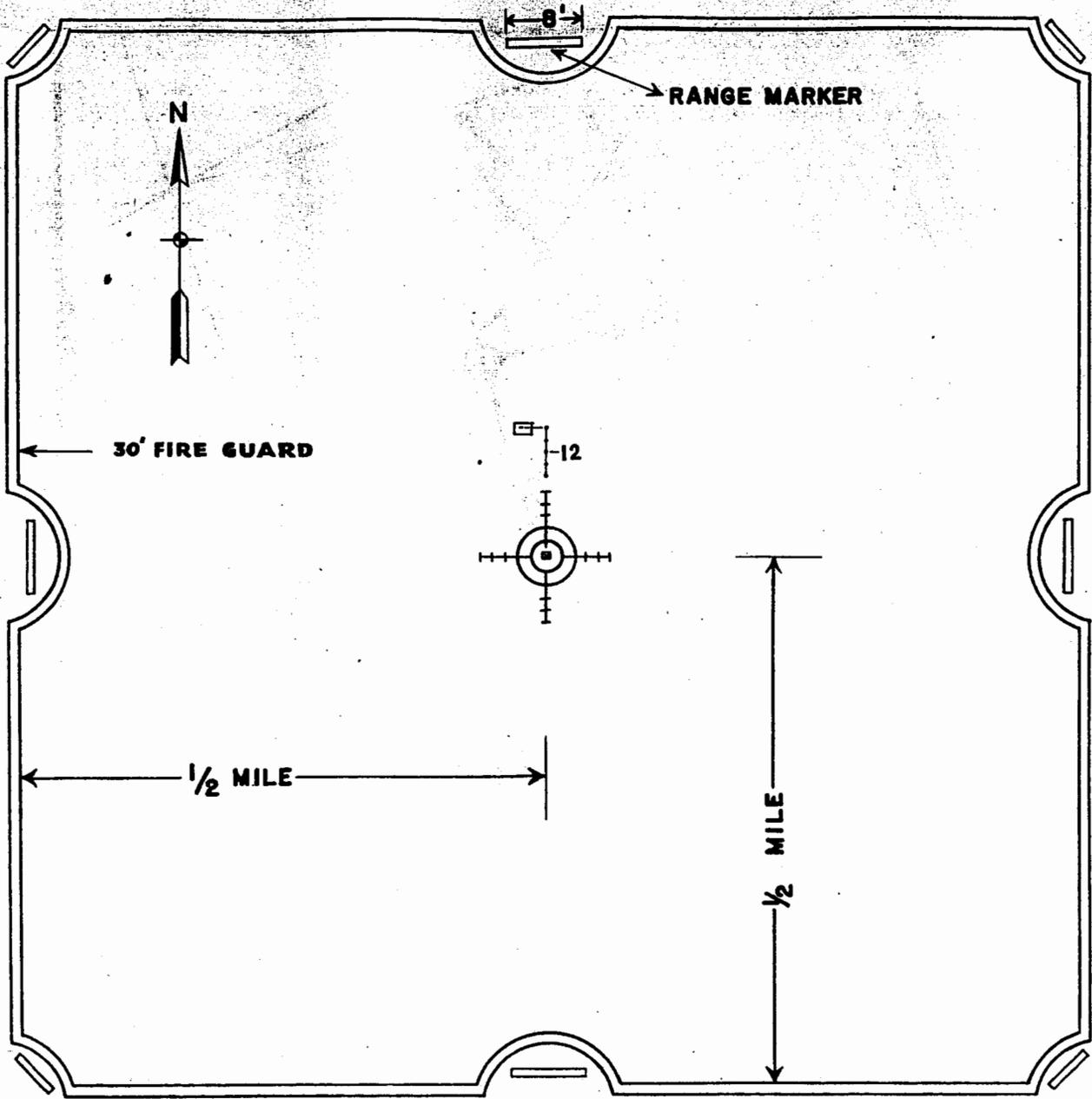


Figure A. Layout of Practice Type Bomb Range



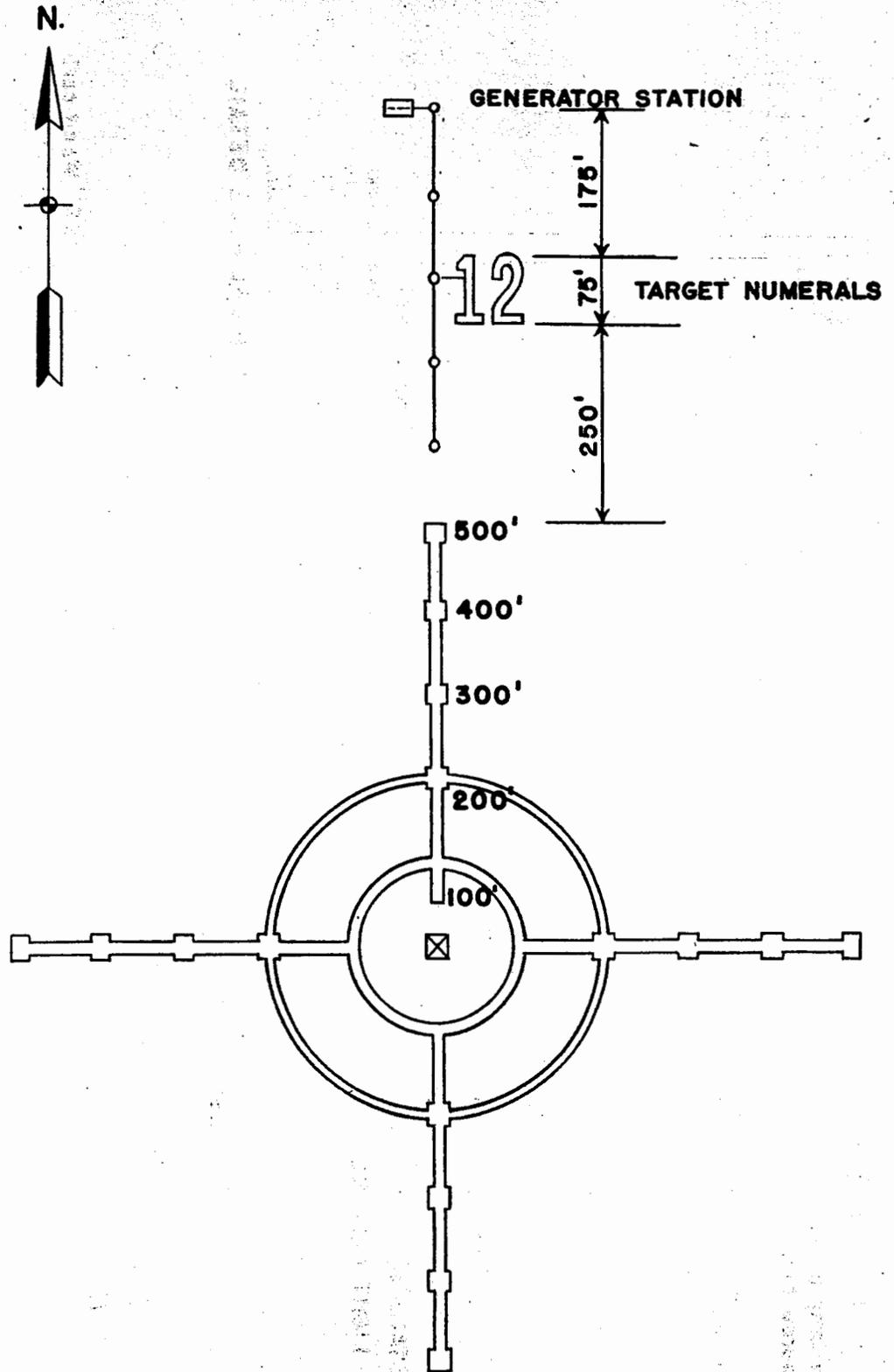
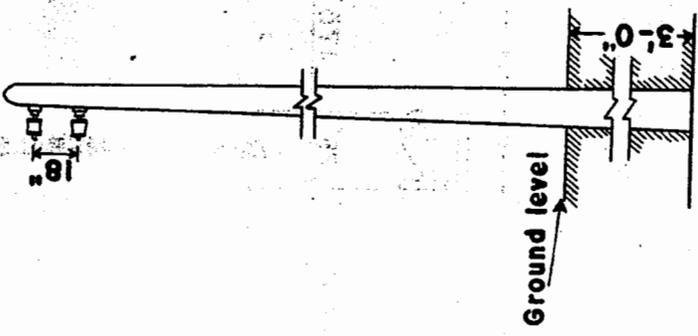
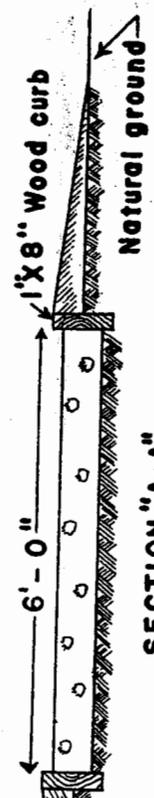


Figure C. Practice Type Bomb Range Day Target

Screw type insulators

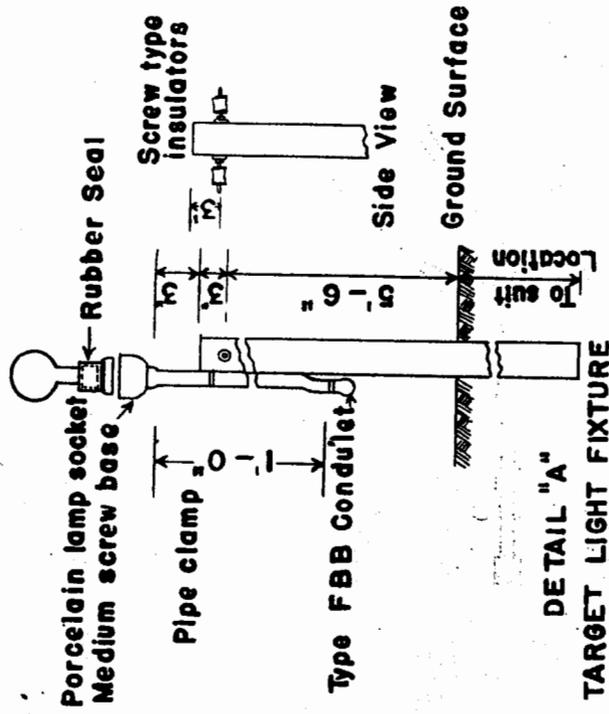


TYPICAL POLE DETAIL



SECTION "A-A"

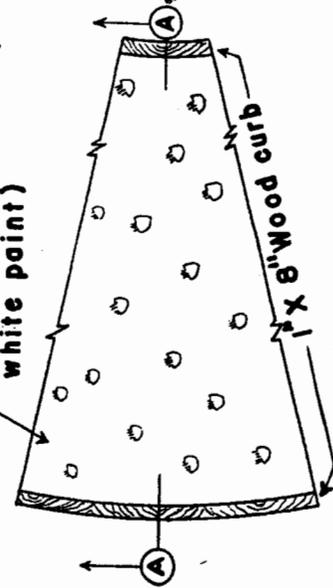
SECTION "B-B" SIMILAR



DETAIL "A"

TARGET LIGHT FIXTURE

Rock filling of as near white texture obtainable (sprayed white paint)



TYPICAL SECTION OF CIRCLE MARKING

Figure D. Details of Circle Marking and Lighting Fixtures

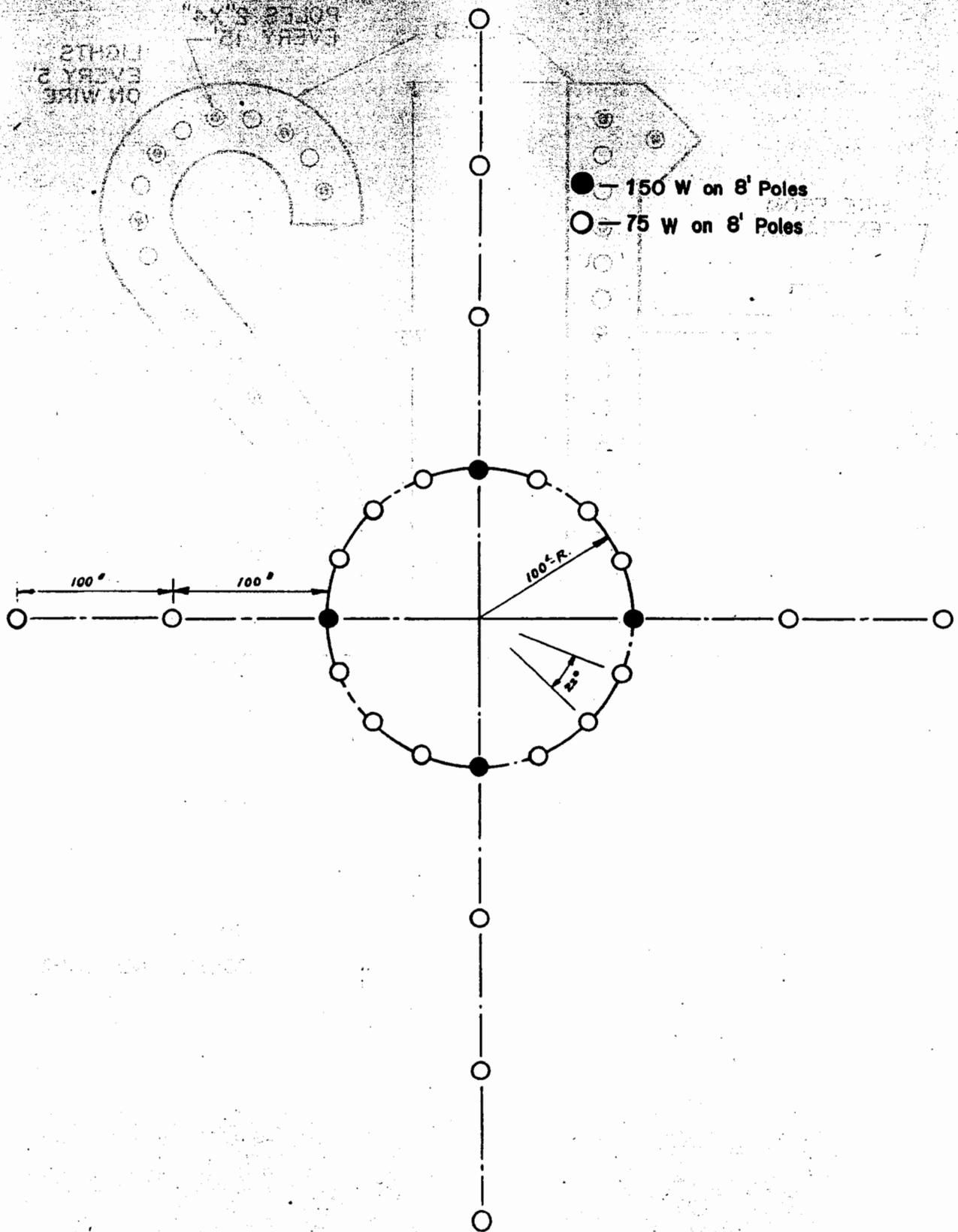
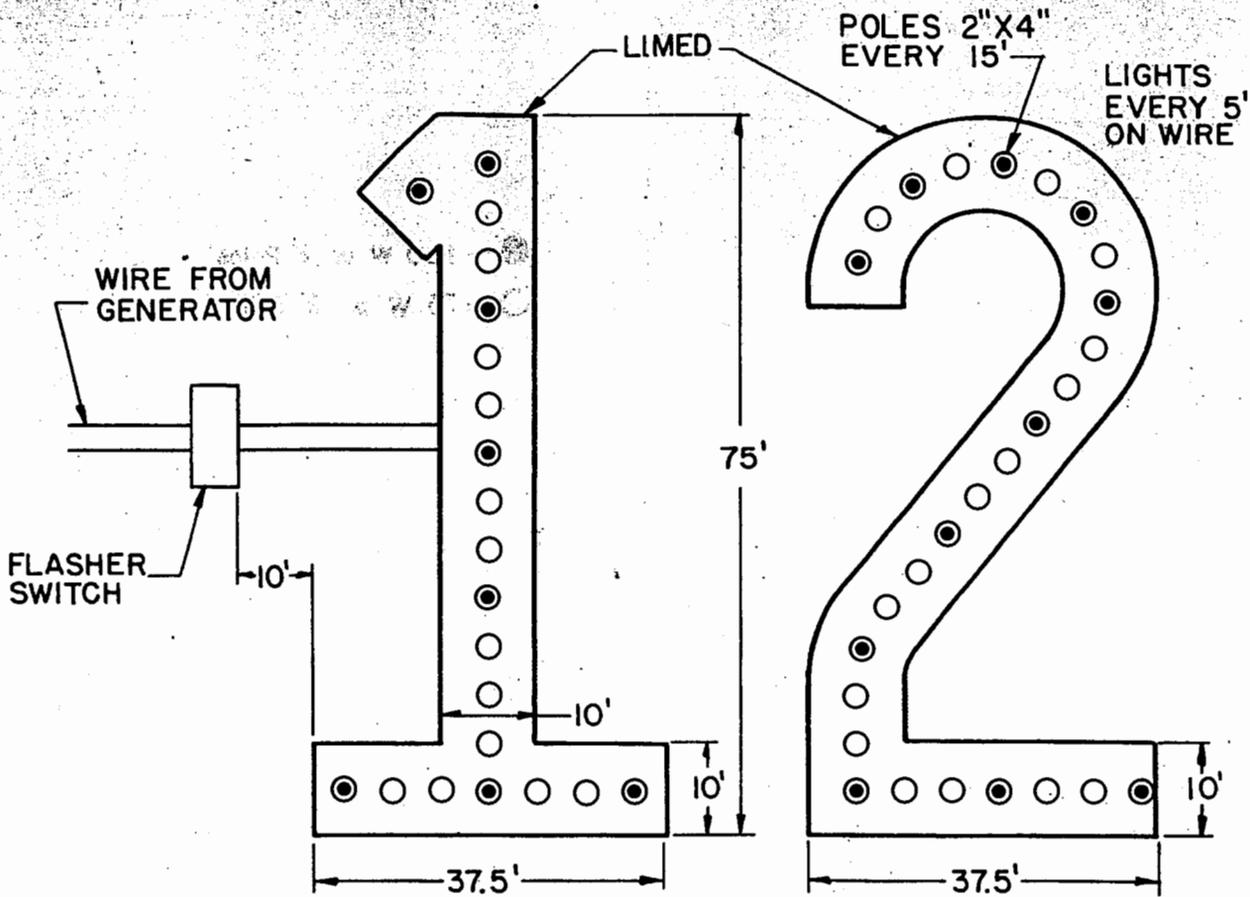


Figure E. Lighting Arrangement for Practice Type Bomb Range Night Target



- LIGHTS
- POLES AND LIGHTS

Figure F. Numeral Layout

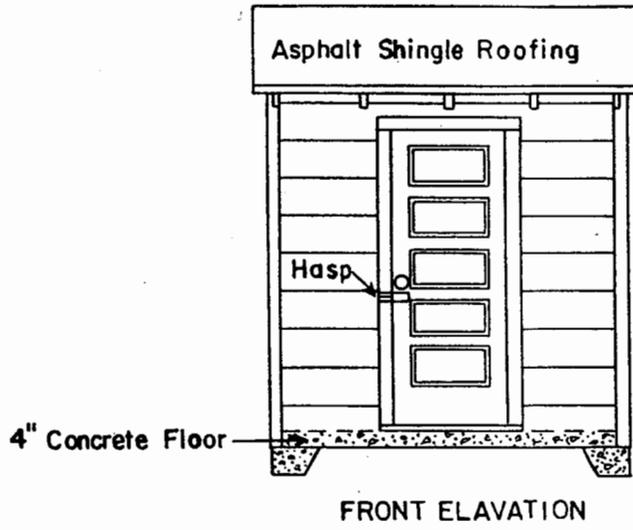
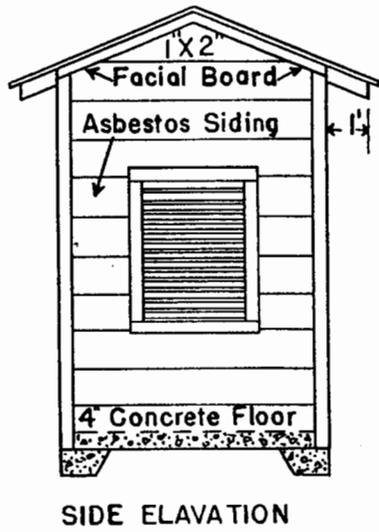
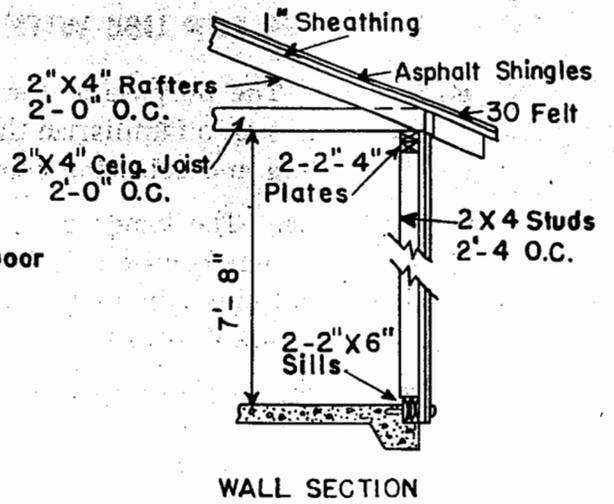
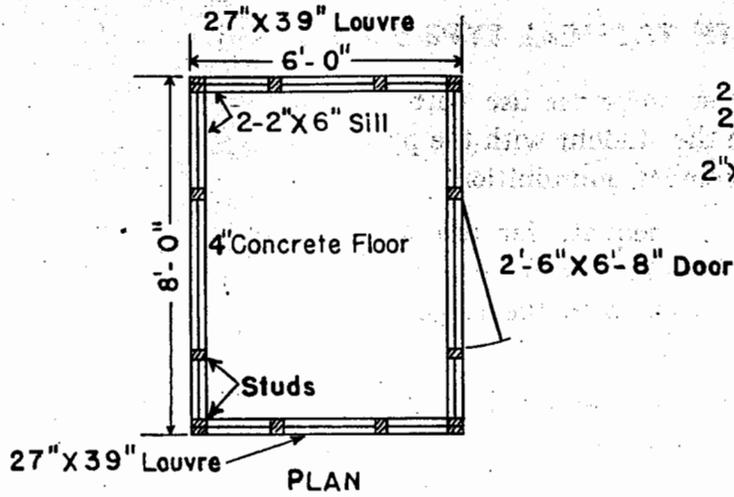


Figure G. Generator House

## 2. RANGE FOR USE WITH TACTICAL TYPE BOMBS

- a. **Purpose:**—The purpose of the range for use with tactical type bombs is to familiarize the student with the problems of handling and releasing combat ammunition.
- b. **The Range:**—The range area, adequate for use with 100 lb. demolition bombs below 15,000', will be a minimum of one and one-half miles square with the target located centrally (see Figure A).
- c. **The Target:**—The target is a cross-shaped ground area scraped free from vegetation and whitewashed. A night target is not used on this type range.
- d. **Scoring Device:**—The photographic scoring device is used with tactical type bombs.
- e. **Range Facility Buildings:**—The range facility buildings are the same as those used on the practice bomb range. In cases where ranges are located great distances from the base, barracks for maintenance crews should be constructed.

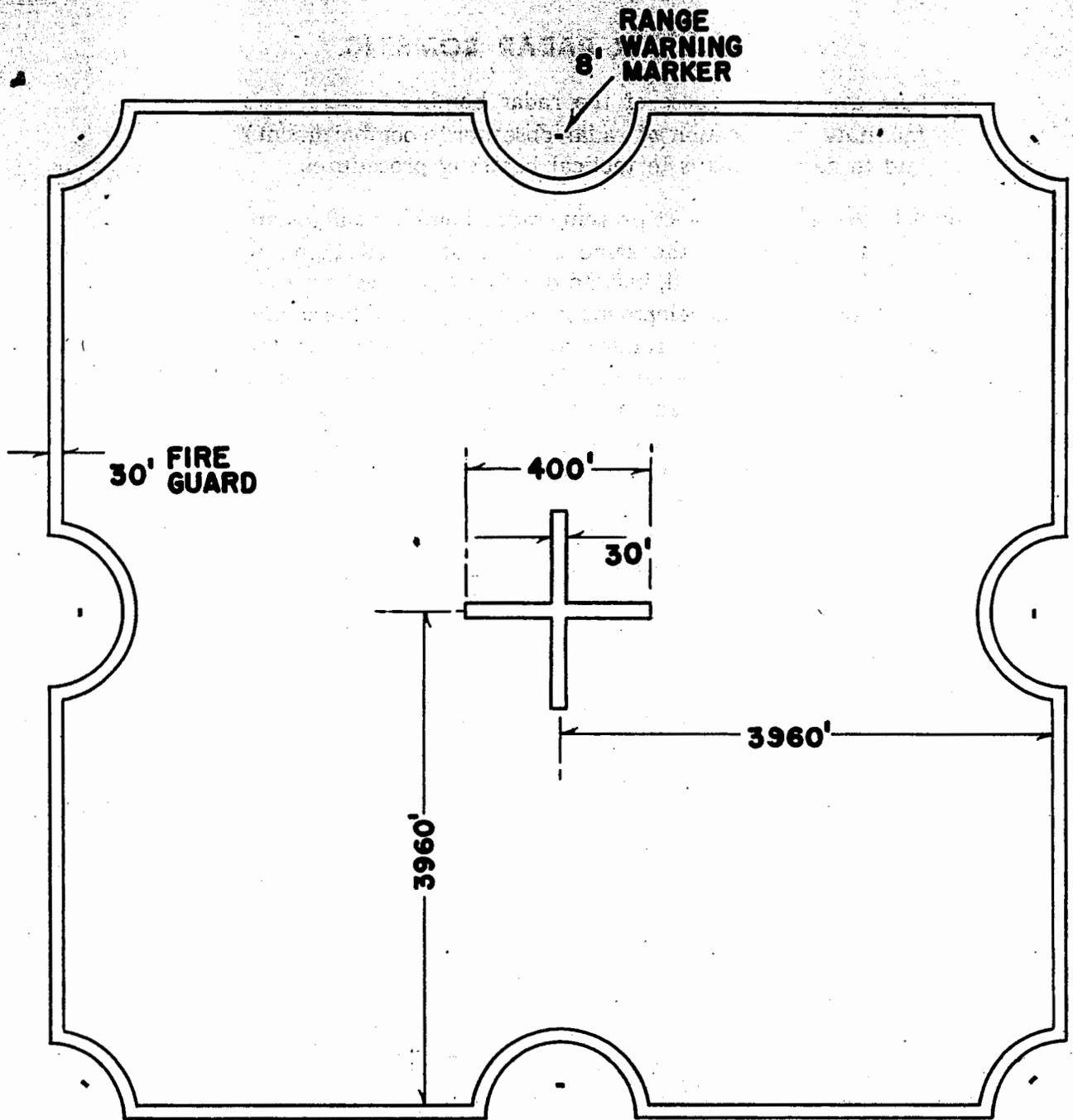


Figure A. Layout of Tactical Type Bomb Range

### 3. RANGE FOR RADAR BOMBING

- a. **Purpose:**—The purpose of the radar bombing range is to facilitate qualification of radar observers (bombardment) and to develop skills in tactical bombing procedures.
- b. **Selection of Range:**—At present, radar bombing ranges are not constructed in the same sense that visual bombing ranges are constructed; instead of being built, radar ranges are found. In the development of the two types of horizontal visual bombardment ranges, the major problem is the selection of a suitable terrain. Once that terrain is located, the construction of an artificial target thereon and the development of necessary safety devices are comparatively simple. In the case of radar bombing ranges, however, the major problem is usually selection of a suitable target, generally a target of opportunity located within reasonable distance of the station where crews are being trained.
- c. **Targets:**—If either practice or tactical type bombs are to be used, substantially the same factors must be considered and the same precautions observed as in the case of horizontal visual bombardment ranges (see *Introduction to HORIZONTAL BOMBING RANGES*, paragraphs b and c). However, inasmuch as radar bombing is inherently less accurate than visual bombing, it is recommended that the range area for radar bombing should be sufficiently large so that the center of any target placed on it will be a minimum of three miles from the range boundary. Obviously, targets must be far enough removed from centers of population or from valuable property or facilities of any kind to preclude possibility of damage. This virtually limits targets to natural topographical features of a type sufficiently different from the terrain immediately surrounding them to show a return on the radar scope—uninhabited islands, rivers, lakes, or dry desert lakes. A partly sunken ship makes an excellent target in bodies of water, provided enough of the hull protrudes to return an echo. At this stage of experimentation, no conclusion has been reached concerning the intensity of radar return of piles of scrap metal and wrecked aircraft distributed over dry desert lakes.
1. **Targets for Camera Bombing:** — Because of the extreme difficulty of locating a sufficient number of suitable natural targets, most radar bombing practice is now done with cameras rather than with actual bombs. Camera

bombing has four distinct advantages: (a) it increases the number and variety of possible targets, (b) it eliminates the need for observing elaborate precautions, (c) it permits selection of targets most likely to be bombed in actual tactical operations, (d) bombing with camera, to a much greater extent than bombing with practice type or demolition bombs, permits a comprehensive analysis of results such factors as range error, deflection error, and error. Any target suitable for actual bombing can be used, and, in addition, camera bomb targets include cities, steel or concrete bridges, airfields, other military installations as railroad yards and vessels or almost any object which will show up on the ground.

2. Artificial Targets: — Various attempts have been made to use artificial targets for radar bombing practice with only moderate success. All such efforts have been based around the use of a corner reflector or a set of reflectors arranged in a definite pattern. Up to the present such reflectors have been mounted on rocks or on anchored barrels, and (by the RAF) on barges. The principal disadvantage of reflectors is the expense of installing them. That expense is warranted for camera bombing since so many other targets are usually readily available. Moreover, when practice or tactical type bombs are used, the target of the target may be completely destroyed by a direct hit or even a near miss which knocks the target out or so distorts it as to produce a false return on the scope.