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**Search Cruiser 8-Inch Turrets**

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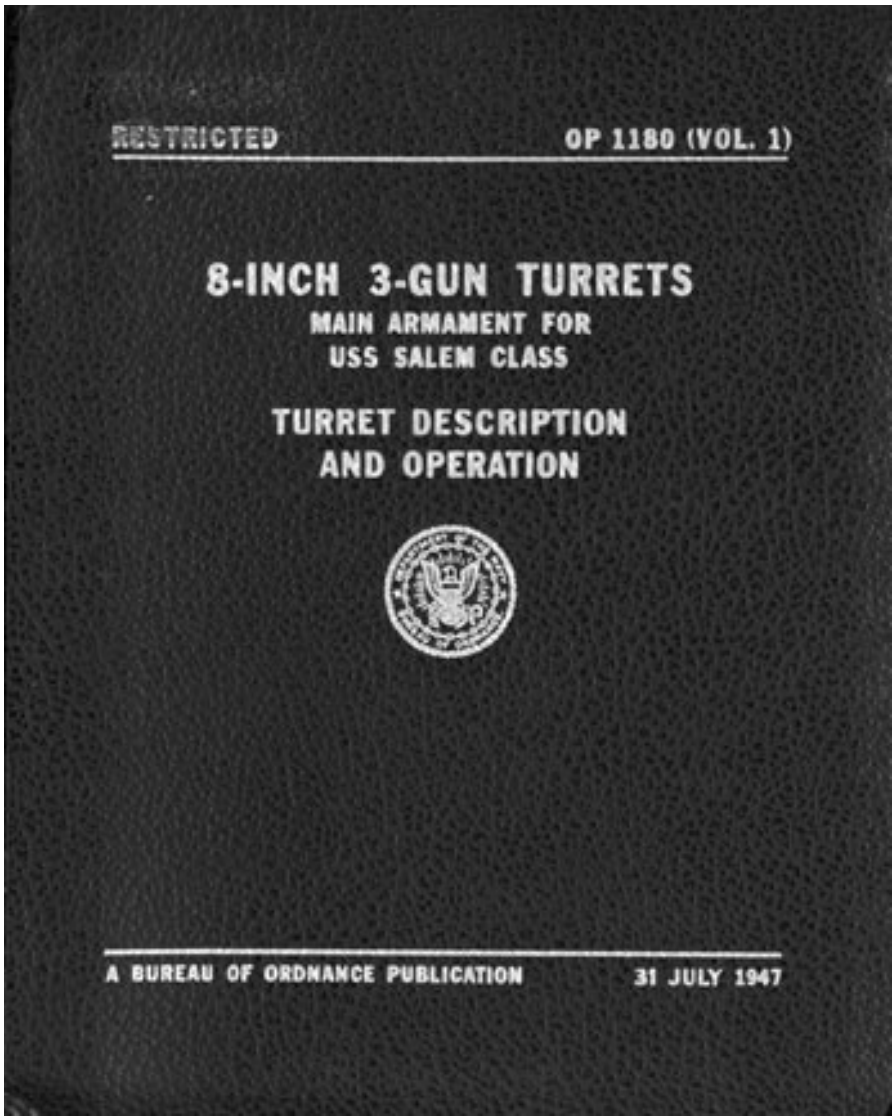


OP 1180 (Vol. 1)

# 8-INCH 3-GUN TURRETS

## MAIN ARMAMENT FOR USS SALEM CLASS

## TURRET DESCRIPTION AND OPERATION

Declassified per ORD 9152/552 RBB of 30 Jul '68

31 JULY 1947

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NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON 25. D. C.

31 July 1947

ORDNANCE PAMPHLET 1180 (VOLUME 1)

TURRET DESCRIPTION AND OPERATION,
8-INCH THREE-GUN TURRETS, USS SALEM CLASS

1. Ordnance Pamphlet 1180 (Volume 1) describes and provides operating and maintenance instructions for the turret of the rapid-fire automatic 8-inch guns of heavy cruisers of the USS SALEM class. It includes appended general engineering data and Safety Precautions applying to the guns and to all other turret installations.

2. This publication, together with the references of paragraph three, provides complete information for all installations of the turrets. It is to be used by operating personnel, maintenance personnel ashore and afloat, personnel of installing activities, inspectors, and the Advanced Technical Service Schools, and all other training activities providing instruction concerning the gun and its mount services.

3. Ordnance Pamphlet 1180 (Volume 1) is one of a series of six volumes describing the turret, turret operation, and all of the turret installations. The other volumes are designated:

OP 1180 (Volume 2)-Guns and Slides
OP 1180 (Volume 3)-Elevating and Training Gear Drives and Controls
OP 1180 (Volume 4)-Ammunition Stowage and Hoist Equipment

OP 1180 (Volume 5)-Turret Fire Control and Electrical Installations
OP 1180 (Volume 6)-Tools, Accessories, and General Instructions for Turret Installations

4. This publication supersedes two volumes of a limited blueprint edition issued by the Naval Gun Factory for interim use of the Advanced Technical Service Schools, designated: OP 1180 (Preliminary), Chapters 1 and 2, respectively.

5. This publication is RESTRICTED and shall be safeguarded in accordance with the security provisions of U. S. Navy Regulations, 1920, Article 76.

G. F. HUSSEY, JR.
Vice Admiral, U. S. Navy
Chief of the Bureau of
Ordnance

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**Chapter 2-Turret Operation**

**Appendix**





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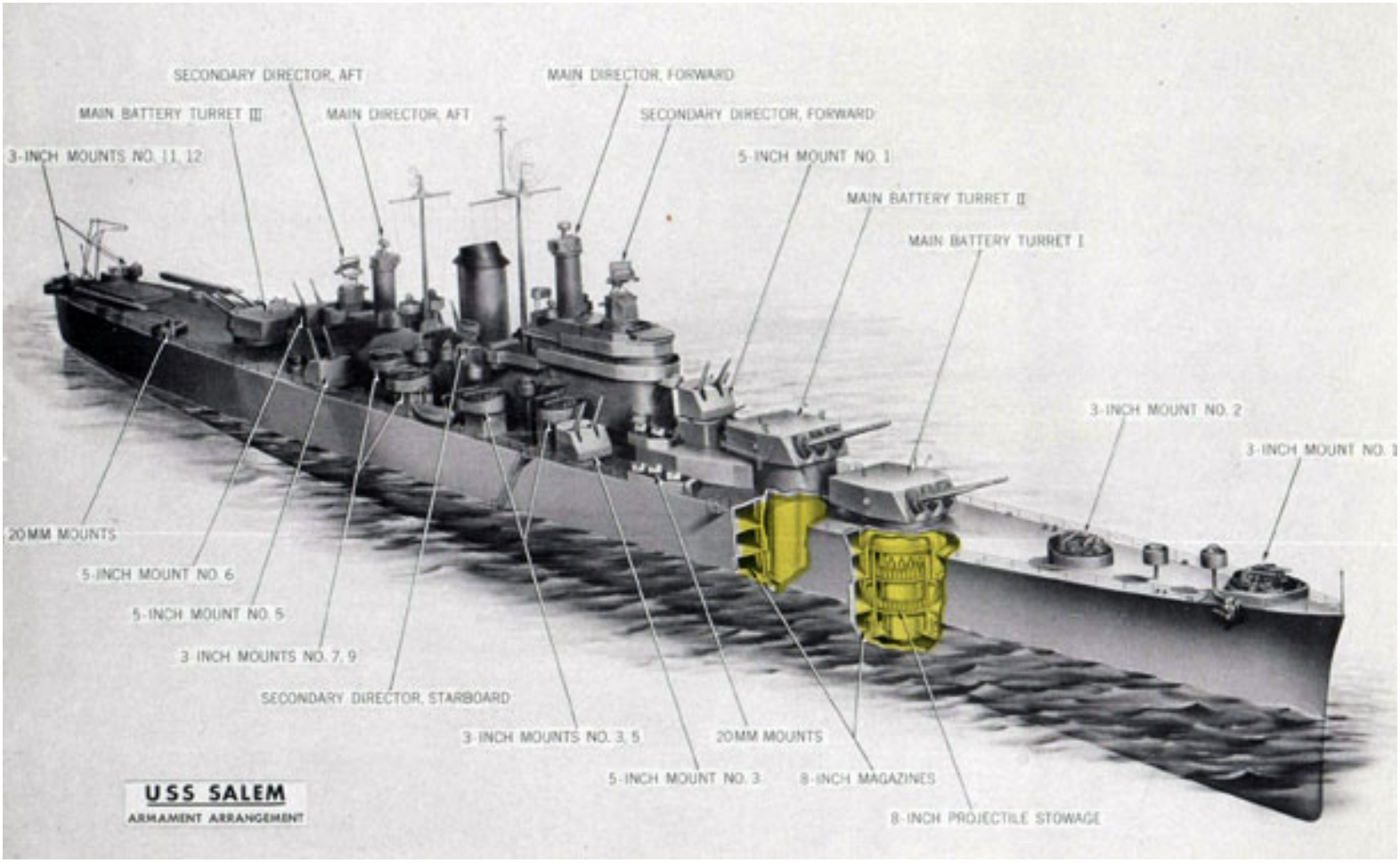


USS Salem-Armament Arrangement

# 8-INCH 3-GUN TURRETS

## USS SALEM CLASS

## INTRODUCTION

### The ship

USS SALEM is the first of a new class of heavy cruisers. The hull is larger; the belt and deck armor are more extensive; and the fire power is greater than in ships of the BALTIMORE and earlier classes. The displacement is 17,000 tons. Over-all length is 716.5 feet; the beam 76.5 feet.

### The armament

Antiaircraft, secondary, and main batteries and fire control installations include new ordnance types and new arrangements.

**Antiaircraft batteries**. Forty-eight minor-caliber guns comprise the defensive antiaircraft armament. These guns are arranged in two batteries; twelve twin mounts of 20-millimeter machine guns are symmetrically located on the weather deck and in the superstructure; twelve twin mounts of 3-inch/50 caliber guns are emplaced on the weather deck and on pedestals above it.

The 3-inch mount is a new automatic, rapid-fire type, tactically replacing the 40-millimeter antiaircraft installations of earlier ships. The mounts are located and arranged for independent or divided fire control. Four mounts are on the weather deck-two forward on centerline, and two aft at the transom. Eight are amidship-four port and four starboard-in positions that permit low-angle fire over adjacent mounts of the secondary Main battery. The main battery consists of three 8-inch 3-gun turrets, described in this ordnance pamphlet. They are rapid-fire, automatic turrets of an entirely new design.

All three turrets are located on centerline, the gun houses of turrets I and III being immediately above the weather deck while that of turret II is at the level of the first superstructure deck. Turret centers are 157.5, 205.5, and 538.5 feet (for turrets I, II, and III respectively) from the bow. Gun trunnion axes, in the same order, are 27 feet 9 inches, 36 feet 2 inches, and 28 feet 9 inches above the 24-foot waterline. These positions and the large arcs of train provide fire concentration of nine guns on either beam, six forward and three astern.

All turrets are virtually identical. Their gun house and below-deck structures, emplacements, magazines, and Ordnance installations only differ in minor details, adapting each to its ship location and the fire control plan.

Turret structural and space arrangement plans however differ substantially from the conventional turret designs of all previous battleships and cruisers. This difference is due, in part, to the use of semifixed ammunition, for the first time in Ordnance of this size, and, in part, to the design types and details of the guns and the ammunition handling equipment. These ammunition and Ordnance equipment designs have permitted and required omission of flameproof bulkheads separating the guns, the control stations, and the

battery.

**Secondary battery**. Six twin 5-inch, enclosed, dual-purpose mounts, of the same type and arrangement of earlier cruisers, comprise the secondary battery. They are located as follows: two port, two starboard on the weather deck amidship, and one before and one abaft the superstructure, on centerline at the second superstructure deck.

powder service.

The emplacements are conventional foundation structure, barbette, and magazine designs. Their arrangements are quite similar to those of earlier heavy cruisers, differing principally in the magazine stowage provisions and powder-passing scuttles for powder cases instead of powder bags.



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In their Ordnance installations, the turrets are entirely new. The guns operate automatically, and require no attendants in the gun compartment; they fire at three times the rate of the 3-gun turrets of the BALTIMORES. Other features are: comparatively fast gun laying and turret train drives; loading at all angles, while gun laying; substitution of radar range taking equipment for optical rangefinder; local radar train control; automatic fuze setting; and other original fire control arrangements for local and remote control.

**Fire control installations**. The ship's fire control installations comprise extensive arrangement of optical and radar director equipment, together with related computing and stabilizing devices. The system is more complex than that of any prior cruiser. It includes forward and after main battery directors; four secondary battery directors, one each located forward, port, starboard and aft; multiple directors for the 3-inch mounts; and four plotting rooms, two each for main and secondary batteries. Plot switching arrangements permit many variations of control.

Main directors are combination radar and optical rangefinder types, adapted, with their plotting room equipments, for divided turret control or single control of all turrets, using remote automatic or remote indicating control.

Secondary directors are of two types. The ones above the superstructure, on centerline, are combination radar and optical rangefinder types of modified Mk 37 design. The other two are an all-radar type of new variation of a similar design. These directors and their switching circuits are arranged to function as auxiliary directors for the main battery.

The directors for the 3-inch battery are fast-tracking, lead computing, gun sight combinations of radar-ranging and open sight arrangement.



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Next Part

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# Chapter I

## GENERAL DESCRIPTION OF THE TURRET

Each turret consists of the following structural units and equipment installations:

Structural assembly Rotating structure Turret roller bearing Turret circular foundation Ordnance installations Guns Gun laying equipment Ammunition hoists Ammunition stowing equipment Ammunition handling equipment Fire control equipment Auxiliary installations Power supply Heating system Ventilating system Fire protection sprinkling system Turret illumination Communications Compressed air supply systems

## STRUCTURAL ASSEMBLY

The three large units comprising the structural assembly are the fixed and movable parts designated in the profile diagram of figure 1. They are a circular foundation, a rotating structure, and a roller bearing between the two.

The circular foundation consists of parts built into the ship to support and protect the rotating structure. These parts are the foundation bulkhead, barbette, and other fixed elements described on pages 10-13.

The roller bearing is the turret roller bearing assembly described on pages 8-10.

The rotating structure is the part that is seated on the bearing and that mounts and encloses all the ordnance mechanisms and

### Rotating structure

The rotating structure is a steel weldment nearly 45 feet high, weighing 270 tons, consisting principally of the structural plates identified in figure 2. It is a five-story structure erected in the form of a rectangular gun house above a cylindrical assembly of four flats.

The plates identifying the five levels are: the shelf plate at the bottom of the gun house, the pan plate at the bottom of the gun pits, two levels called the upper and lower projectile flats, and, at the lowest level, the powder handling platform. These plates are joined together by a cylindrical bulkhead and gun girders between the shelf and pan plates, a id another cylindrical

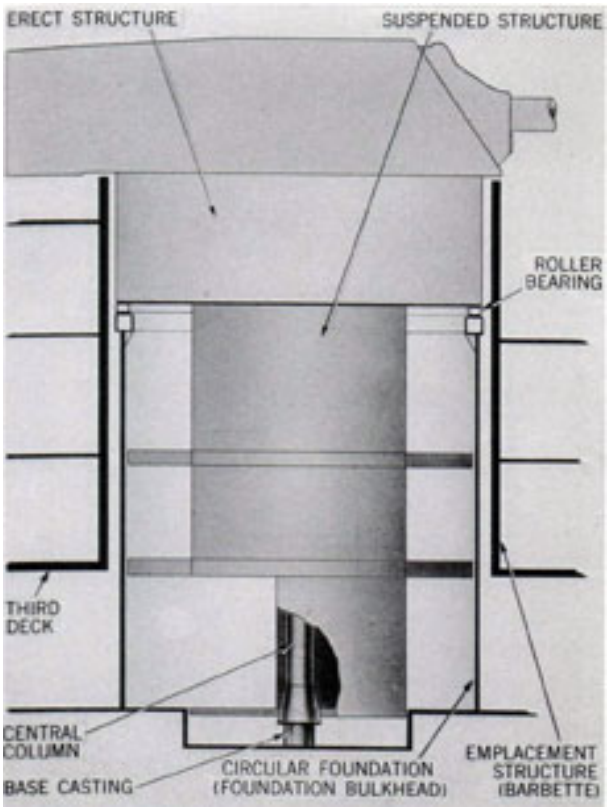


*Figure 1. Turret Structure Fixed and Rotating Elements*

auxiliary installations. This rotating structure is the armored gun house, the structure beneath the gun house, and the attached hatches, doors, ladders, trusses, and special devices described in the paragraphs which follow.

**1**

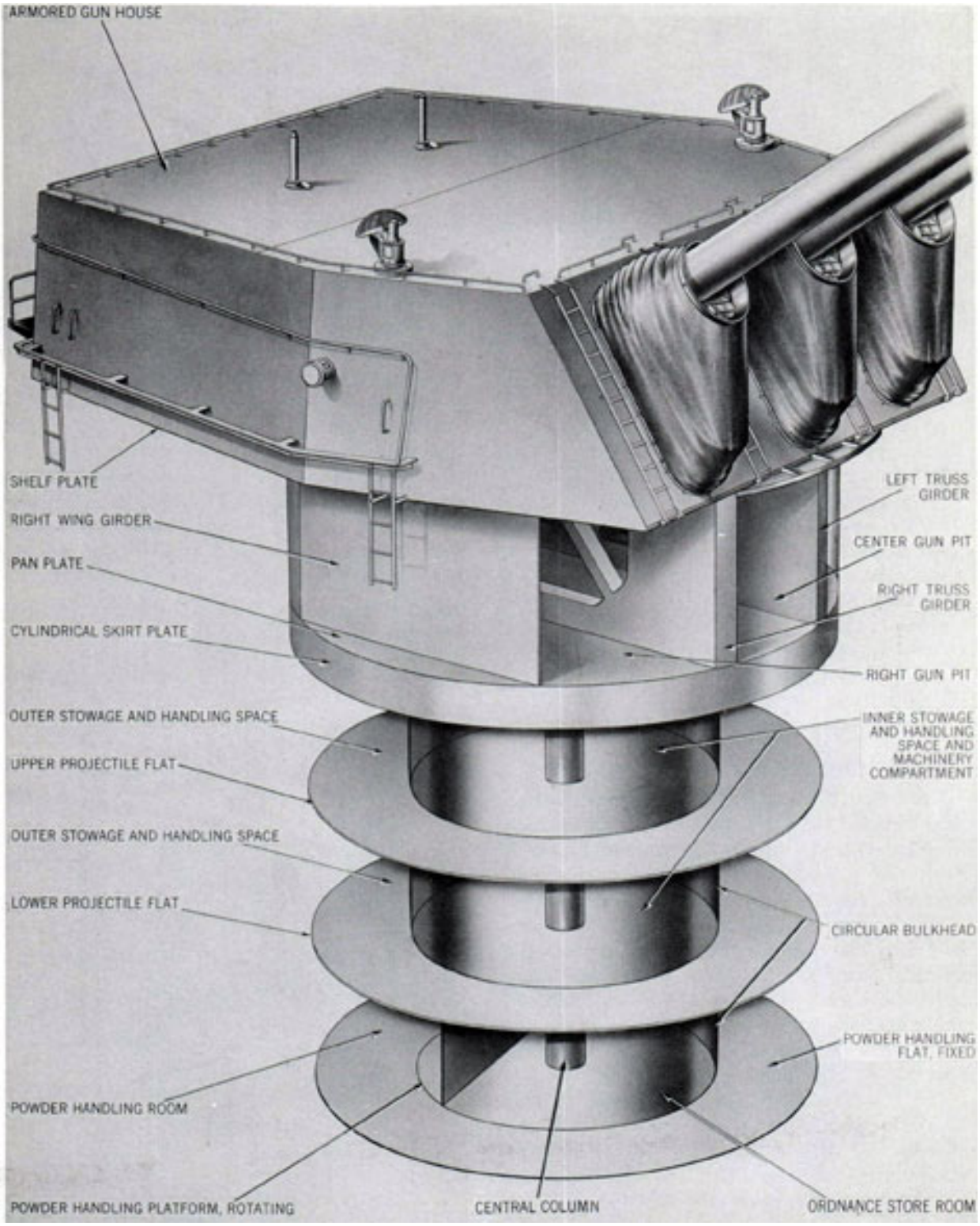

*Figure 2. Turret Subdivisions and Principal Structural Units*



bulkhead and a central column extending from the pan to the powder platform. The column, both bulkheads, and the outer edges of all floor plates below the shelf plate are concentric with the turret center of train rotation. This arrangement-and the welded construction of all plates, girders and bulkheads-ties the entire rotating structure together in one rigid unit. It divides the turret into its principal functional spaces of gun compartment and ammunition handling compartments. Those spaces are within the following over-all measurements:

**Dimensions, Rotating Structure**

Vertical distances:-

| | |
|---|---|
| Powder platform to lower projectile flat | 10 ft. |
| Lower projectile flat to upper projectile flat | 7 ft. 6 in. |
| Upper projectile flat to pan plate | 9 ft. 7 in. |
| Pan plate to shelf plate | 8 ft. 7 in. |
| Shelf plate to turret roof plate | 9 ft. |
| Gun house length | 32 ft. 10 in. |
| Gun house width | 30 ft. 8 in. |
| Diameter at pan plate | 24 ft. 3 in. |
| Upper projectile flat diameter | 22 ft. 10 in. |
| Lower projectile flat diameter | 22 ft. 10 in. |
| Powder handling platform diameter | 14 ft. 4 in. |
| Central column diameter | 22 in. |
| Lower circular bulkhead diameter | 14 ft. 4 in. |

**Gun house structural plan**

The space enclosed between the gun house roof

Wing girders isolate two small spaces between their outboard sides and the circular bulkhead. These are called the pan plate wing chambers, left and right. In each a series of vertical plates, transversely placed and welded between the bulkhead and the girder, stiffen the girder and the pan plate. These details and the arrangement of access openings in each plate girder and within the wing compartments are shown in figure 3.

Truss girder details are also illustrated in figure 3. Each is a weldment of two parallel plates with web bracing and stiffening plates. They are transversely stiffened with box structures at the front, extending from wing girder to wing girder. In the interior open spaces of both truss girders, electric cabinets, hydraulic system tanks, and other equipment are mounted. These installations fill the trusses-except for personnel passages between pockets, at the rear.

All four girders extend above the shelf plate to the level of an elevated floor of the gun house. The forward portion of each has two structural extensions that extend nearly to the

and the pan plate is not subdivided by flame barriers. This 17-foot high gun and gun pit compartment is formed and partially subdivided by the following design arrangements.

**Gun pit details**. Extending vertically above the pan plate (and supported by it) are five major components of the turret. These are the enclosing circular bulkhead and four gun girders. The latter are longitudinally parallel, vertical units dividing the gun pit into three pockets.

All gun pockets are approximately the same size: each is ten feet deep and seven feet wide, and the average length within the curving end walls is 22 feet. The gun girders that form their parallel sides are different design types; the outer, or wing, girders are plate structures; the center units are truss girders.

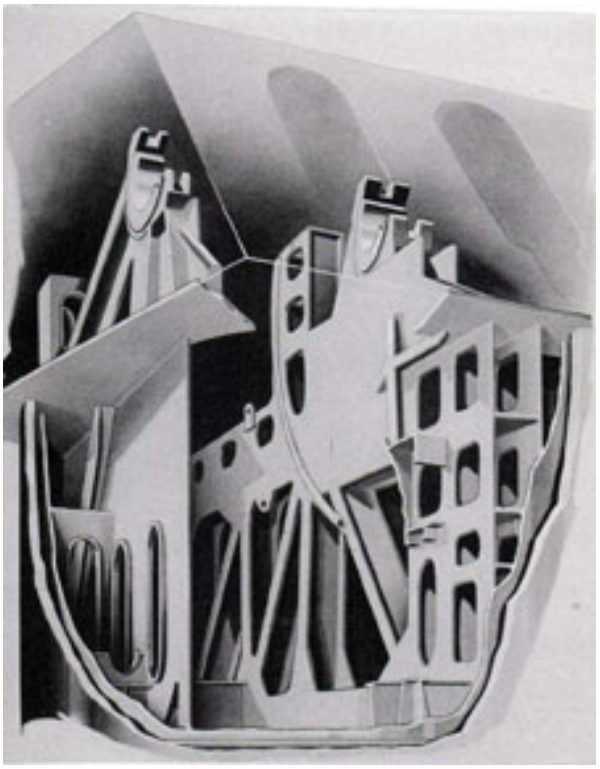

*Figure 3. Gun Girder Construction*



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turret roof plate. These extensions are shown in figure 3. One is a seat for a deck lug bearing; the other is a support for a curved guide rail that is an element of the ammunition hoists described on pages 37-41.

**Gun house details**. The shelf plate is welded to the above-described gun pit structure, resting on the circular bulkhead and abutting the two wing girders. It extends outboard beyond the circular bulkhead, overhanging slightly at the front and sides and nearly nine feet at the rear. It is cut away in the area between the wing girders, providing a clear opening above all three gun pits.

Parallel with the shelf plate and elevated 18 inches above it, are floor plates. These form a continuous floor throughout the gun house, including the top plates of the truss girders, except for the gun pit area and two depressed control station areas, one at the right side and one

opposite at the left side.

In the space under the floor, floor beams and stiffening plates, together with the shelf plate, form a rigid box structure. This structure is designed to receive and support the gun house armor at its outer edges, and, in the space between shelf and floor plates, to accommodate units of the ventilating system described on pages 52-55.

Three transverse arch-beams rise from the shelf structure and extend across the gun pits,

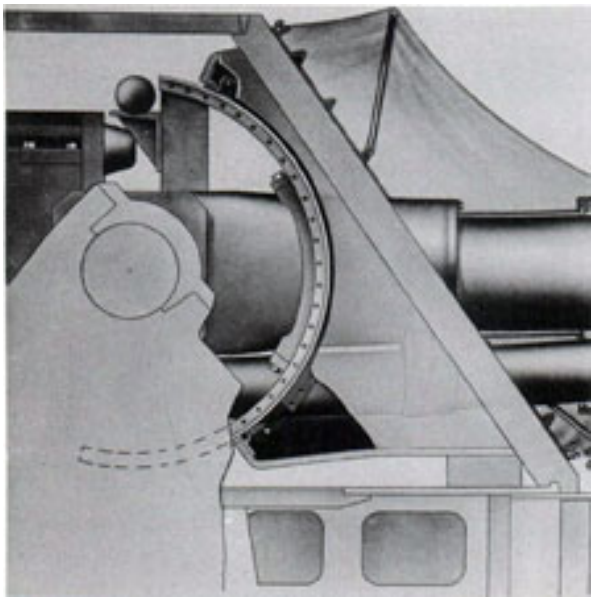


*Figure 4. Gun Port Arrangement*

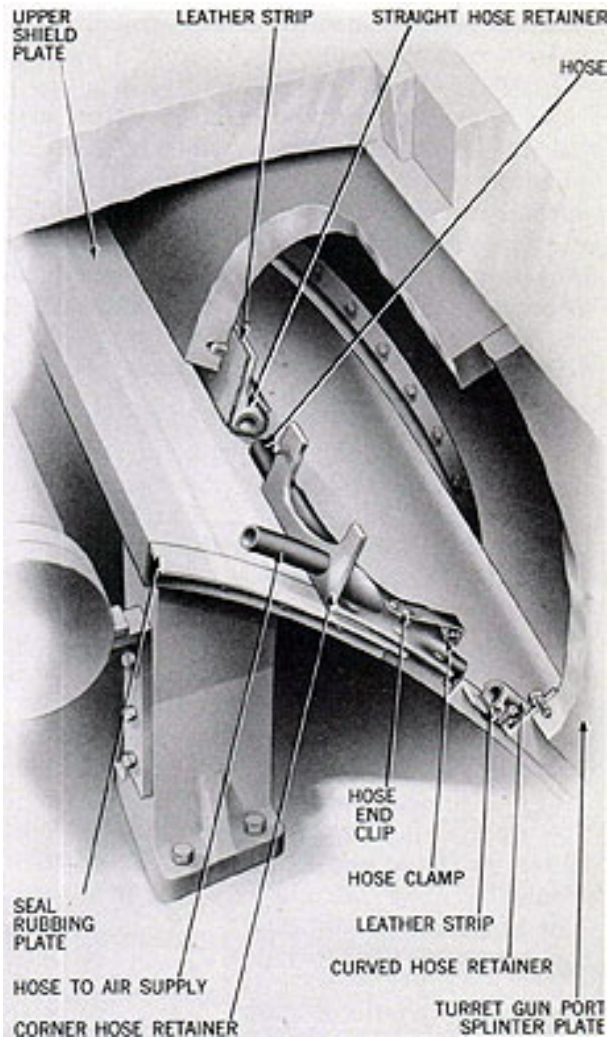



*Figure 5. Gun Port Gas and Water Seal Details*

six feet above the floor level. These large structural columns and beams .are armor plate supports. With the shelf structure and the armor plates, they constitute ,the entire gun house structure.

**Armor**. The armor plates consist of nine pieces shaped, fitted, and welded together to form an integral structure. Their identities and thicknesses are:

| | |
|---|---|
| Face plate | 8 inches |
| Front side plates, right and left | 3.75 inches |
| Rear side plates, right and left | 2 inches |
| Rear plate | 2 inches |
| Roof plates, front, center, rear | 4 inches |

Figure 2 shows the assembled form of the armor plates and details of the attached foot

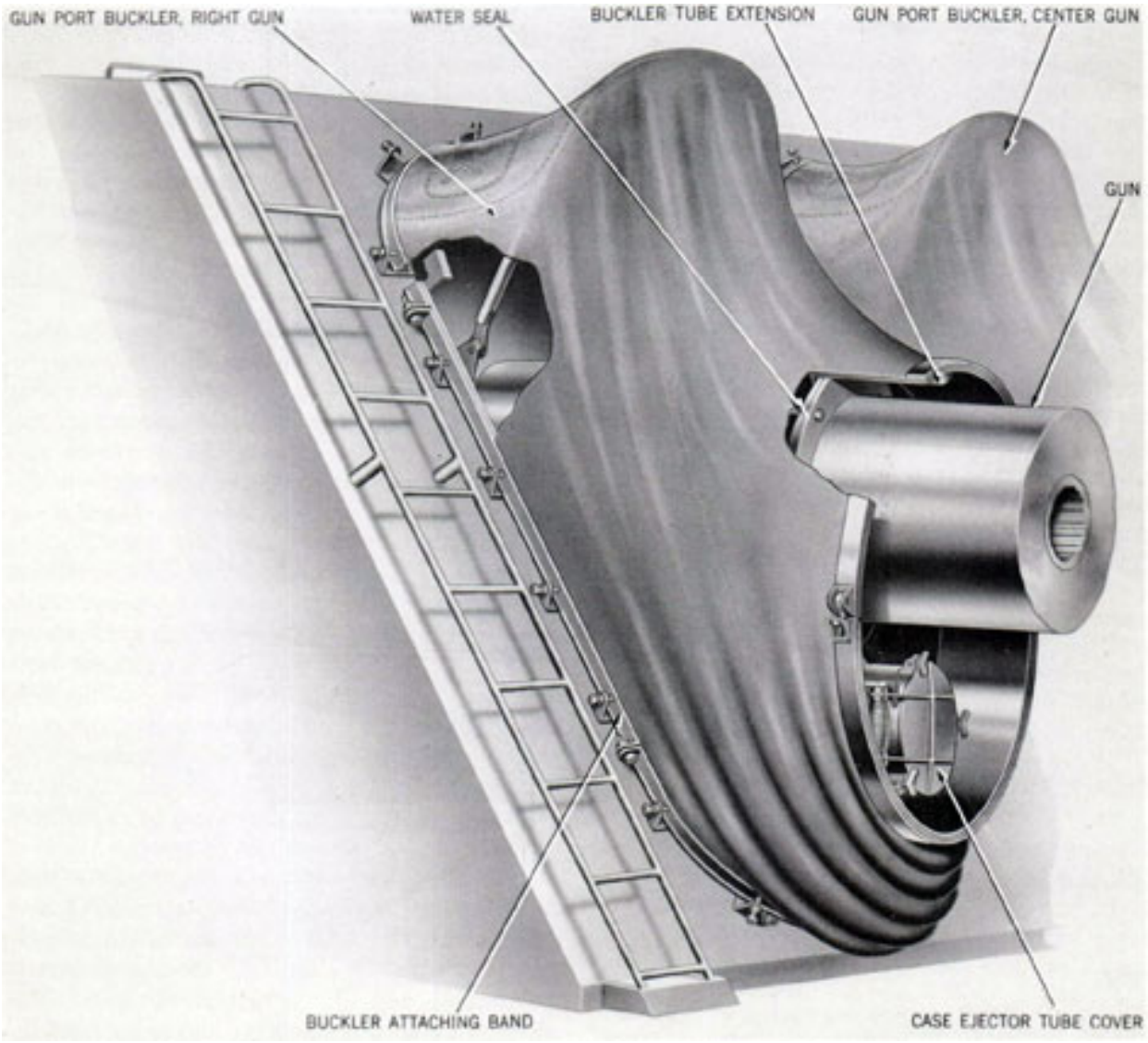


and hand rails, ladders, and platform. Face and side plates slope inward; the rear plate is vertical. Attached devices and the openings in the armor differ for the three turrets; the arrangements of the illustration, for turret II, are the most extensive.

The armor openings of turrets II and III are the same. Each has 13 openings. These are: three gun ports, three sight hood openings, two periscope and two antenna openings, and three access doorways. Turret I openings are the same, except for omission of the antenna holes in the roof plate. Access doors in all turrets are located in the rear plate. These and all other openings, with exception of the gun ports, are fitted with conventional gasket seals or fabric bucklers. They are arrangements that make the gun house a weather and gas sealed enclosure.

**Gun** ports. Arrangements for sealing the three gun ports are fixed and moving and inflated elements of special design. They are the arrangements illustrated in figure 4. These consist of a weldment of splinter plates on the rear side of the face plate, a mating shield plate on the gun slide, an air hose sealing device, and, on the exterior, a large fabric buckler.

Figure 5 shows the details of the special gun port gas and weather sealing device. This device




*Gun Port Buckler*



is a leather strip that encircles the edge of the splinter plate weldment and bears on the surface of the moving gun port shield. A rubber hose, distended by compressed air, is secured in special fittings and clamps, so that it presses against the leather strip to assure mechanical seal. Air supply for this seal is tapped from the gas ejector system described on pages 67-68.

Figure 6 shows the details of the buckler. It includes a steel weldment called a buckler tube extension, mounted on the gun slide. This unit has a water seal between the extension and the recoiling surface of the gun. A laminated fabric

of the three lower levels of the turret. It is suspended from the pan plate and the upper roller path.

**Upper roller path**. The upper roller path is a large forged steel ring, 24 feet in diameter, secured under the pan plate and the circular bulkhead and concentric with the train axis and the cylindrical structure. It is the upper race of the turret roller bearing. The bottom face is a precisely milled horizontal surface 13 feet below the gun trunnion axis. From this bearing surface, the suspended structure hangs 27 feet to the level of the powder flat.

**Suspended structure details**. The main units of the

buckler* is clamped to this tube extension and also to a buckler attaching band bolted on the face plate.

**Gun house subdivision**. No bulkheads subdivide the interior of the armored enclosure, but pipe stanchions and rails enclose the rear and two sides of the gun pits. On the rear line of stanchions and rails are mounted many control instruments and devices. These form a partial bulkhead separating the gun compartment from the turret overhang space called the turret officer's booth.

Access passage between the booth and wing spaces and the gun pits is provided by the following arrangements. Left and right sight control station areas are directly accessible from the booth by narrow walkways at the sides of the gun pits. Similar narrow walkways along the tops of the two truss girders are unobstructed by doors and give access passage from the booth into the gun compartment. Ladders at the rear of the gun pits permit passage between the booth and the pan. At the left side, a floor hatch and ladder give access to the left wing compartment of the pan and thence to the forward part of the left gun pocket.

**Suspended structure**

The portion of the rotating structure extending below the pan plate is a suspended structure that is isolated from the gun house and gun pits except for conventional flame-tight hatches in the pan plate, one at the rear center and two forward. This structure consists

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* Tentative material; actual specification of this material or alternate leather buckler not provided at date of this publication.

suspended structure are the lower circular bulkhead, the central column, the upper and lower projectile flats, and the powder handling platform.

The column and the bulkhead are continuous steel cylinders fastened to the pan plate and extending through and supporting all three floor structures. On each level the bulkhead has cutaway sections. These provide access archways through the cylinder on the two projectile flats and form an open sector for part of the powder handling platform. A straight bulkhead, built-in with the ammunition hoists described on pages 37-41, encloses the remaining portion at the bottom level. This forms a semicircular compartment that is partitioned into three small storerooms, flameproofed from the surrounding powder handling space and from each other. Although they are identified as "storerooms," these three sub-compartments are primarily fire-hazard safety spaces. They are flame isolating chambers. Each confines the downward flame and explosion of a powder hoist fire, permitting limited expansion but blocking the fire hazard from the other hoists, the powder handling space, and the magazines. This purpose limits the type and amount of storage permitted in the three chambers to noninflammable tools and accessories of small volume.

Both the upper and the lower projectile flats / are identical in compartment subdivisions and space arrangements. The circular bulkhead separates each flat into an inner circular compartment, and an outer ring-shaped space. The latter is 23 feet in diameter and is enclosed by the foundation bulkhead of the fixed structure.

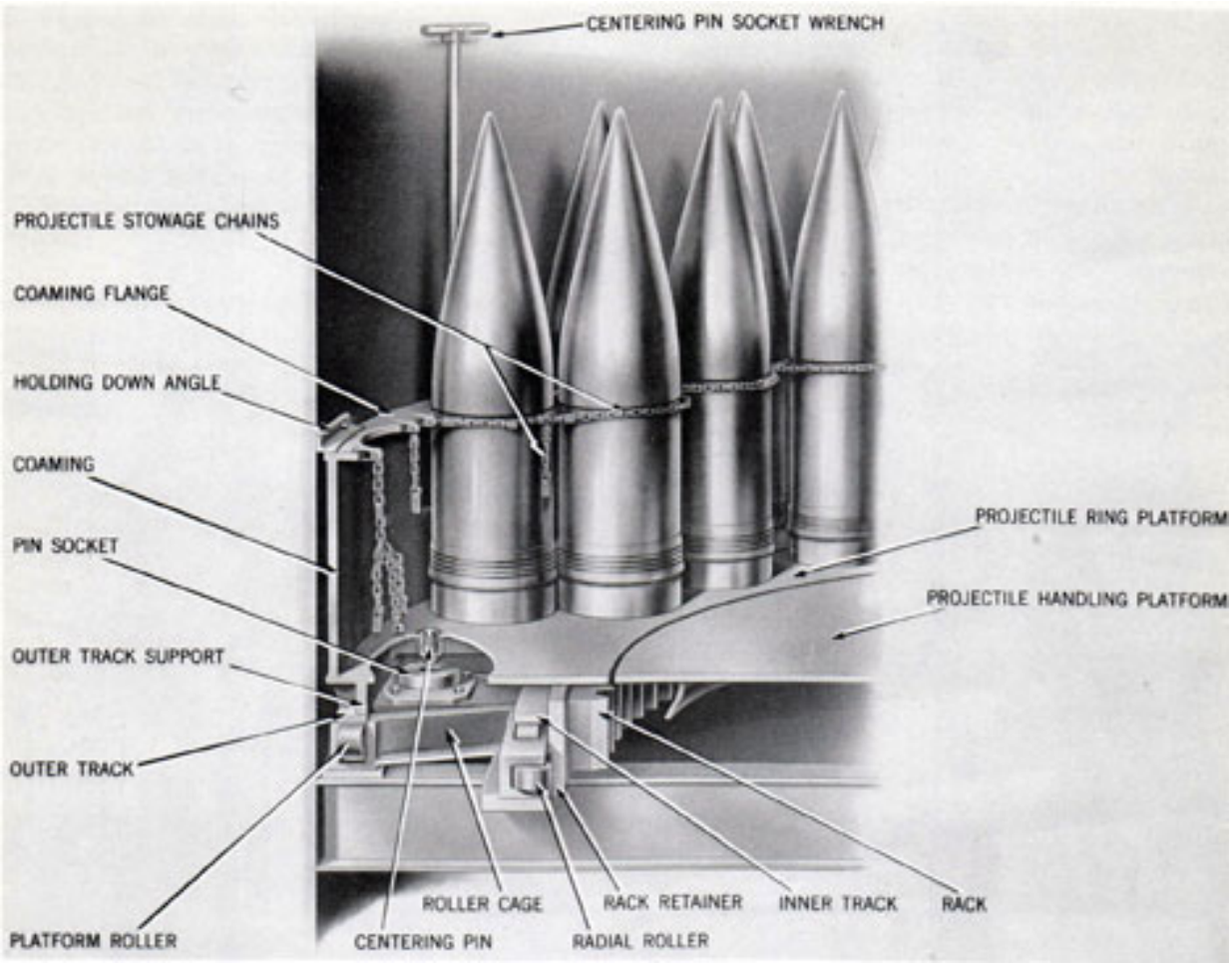



*Figure 7. Projectile Ring Arrangement*

In the floor of both compartments are roller-mounted circular platforms. These are at the outer limits of each space and concentric with the central column and the circular bulkhead. They are rotating platforms that are power-driven by the equipment described on pp. 49-50. The top surface of each is flush with the adjacent floor plates of the flat. These units are projectile stowage platforms called projectile rings. Each is an integral platform weldment with an enclosing circular coaming, arranged with chain lashings and other details as illustrated in figure 7. The platforms are 16.75 inches wide and their outer diameters are 14 feet 1.5 inches and 22 feet 11 inches for the inner and outer rings respectively. Their projectile capacities and other data are included with the descriptions of the ordnance installations on pages 19-21.

A cross web of heavy I-beams, passing through the circular bulkhead, supports the floor plates and the two stowage rings of each projectile flat. It is an exceptionally heavy floor-beam construction, cross-braced by other beams, stiffened by the platform plates, and designed to carry the large floor loads and particularly the cantilever outer ring loads without apparent deflection.

The structural details of the upper flat include a major difference. In the inner compartment a heavy transverse platform, in the forward sector, extends across the compartment above the projectile ring. This is a supporting platform for mounting some of the units of the train power drive.

Access facilities between the projectile and powder

flats are vertical ladders located under hatches at the rear of the turret. These hatches

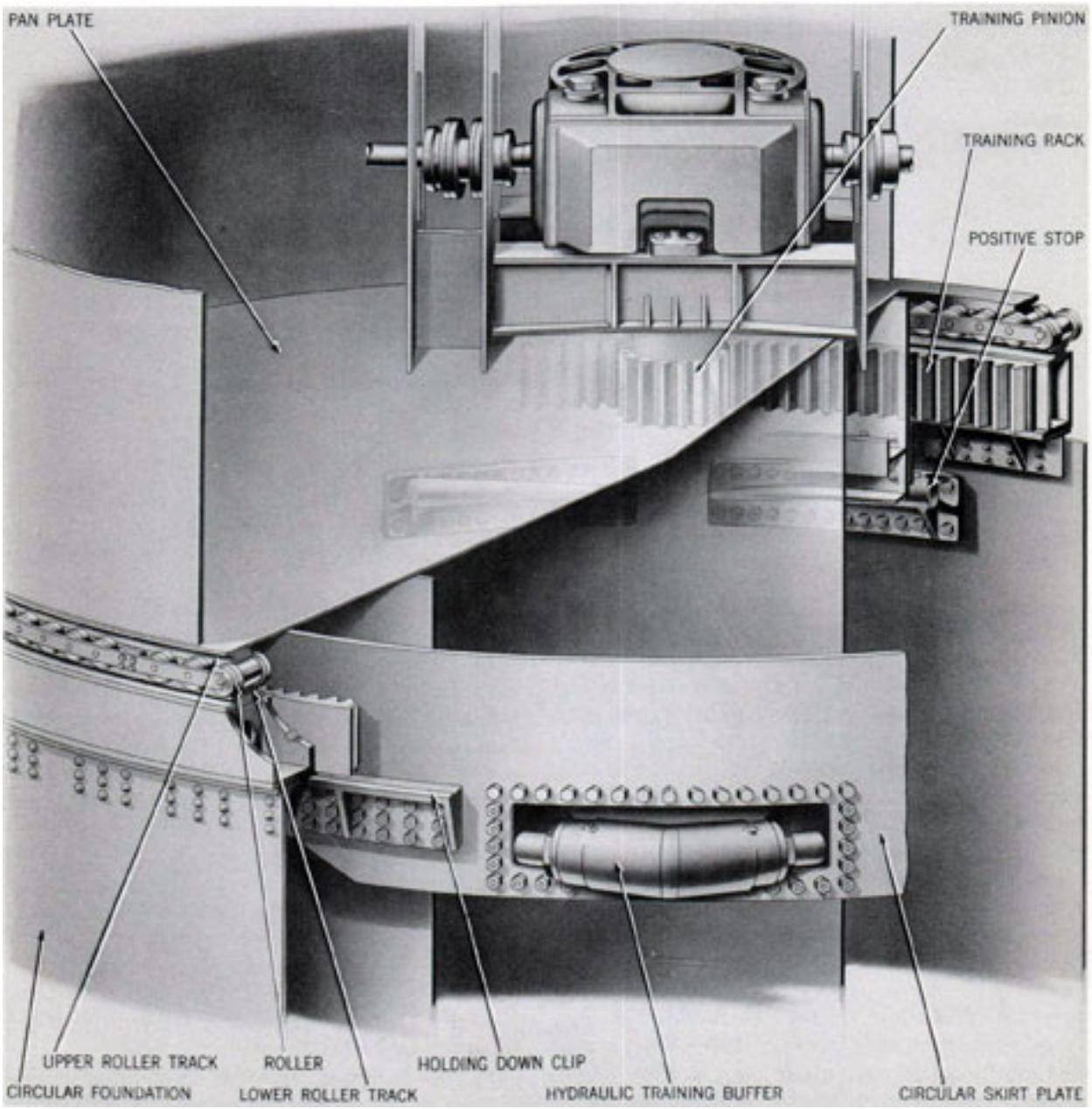


in the projectile flats are vertically under the rear flame-tight hatch of the pan plate. Together they provide a clear hoist strike, for removing and installing equipment, between the gun house and the powder handling compartment.

**Skirt plate**. A cylindrical plate hangs from the bottom of the pan plate into the projectile stowage space of the outer compartment of the upper projectile flat. This is called the cylindrical skirt plate. It is a functional element of the turret turning installation and not a structural member. On it are mounted the units that hold the rotating structure down and that buff the turning movements at train limits. These parts are the holding-down clips and the hydraulic training buffer identified in figure 8.

**Turret roller bearing**

The rotating structure turns on the roller



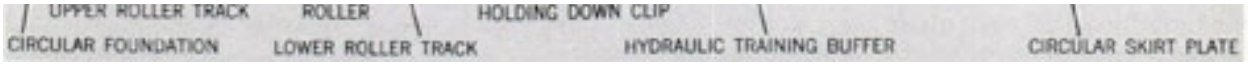



*Figure 8. Turret Roller Carriage Arrangement*



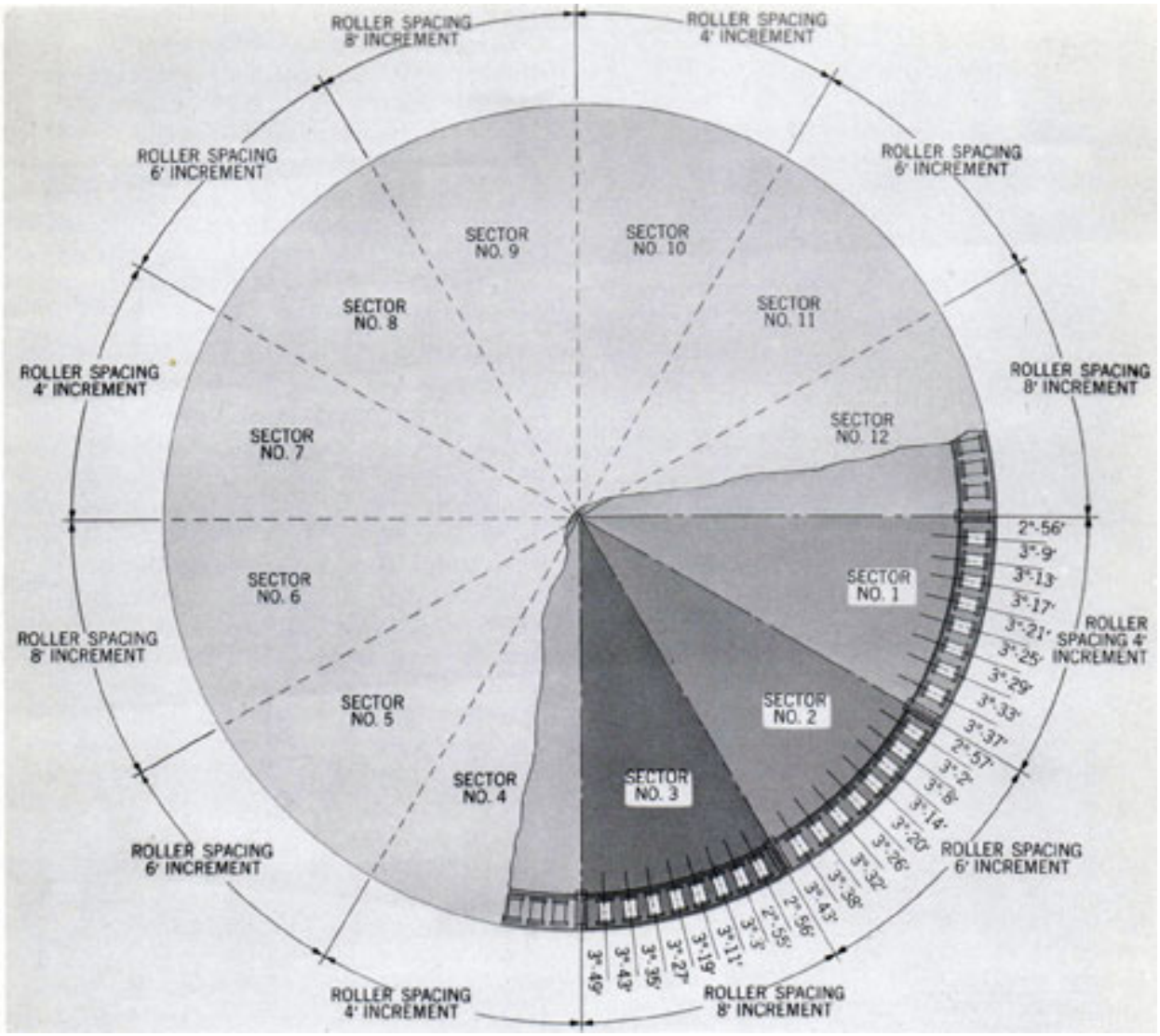



*Figure 9. Cage Sector and Roller Spacing Details*

bearing assembly shown in figure 8. This unit is a conventional turret bearing design. It is supported on a lower roller track unit of the fixed structure described on the next page.

**Bearing components**. The bearing consists of 96 rollers assembled in 12 cage sectors that are attached together by butt straps to form a 360° bearing ring. Its outside diameter is slightly more than 24 feet.

**Rollers**. All rollers are identical. Each is a tapered roller tracks of the upper and lower races or roller paths. Each roller is drilled, bushed, and fitted with a spindle bolt. This bolt locates and retains the roller in a precisely allotted position in the cage sector.

**Cage sectors**. The twelve cage sectors are alike as to construction, but differ as to the assembled positions of the eight rollers retained by each. This difference applies to variations in the spaces between the axes of the 24 rollers of a quadrant; all four quadrants are alike. Thus in each quadrant of three 30° sectors, the spaces between rollers vary by

roller of forged steel with integral flanges, 10.5 inches across flanges, 6.75 inches maximum diameter (at the inner flange) , providing linear contact of eight inches on the

increasing increments that are constant for each sector but differ



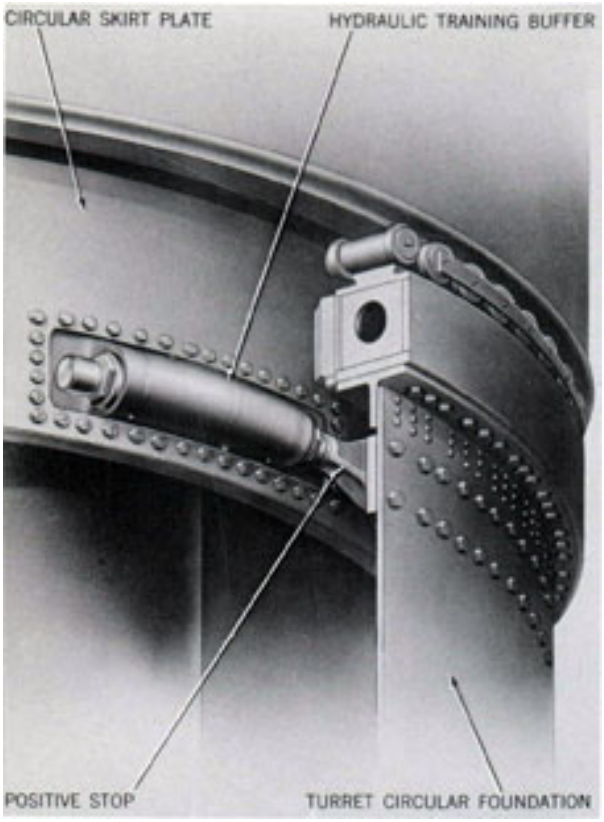



*Figure 10. Lower Roller Path, Training Buffer and Train Stop Arrangement*

in value for the three sectors. The spacing data of a typical quadrant are indicated in figure 9. In sector No. 1, the distances between rollers increase clockwise by increments equal to four minutes of arc, in sector No. 2 by six minutes of arc, and in sector No. 3 by eight minutes of arc. The design arrangement is for the purpose of preventing "brinelling," or roller path deformation, from developing at the points of linear contact-a condition that would develop under firing and sea-way load stresses if all spaces were equal.

**Roller access**. The arrangements of the cage sectors and the turret structure provide for

may be jacked until the roller flange can clear the tracks, sliding the roller from the spindle bolt without disturbing the outer cage ring or spindle.

**Fixed structure**

The fixed, or nonrotating, turret structure consists of the circular foundation, lower roller path, powder handling flat, base casting, and barbette. Their form and relative positions are indicated in figure 1.

**Turret circular foundations**. Turret circular foundations differ for the three turrets. Each is a large cylindrical steel weldment, 23 feet 8 inches in diameter, supported and secured at the ship's second platform. For turret I this cylinder extends upward 25 feet 2 inches above the second platform; for turret II, 33 feet 3 inches; and for turret III, 24 feet 2 inches.

Each circular foundation is a stand for the lower roller track unit. See page 11. In addition, it is an enclosing bulkhead for the projectile and powder handling compartments and provides attached elements that function with the arrangements of those compartments and the turret turning mechanism. These elements are training stops, flame seals, and powder scuttles.

Two training stops are located near the top of the foundation in the way of the training buffer, as shown in figures 8 and 10.

Two flame seals isolate the ammunition flats. They are angle brackets formed into complete rings. Each is mounted on the bulkhead so that it mates with a

inspection, lubrication, and replacement of rollers without dismantling the turret. Holes in the cylindrical skirt plate permit access to any and all rollers from the upper projectile flat by turning the turret. To remove a roller, the inner ring of any cage sector can be unbolted and lowered into the projectile flat. By similarly removing the holding-down clips, the turret

complementary ring at the bottom of a projectile flat. This combination provides a mechanical barrier between the compartments, but permits free turning of the turret.

Six powder passing scuttles and two access doors are located in the bottom section of the bulkhead. These are communications arrangements between the powder handling room and the magazines. Scuttles are vertically positioned cylinders, each with two powder cartridge chambers. They are manually rotated units that transfer powder cases (without tanks) from the magazines to the handling room and maintain mechanical seal between the turret and magazine compartments.



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**Powder handling flat**. At the bottom of the circular foundation, a ring-shaped floor structure forms the powder handling flat. The floor plates of this flat are flush with the powder handling platform of the rotating structure. They provide a powder case truck maneuvering area nearly five feet wide in front of the six magazine scuttles, which are equally spaced in the foundation. Thus, at all positions of turret train, three scuttles are conveniently accessible to the open sector of the revolving platform (and the hoists), and rapid passing is possible without traffic interference.

**Lower roller track**. The lower roller track an assembled ring-shaped weldment of box-section. Its form and construction, and its riveted attachment at the top of the foundation, are illustrated in figure 10. Two surfaces are precisely milled after the ship is launched. The top or roller track is a bearing surface of the same form, finish, and size as the similar surface of the upper roller track (24 feet in diameter). The inner vertical face is a true cylindrical surface, concentric with the roller paths and the axis of the rotating structure. It is keyed and tapped for accurately seating the sections of a large annular rack called the training

circle. This rack is a 360° gear of 196 teeth and 256-inch pitch diameter. It is the fixed gear of the turret turning drive described on page 29.

**Base casting**. The lowest element of the fixed structure is the base casting. This part is a large flanged and hollow pintle, of 22.5-inch diameter, 3 feet high, that is secured below the second platform and is accurately centered beneath the turret center of rotation. It is a dual purpose element, functioning to align the rotating structure and to lead-in the communications, power, and air supply. It extends into and provides a radial bearing for the lower end of the central column. A circular plate, horizontally positioned at the bottom and drilled in a pattern of equally spaced holes, separates the cables and prevents them from chafing. These features are shown in figure 11.

**Barbette**. The barbette is an assembled cylinder of heavy armor plate consisting of seven cylindrical segments. These are joined by dovetail keys and, at the abutting decks, by deck

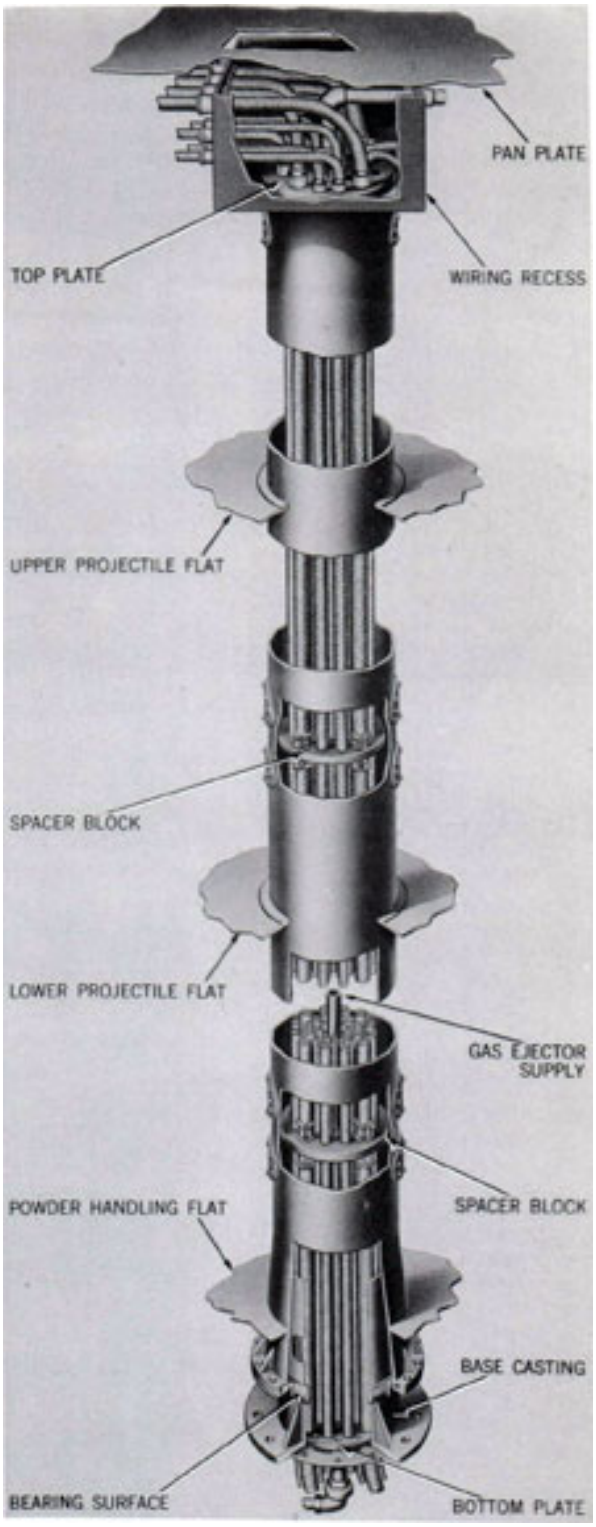



*Figure 11. Base Casting and Central Column Wiring Tube Arrangements*

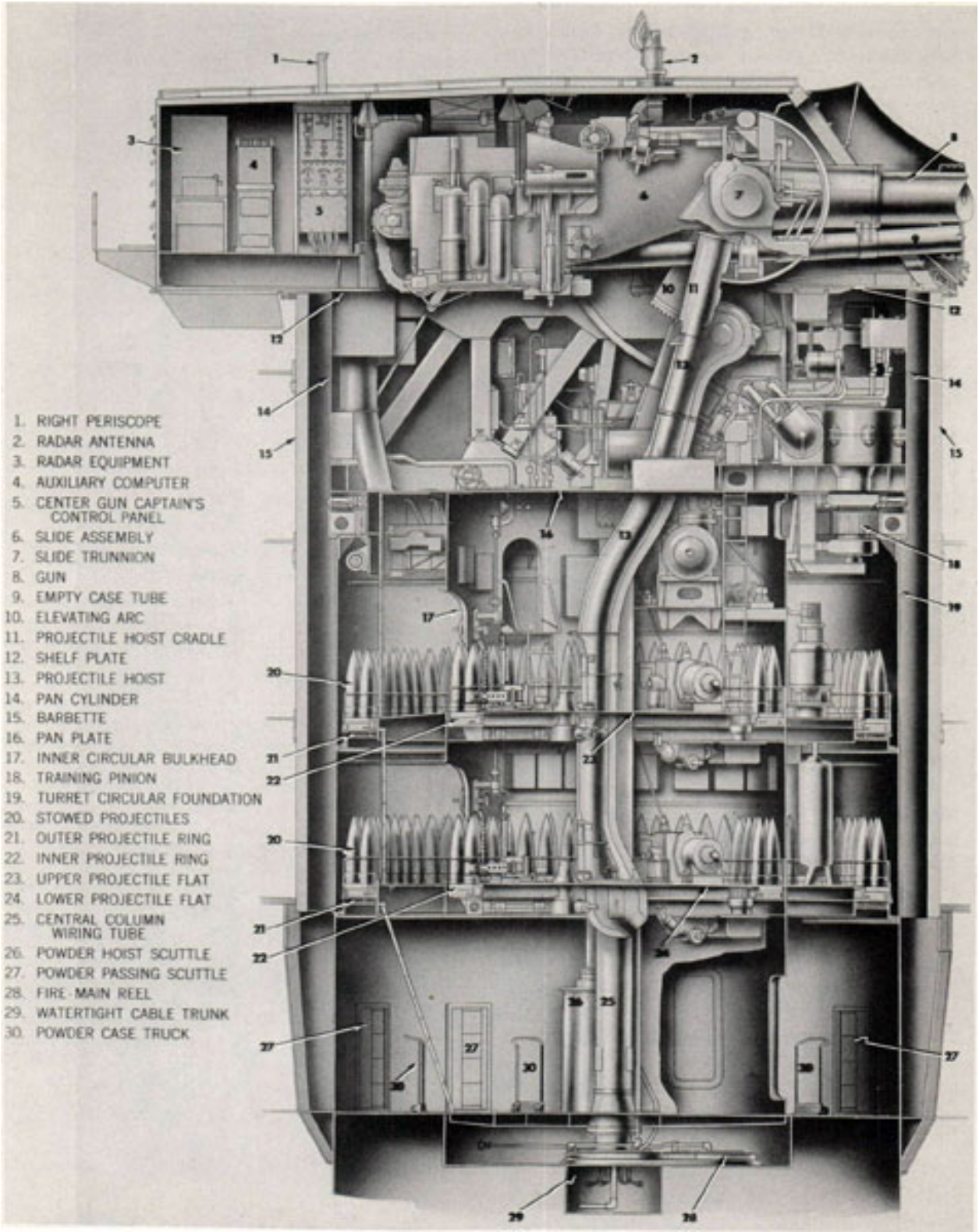



*Figure 12. Turret General Arrangement, Longitudinal Section*

seam straps, the whole forming a built-in unit that encloses all of the turret that is not protected by the belt, deck, and gun house armor. Its outside diameter is 27 feet. It extends vertically upward from the third deck, through the second and weather decks and above the latter to a plane one inch below the shelf plate. Thus the three barbettes of the ship have different heights because of the different heights of the foundation bulkheads and the positions of the roller tracks with respect to the weather deck. For turret I this barbette dimension is 19 feet; for turret II 27 feet 5 inches; and for turret III 20 feet.

Barbettes differ also in thicknesses of plates. The standard thickness is 6.3 inches for the entire perimeter of turret III and for six plates each of turrets I and II. One plate each of the barbettes of turrets I and II is 5.5 inches thick. These are the opposing 45° segments of those barbettes.

All barbettes are supported at their lower edges by large, heavy steel plate, flanged brackets that are attached to the outside of the respective turret circular foundation. These brackets are entirely below the armored, third deck and are in the respective powder magazine compartments. This construction of supporting brackets is otherwise stiffened and braced by weldment of the abutting deck seam straps and other details at the juncture of the barbettes with the three decks.

The space within the barbette brackets, between the circular foundation, the brackets, and the barbette, is isolated from the magazines. But it has portable plate access to ladders on the outside of the foundation. These provide access to the exterior cage sectors of the turret roller bearing.

## ORDNANCE INSTALLATIONS

The ordnance installations mounted in the turret rotating structure described in the preceding text

Gun equipment
Gun laying equipment
Ammunition hoists
Ammunition stowing equipment
Ammunition handling equipment
Fire control equipment

**Turret ordnance assembly differences**. The several types of equipment are identical turret assemblies in all turrets, with exception of the fire control equipment of turret I. In that turret, the radar assemblies and certain instruments associated with turret local control are omitted.

**Turret ordnance design identities**. The equipment of the above types comprising each turret assembly includes one or more units of the following 8-inch Ordnance design identities, with exception of the omissions mentioned in the preceding paragraph.

GUN UNITS, 8-INCH
- Gun Mk 16 Mod 0
- Housing Mk 1 Mods 0 and 1
- Gas Ejector Mk 16 Mod 0
- Slide Mk 20 Mods 0 and 1
- Rammer Mk 18 Mods 0 and 1
- Case Ejector Mk 1 Mods 0 and 1
- Slide power equipment
- Deck Lug Mk 18 Mods 0 and 1

GUN LAYING EQUIPMENT, 8-INCH
- Elevating Gear Mk 23 Mods 0, 1, and 2
- Training Gear Mk 22 Mod 0

AMMUNITION HOISTS, 8-INCH
- Projectile Hoist Mk 31 Mods 0, 1, and 2
- Powder Hoist Mk 36 Mods 0 and 1

AMMUNITION STOWING EQUIPMENT, 8-INCH
- Projectile Ring Mk 1 Mod 0

AMMUNITION HANDLING EQUIPMENT, 8-

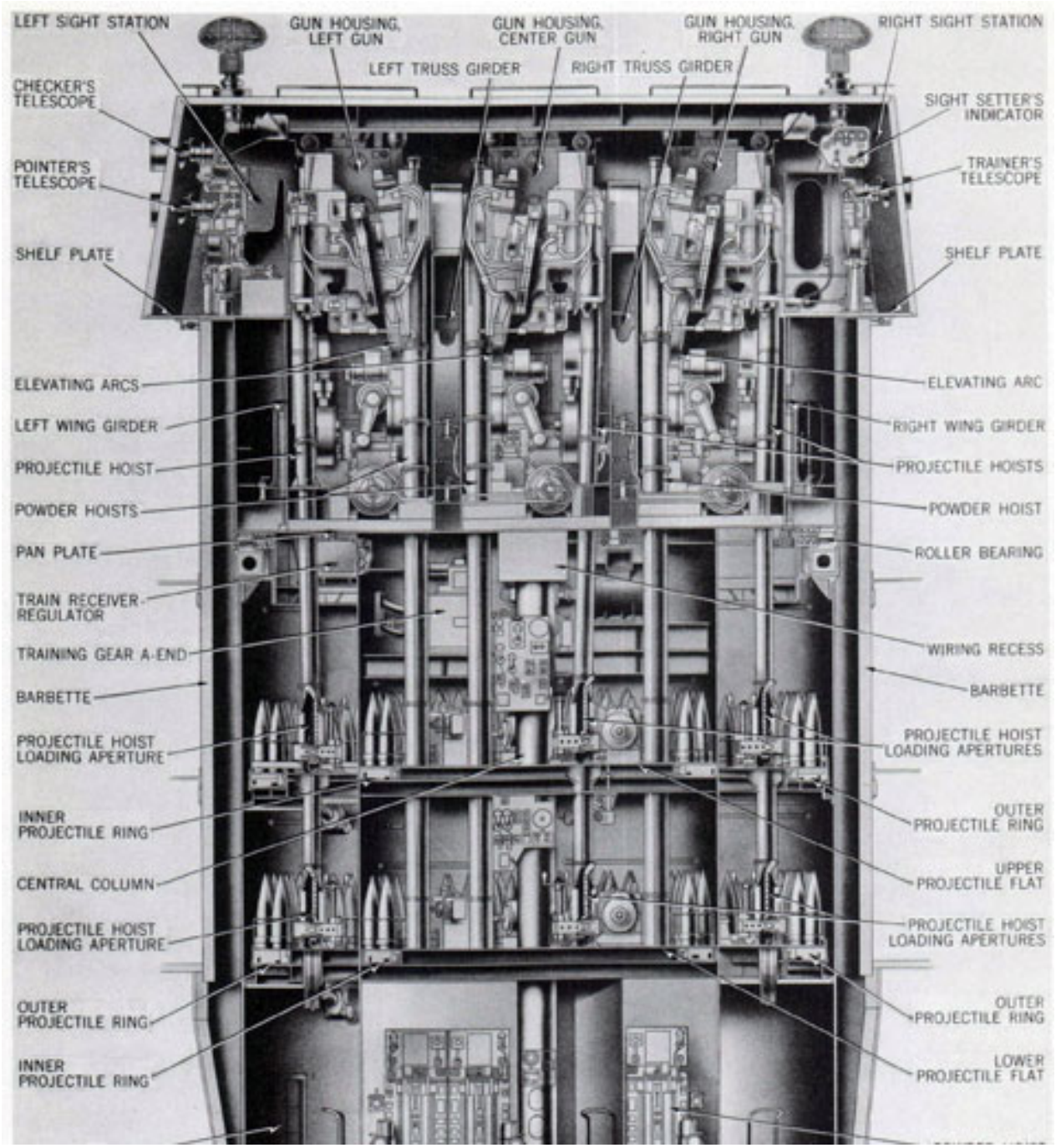
consist of the units identified and arranged as shown in the vertical sections of the turret, figures 12 and 13, and the turret floor plans of figures 14 to 21 inclusive. These installations comprise the following types of equipment.

**Ordnance types**. Each turret ordnance assembly consists of units of the following types:

INCH
Parbuckling Gear Mk 1 Mod 0

FIRE CONTROL EQUIPMENT
8-inch Sight Mk 32 Mod 0
8-inch Elevation Gun Attachment Mk 7 Mods 0, 1, and 2
8-inch Training Gun Attachment Mk 7
Mod 0 Fuze Setter Mk 20 Mod 0
8-inch Firing Circuit Mk 8 Mod 0
Train Receiver-Regulator Mk 25 Mods 0, 1, and 2





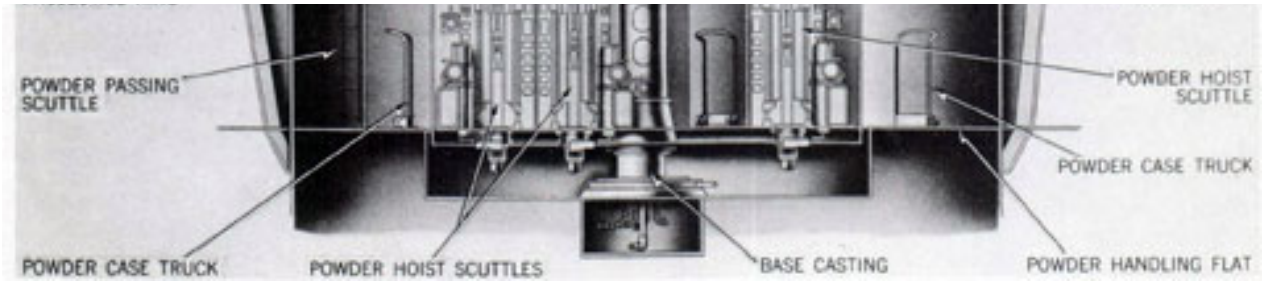



*Figure 13. Turret General Arrangement Transverse Section*

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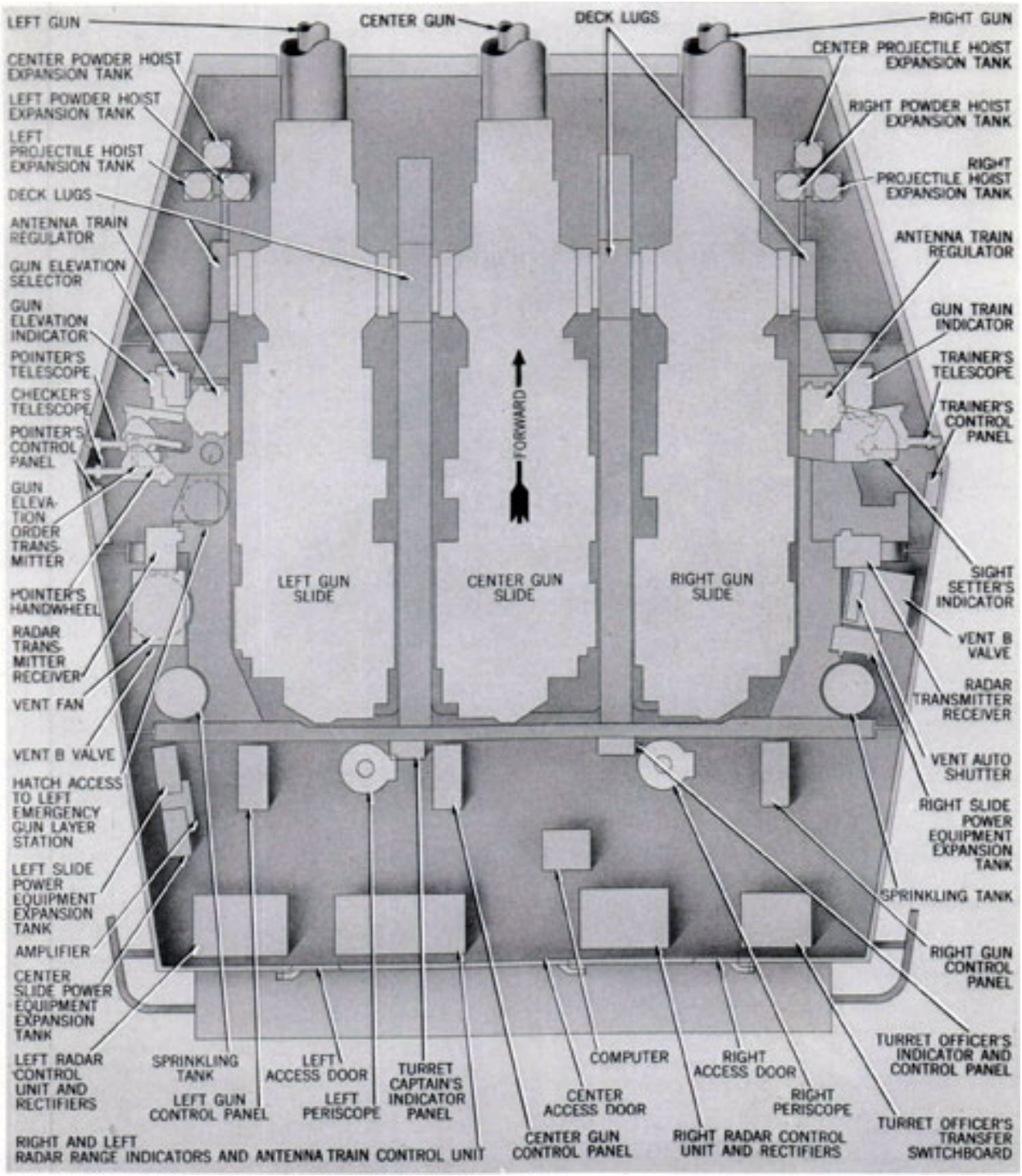


*Figure 14. Gun House Ordnance Equipment. Plan View*

FIRE CONTROL EQUIPMENT (CONTINUED)
Gun Elevation Indicator-Regulator Mk 47 Mod 0
Error Reducer Mk 1 Mod 0
Fuze Setting Receiver-Regulator Mk 1 Mod 1
Radar Equipment Mk 27 Mod 0
Antenna Train Drive Mk 5 Mod 0



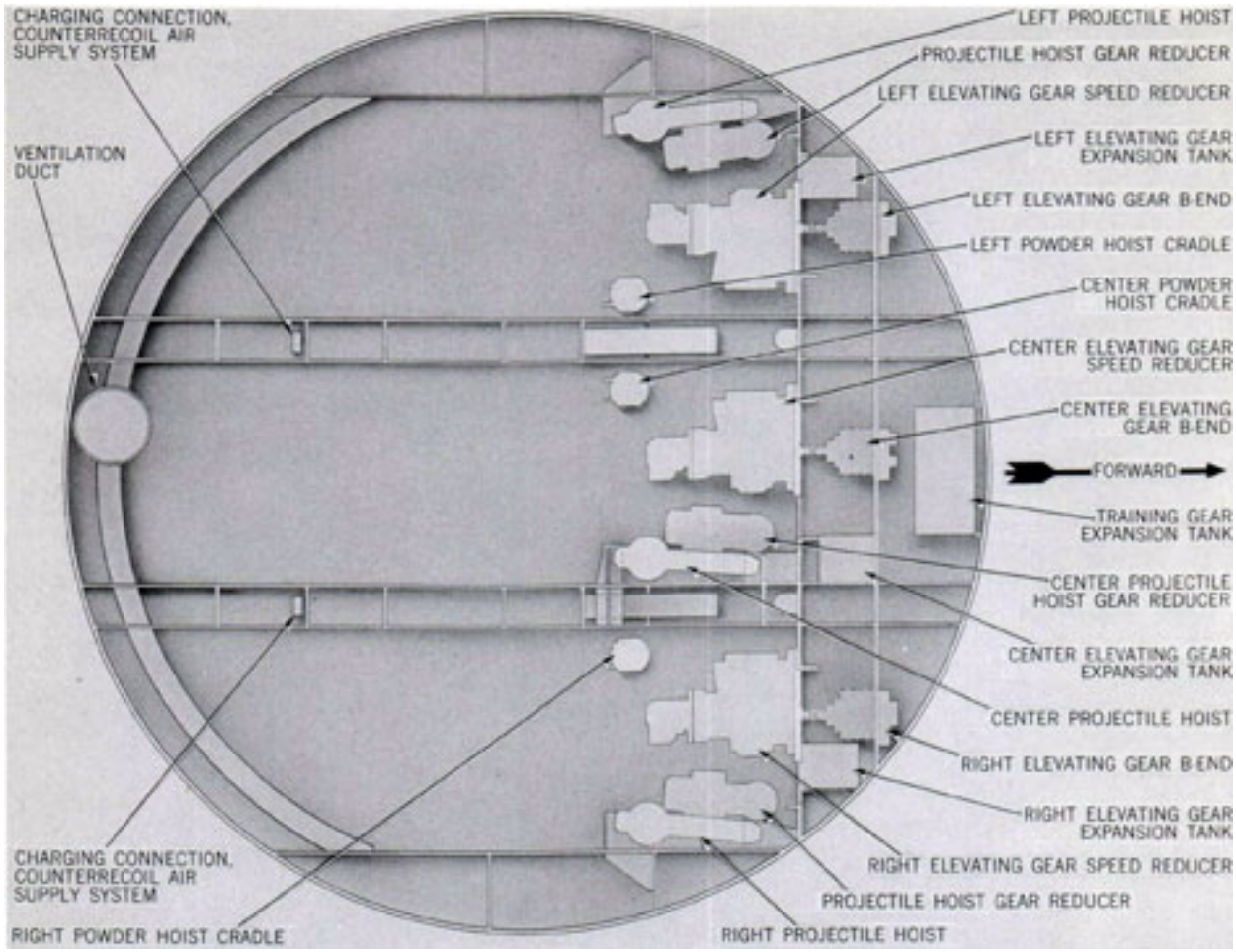


*Figure 15. Ordnance Equipment Above Pan Plate. General Arrangement. Plan View*

FIRE CONTROL EQUIPMENT (CONCLUDED)
Computer Mk 3 Mod 9
Multiple Turret Train Indicator Mk 12 Mods 7 and 9
Gun Elevation Indicator Mk 45 Mod 0
Gun Train Indicator Mk 25 Mod 7
Gun Elevation Order Transmitter Mk 4
Mod 0 Sight Setter's Indicator Mk 8 Mod 0
Turret Train Order Transmitter Mk 14
Mod 1 Periscope Mk 20 Mod 5
Periscope Mount Mk 5 Mod 15 Telescope Mk 53 Mod 1
Telescope Mk 98 Mod 0
Telescope Mk 99 Mod 0

the tabulations of 8-inch Turret Assemblies appended at the back of this book. These listings include references identifying the Fire Control Equipment Sketch Lists of Assemblies and the Turret Ordnance Equipment Sketch Lists of Assemblies for every turret installation of CA 139 class.

**Turret ordnance location arrangements**. All ordnance items listed on pp. 13-16 are mounted in the rotating structure as indicated in the ensuing description of the five floor levels.

**Gun house ordnance arrangement**. Figure 14

**Turret ordnance assembly references**. The exact number and identity of each of these components of the turret assemblies are listed in

shows the location arrangements of all ordnance equipment in the gun house, with exception of the sight and gun attachment shaft transmission systems. These are located at the front above the guns, transversely spanning the compartment, and under the floor at the



sides and rear of the gun pits. In addition to the ordnance installations, the picture also shows the positions and relative sizes of some large elements of the ventilating and sprinkling auxiliary installations described on pp. 52-60.

In the gun house are located all units of all three guns, except the forward portions of the barrels and the power plants of their slide power equipments The latter are located two levels below.

Other principal units in this space are components of the fire control equipment. They are grouped in three locations; trainer and sight setter controls at the right side, pointer and checker controls at the left side, and controls for the turret officer, the turret captain, the three gun captains, the radar control operators, and the computer operators in the booth over the overhang at the rear of the compartment. Many elements of these controls are mounted

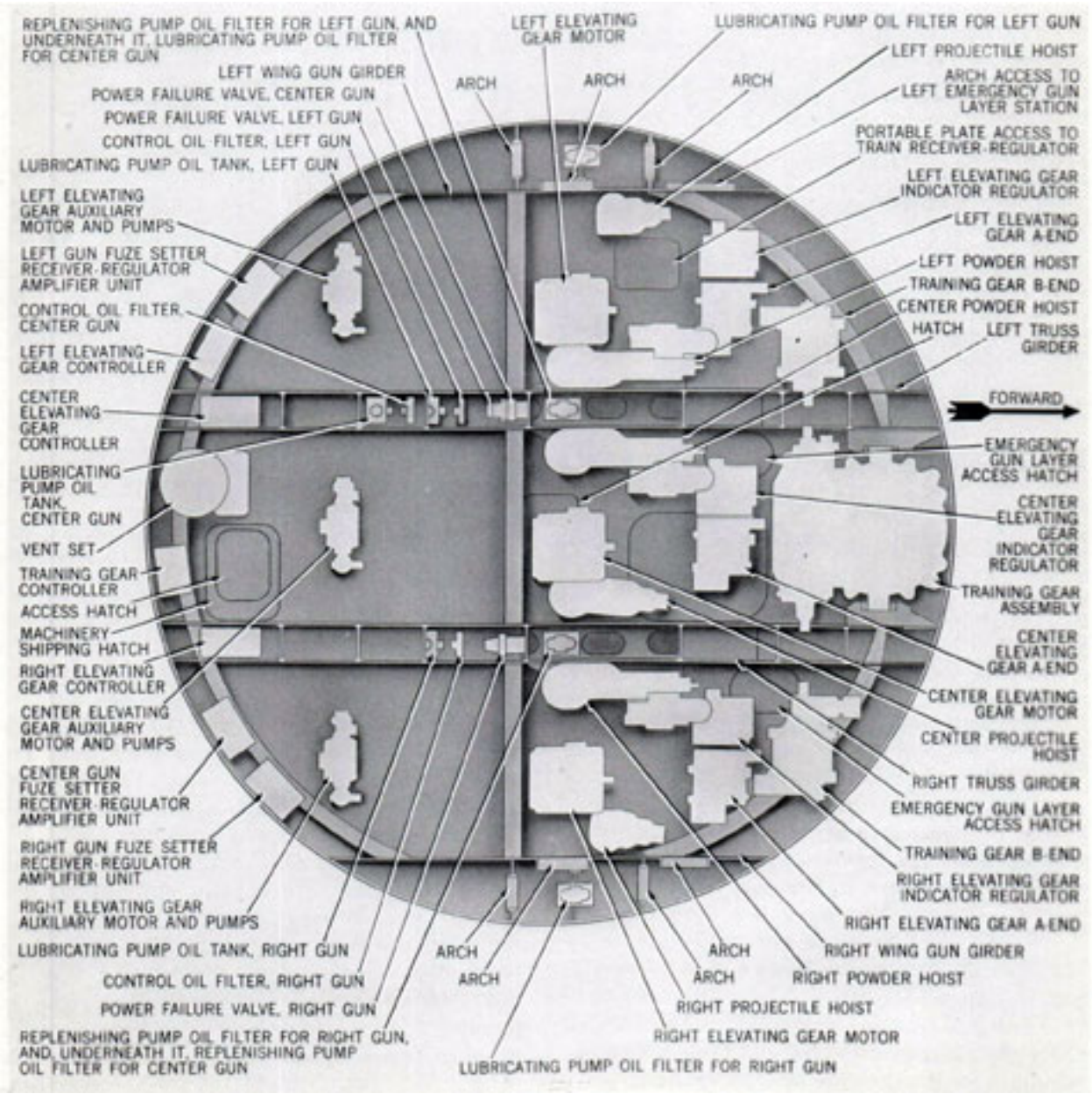


*Figure 16. Ordnance Equipment on Pan Plate. General Arrangement. Plan View*

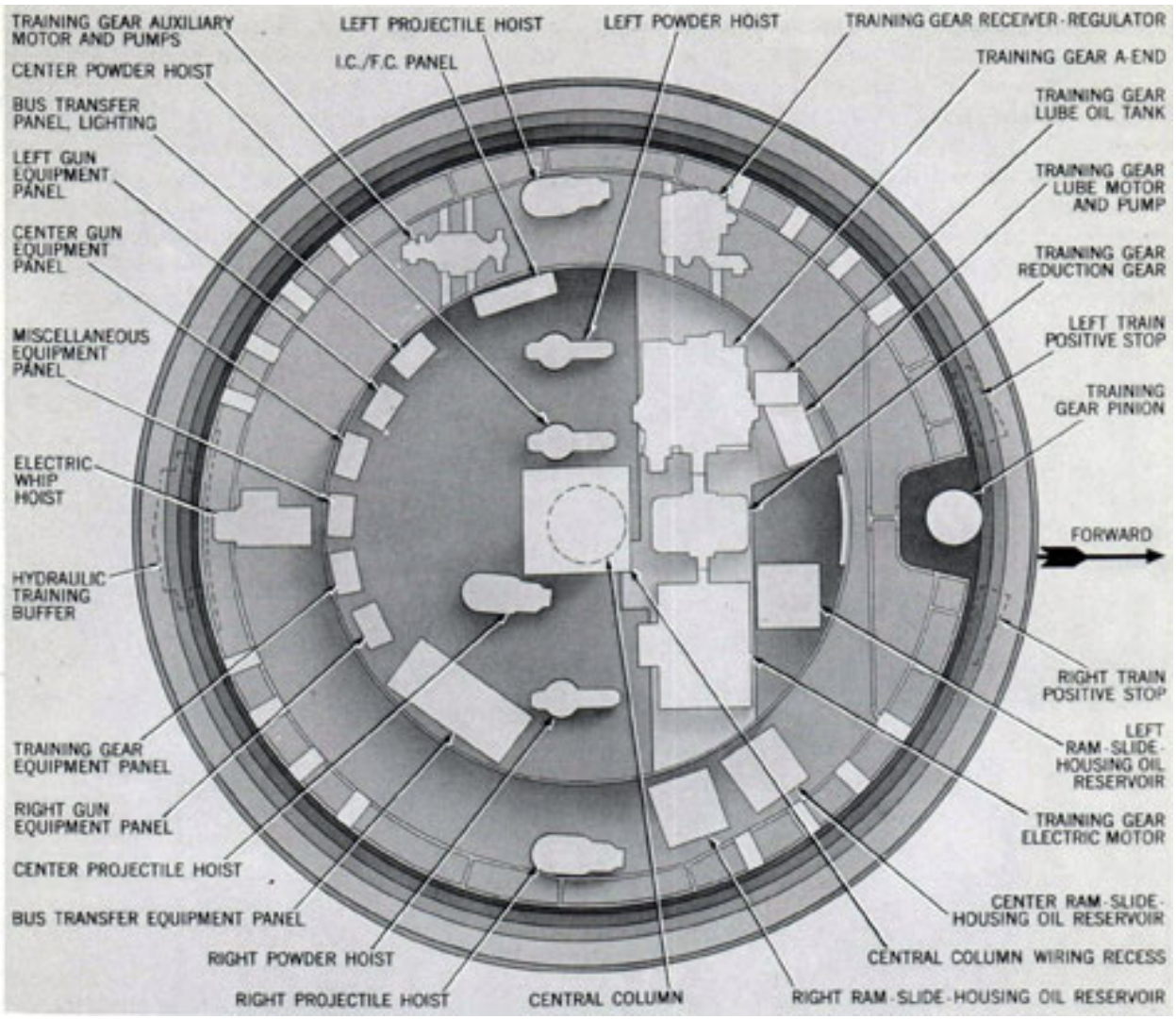


*Figure 17. Ordnance Equipment Above Upper Projectile Flat. General Arrangement. Plan View*

on panels under the rear transverse roof girder and are not shown in the figure. They are identified in the descriptions of the fire control arrangements on pages 43-45.

**Gun pits ordnance arrangement**. Figures 15 and 16 show the location arrangements of all ordnance equipment in the gun pits; units immediately under the guns are designated in figure 15, while those on the pan plate or on platform structures are located just above the pan in figure 16.

In the gun pits are located all components of three elevating gear drives and their indicator-regulator controls, parts of the training gear drive, the upper ends of six ammunition hoists, three fuze setters and fuze setting regulators, electric controller cabinets, and many tank and other devices. of the elevating and training gears. Many of these units are mounted within the void spaces of the two truss girders.

Two important access hatches are indicated in figure 16. These are control station hatches giving access to the emergency gun laying stations for the right and center guns. They are reached by ladders from the upper projectile flat. The similar station for the left gun is manned from the gun house via a hatch indicated in figure 14 and thence through the left wing girder compartment and the archway designated on figure 16.

**Upper projectile flat ordnance arrangement**. Figures 17 and 18 show the location arrangements of all ordnance equipment and of stowed ammunition units in the upper projectile flat compartments. Figure 17 designates the units that are above the floor and overhead; figure 18 those on the floor.

In the inner compartment of this space are four ammunition hoists, three principal units of the training gear drive, eight electric power cabinets, a large hydraulic oil reservoir, and a motor, pump, and tank of a training gear lubricating system, all as shown in figure 17; also two projectile ring drives, a parbuckling gear motor, gypsy head, and steady arm mechanism, 74 service projectiles, and three drill projectiles, as identified in figure 18.

In the outer compartment are two ammunition hoists, a whip hoist, two large hydraulic reservoirs, training gear control motor, receiver-regulator and main driving pinion, as indicated in figure 17, and, nine power plants for hoists and slide equipment, two parbuckling gypsy heads, two steady arm mechanisms, and 151 service projectiles and four drill projectiles, all as shown in figure 18.

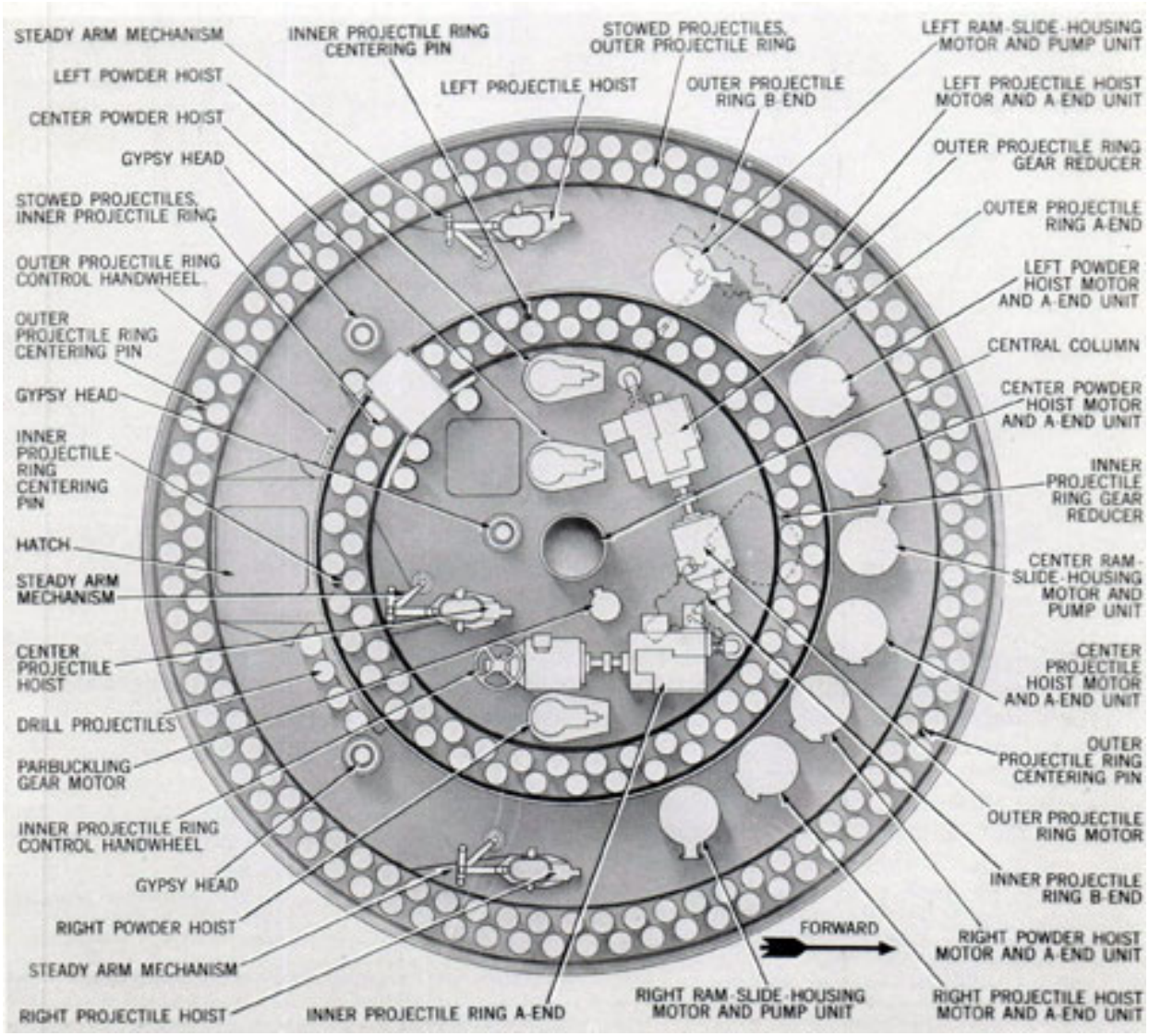


*Figure 18. Ordnance Equipment on Upper Projectile Flat General Arrangement. Plan*

*View*

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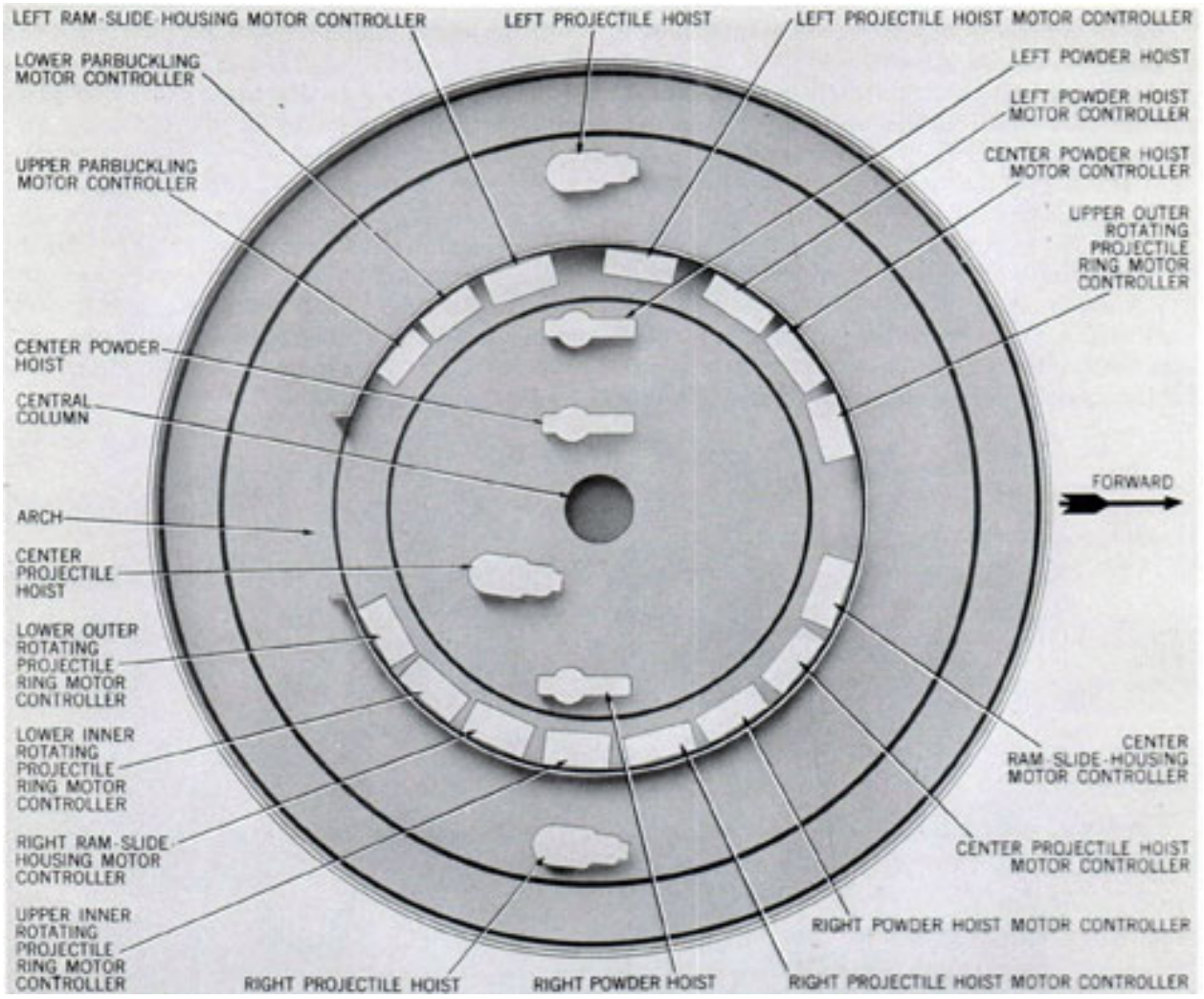


*Figure 19. Ordnance Equipment Above Lower Projectile Flat General Arrangement. Plan View*

This congested flat has clear areas for handling projectiles in the immediate vicinity of the three projectile hoists only.

**Lower projectile flat ordnance arrangement**. The arrangements of the lower projectile flat are similar to those of the upper flat with respect to the ammunition hoists, parbuckling gear, and projectile ring installations. Projectile stowage is the same, with the exception of one additional drill projectile. These arrangements and the following differing details are indicated in figures 19 and 20.

power drive controllers except the elevating and training gear drive controllers, which are in the gun pits (fig. 16).

In the outer compartment, three large relay tanks of the gas ejector air supply system are mounted in the forward quadrant. This compartment has space for stowing 40 additional projectiles in the forward sectors, but the initial turret designs do not include stowing brackets and lashings.

**Powder handling flat ordnance arrangement**. Figure 21 shows the arrangements at the bottom of the turret. These include three powder hoists and

In the inner compartment, 15 electric controller cabinets are mounted on the circular bulkhead over the projectile stowage, as shown in figure 19. These comprise all of the ordnance their loading scuttles, and six magazine scuttles.



This picture also indicates three compartment subdivisions in the rotating structure.* These are miscellaneous store rooms for powder drill cases, turret tools and accessories, and an oil clarifying plant. The latter is a Skinner pump, filter, tanks, and pipe system for flush-cleaning the hydraulic drive units and purifying the hydraulic fluid.

**Ordnance designs**

The installation arrangements described on pages 22 to 26 include design features, details of construction, and functional relations of equipment controls that adapt the assemblies for continuous automatic fire. These are mechanical, electrical, and hydraulic operating and controlling devices which enable the guns to be separately served and loaded but provide for different methods of selective control of all guns and the turret, so that the turret is controlled as a unit. They constitute new turret operating and coordinating systems. The features of each type of assembly that provide these characteristics are briefly indicated in the descriptions beginning on page 22.

*For an explanation of this compartment and structural arrangement, see page 6.

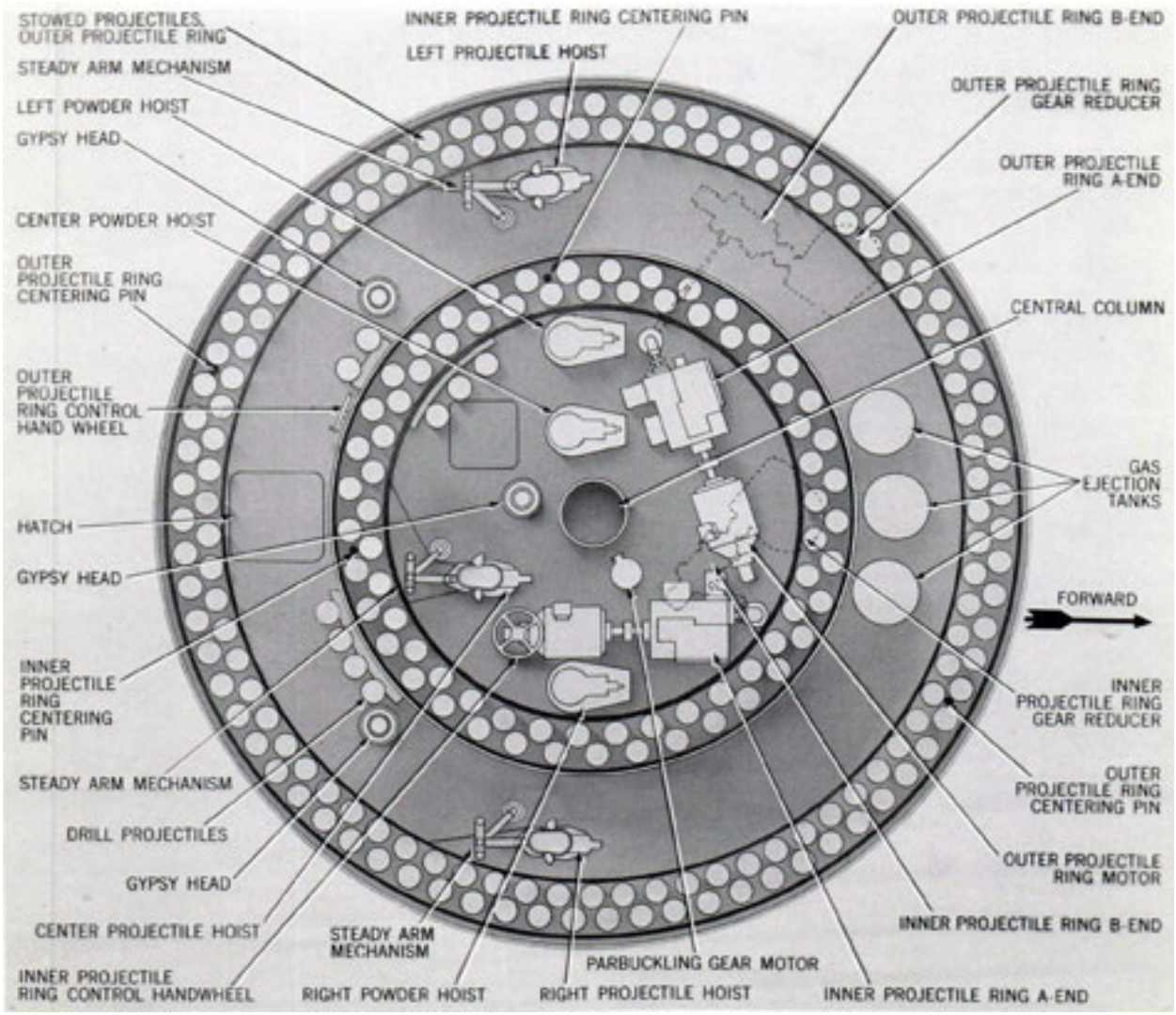


*Figure 20. Ordnance Equipment on Lower Projectile Flat General Arrangement. Plan View*

**21**

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## Gun and slide assemblies

Figures 22, 23, and 24 show the assembled arrangements of a typical gun. This unit consists of a gun, gun housing, gas ejector, slide, rammer, and case ejector.

**Gun**. The gun is a two-piece 8-inch/55-caliber design consisting of a tube and a rifled liner. It is a "loose" assembly, the liner being fitted for convenient removal and replacement on board ship. Powder chamber and breech designs provide for pre-loaded semifixed ammunition.

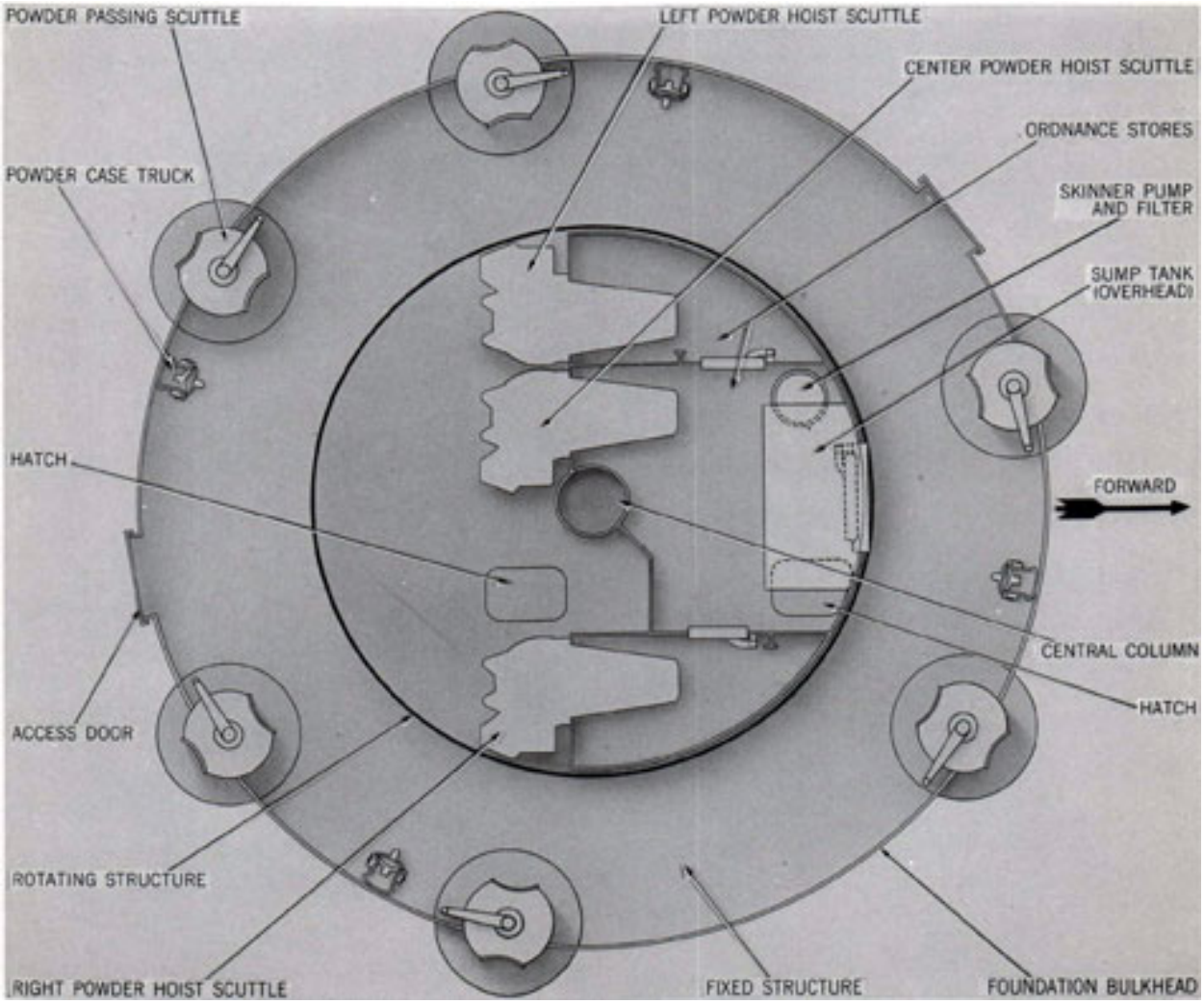



*Figure 21. Powder Handling Flat. General Arrangement Plan View*

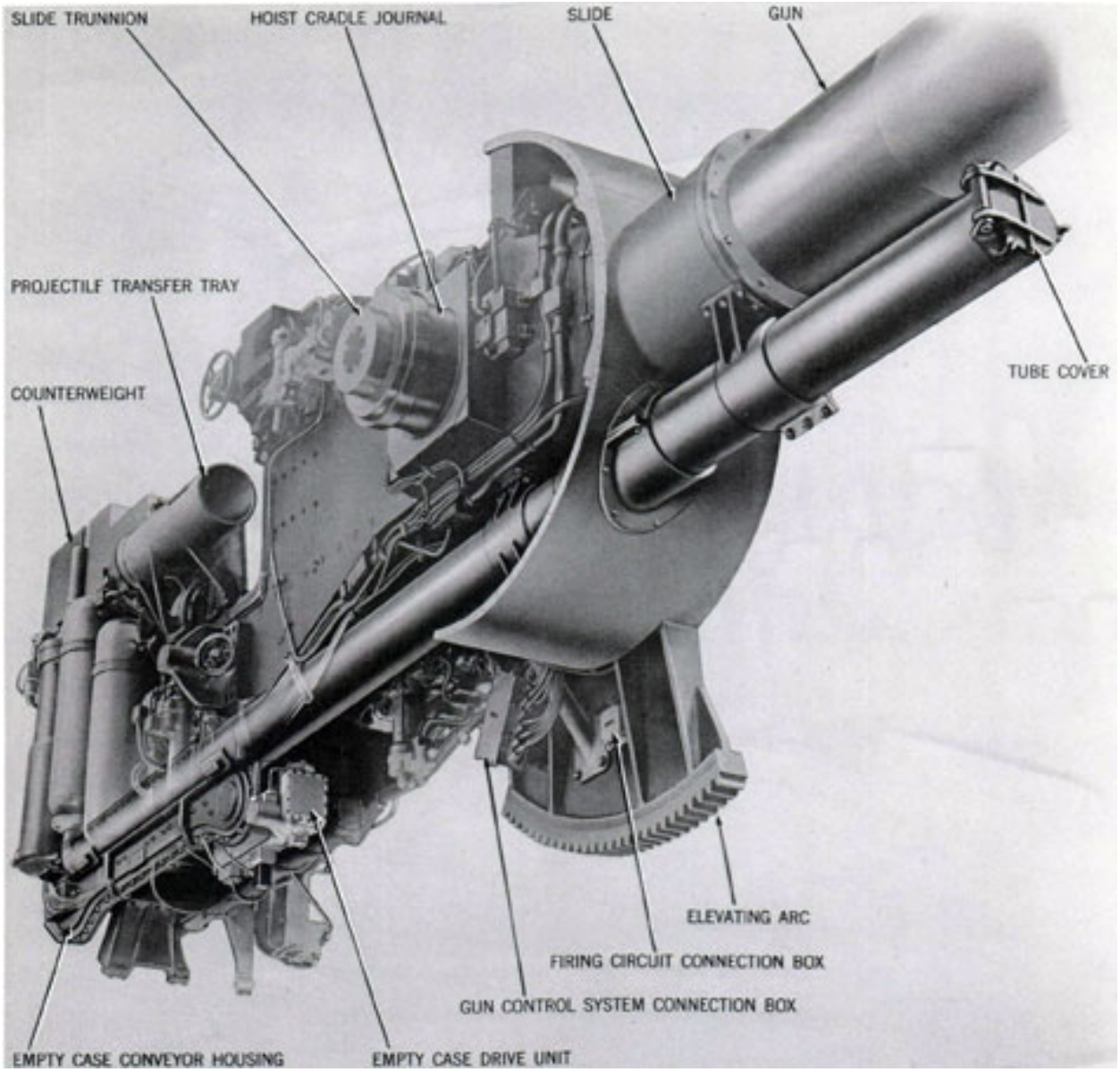



*Figure 22. Gun and Slide Equipment. General Arrangement Bottom View*

**Gun housing**. The breech mechanism is a sliding block type similar to the 6-inch/47-caliber light cruiser gun arrangements. It includes hydraulic power cylinder and manual operating devices, as shown in figure 25. The unit is part of the large steel forging designated "housing" which is attached on the gun shoulder and rear cylinder by a bayonet-type joint.

**Gas ejector**. Internal air leads and nozzles of the housing and connecting air lines and air porting valve on the slide comprise the gas ejector system. Their arrangements are shown in figure 26. This system is entirely automatic, porting air to the breech nozzles when the case extractors operate and cutting off flow according to time-setting of a pilot valve.

**Slide**. The gun slide is a loading-tray type. It supports the gun and housing in a cylindrical bearing and two parallel rails. It controls gun recoil through a hydraulic cylinder unit as

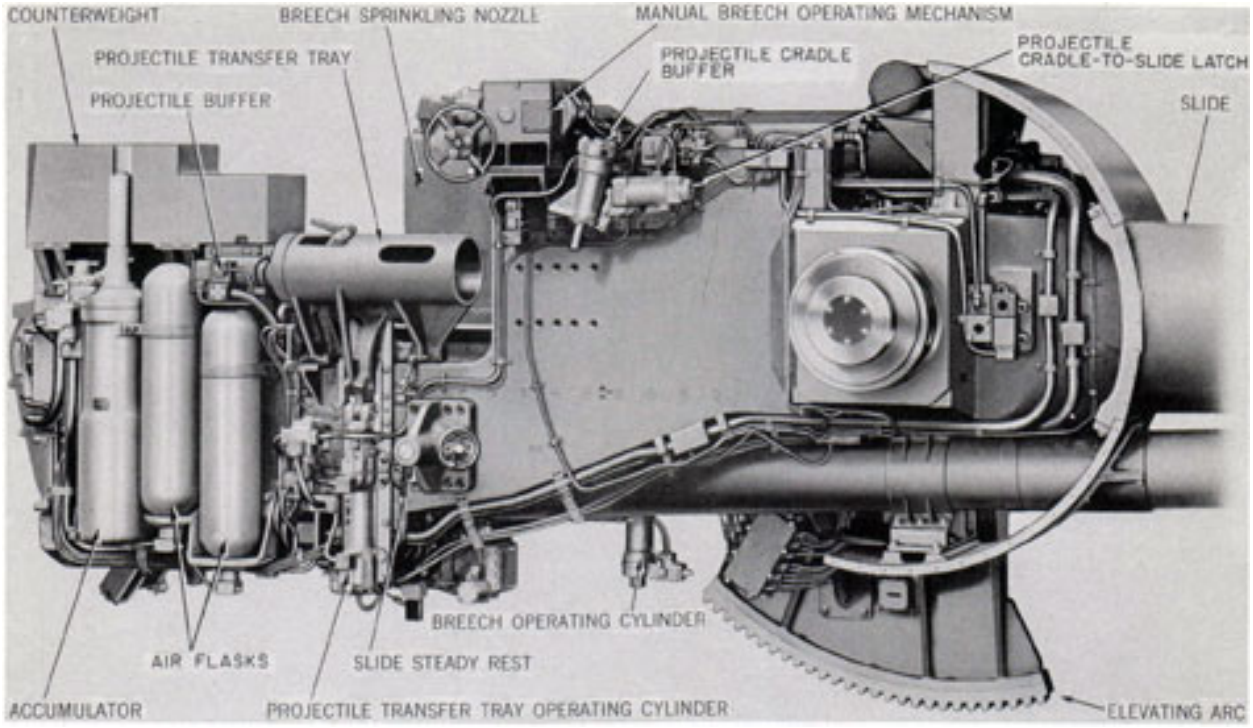



*Figure 23. Gun and Slide General Arrangement Right Side*

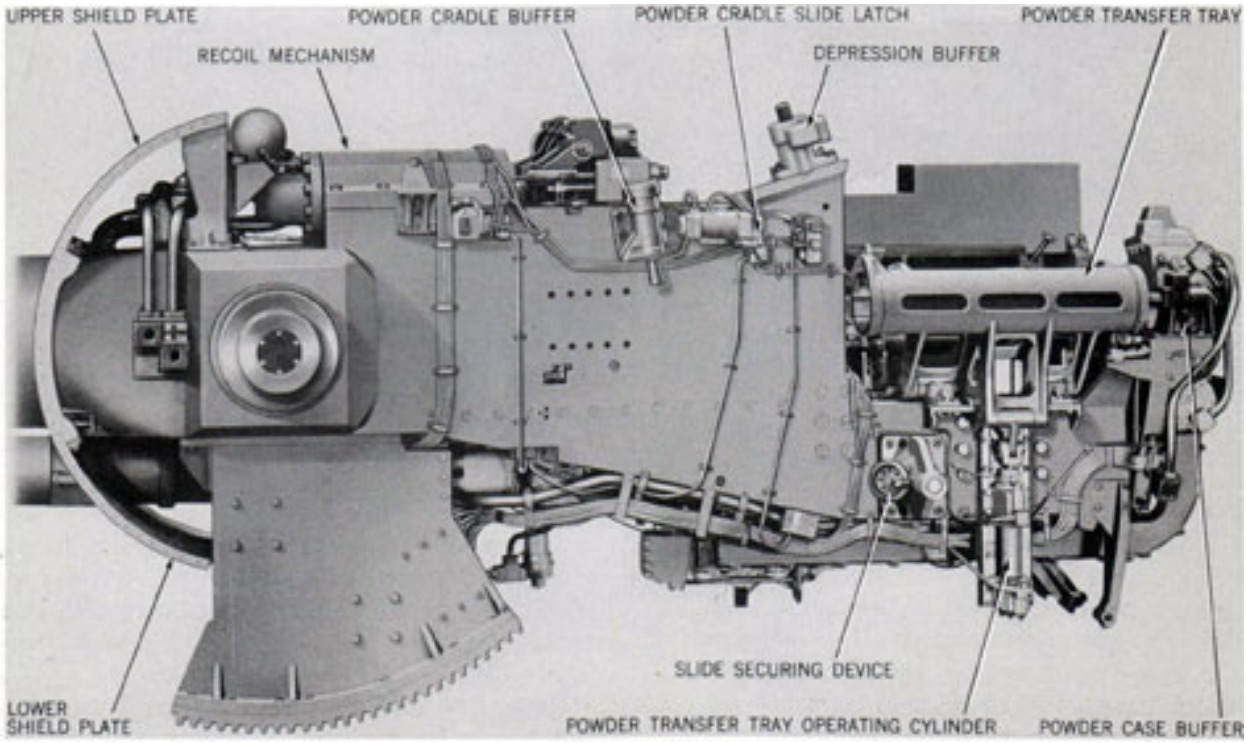



*Figure 24. Gun and Slide General Arrangement Left Side*

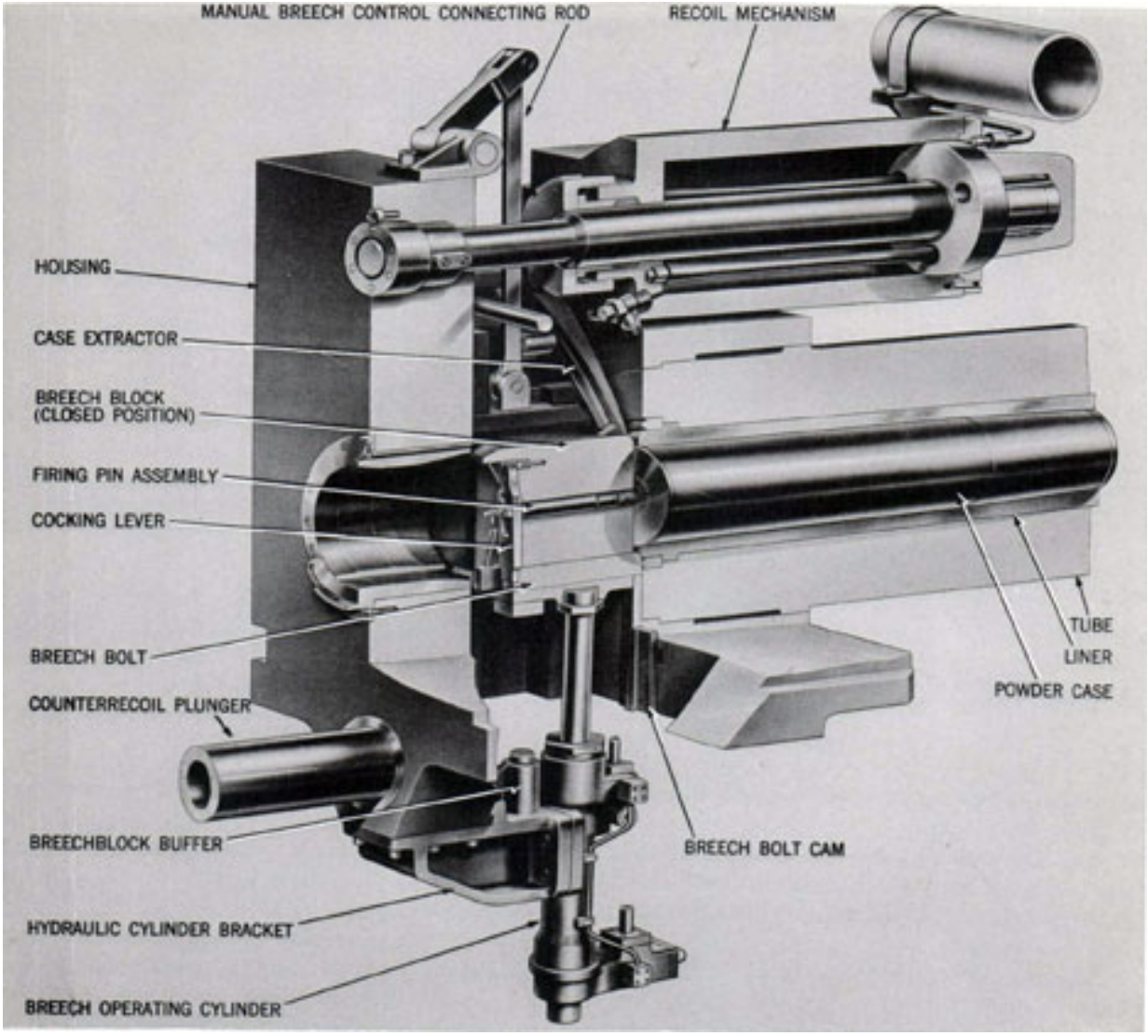



*Figure 25. Gun and Housing Arrangement*

shown in figure 25, and returns the gun to battery by means of a conventional hydropneumatic counterrecoil cylinder unit. Its loading-tray design includes two large tubular transfer trays, hinged and operated by hydraulic cylinders arranged as shown in figures 23 and 24.

These trays fold inboard into ramming position in alignment with the bore and a power-operated folding chain rammer. The power unit is a hydraulic motor, mounted at the rear and coupled to a large chain sprocket.

The powder transfer tray of this loading tray arrangement has an attached tray that is mounted on curving rails. This tray is called an empty-case tray. In firing position it is aligned with the bore and receives extracted empty powder cases. When the transfer trays move to loading position for ramming the next round, the empty-case tray dumps the empty case into a compartment at the rear and bottom of the slide. In the floor of this compartment is an endless chain conveyor, driven by a hydraulic motor, arranged as indicated in figure 22. This conveyor thrusts the empty case into a tube that extends through the gun port shield and the front of the turret.

The slide is pivoted by means of trunnions in roller bearings supported in deck lugs that are

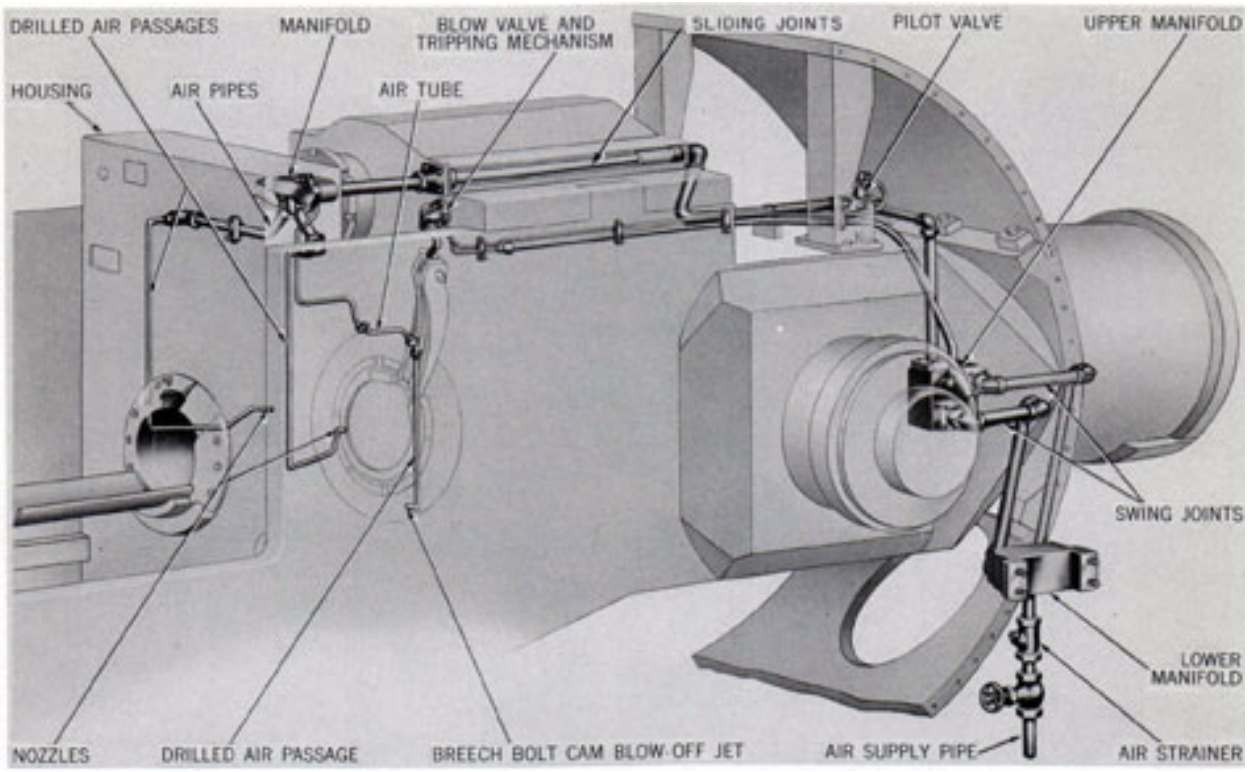



*Figure 26. Gas Ejector System. General Arrangement*

attached to gun girder extensions illustrated in figure 3. In this position, the entire assembly of gun and slide is balanced, and the elevating arc indicated in the pictures is meshed with a spur pinion of a speed reducer of the elevating gear mechanism.

The trunnion arrangements of the slide include journals for mounting two cradle units. These are elements of the ammunition hoists described on pages 37-41.

**Slide power equipment**. The breech mechanism, the transfer trays, and the rammer and case ejector hydraulic operating units receive hydraulic power for performing their actions from a hydropneumatic accumulator. This unit consists of the large vertical cylinder and two air flasks mounted at the side of the slide as shown in figure 23. It is connected by an extensive system of hydraulic pipes to all operating units and to a pump that is mounted with its electric motor on the upper projectile flat, as shown in figure 27. A feature of this power operating arrangement is Slide equipment control system. Hydraulic power operations of the gun units are controlled by an electric installation of switches and solenoids. These are limit and interlock switches and valve operating solenoids on the breech, rammer, tray and case ejector mechanisms, and control switches of a gun captain's control panel. The latter is mounted at the rear of the gun in the turret officer's booth. Its interconnecting system of wire circuits to the slide switches and solenoids, and the identities and functions of the latter, are indicated in figure 27. This system enables all loading and firing actions to be performed without attendants in the gun compartment and without stopping gun laying. It is part of the system which controls the hoists as well as the slide, breech, and rammer. This system is called the **gun loading control system**.

**Gun laying equipment**

Figures 28 to 34 inclusive show assembled

continuous delivery of power, throughout the periods of all gun loading and gun firing actions.

arrangements of the turret turning mechanism and typical gun elevating drives and their controls. These units consist of the training gear



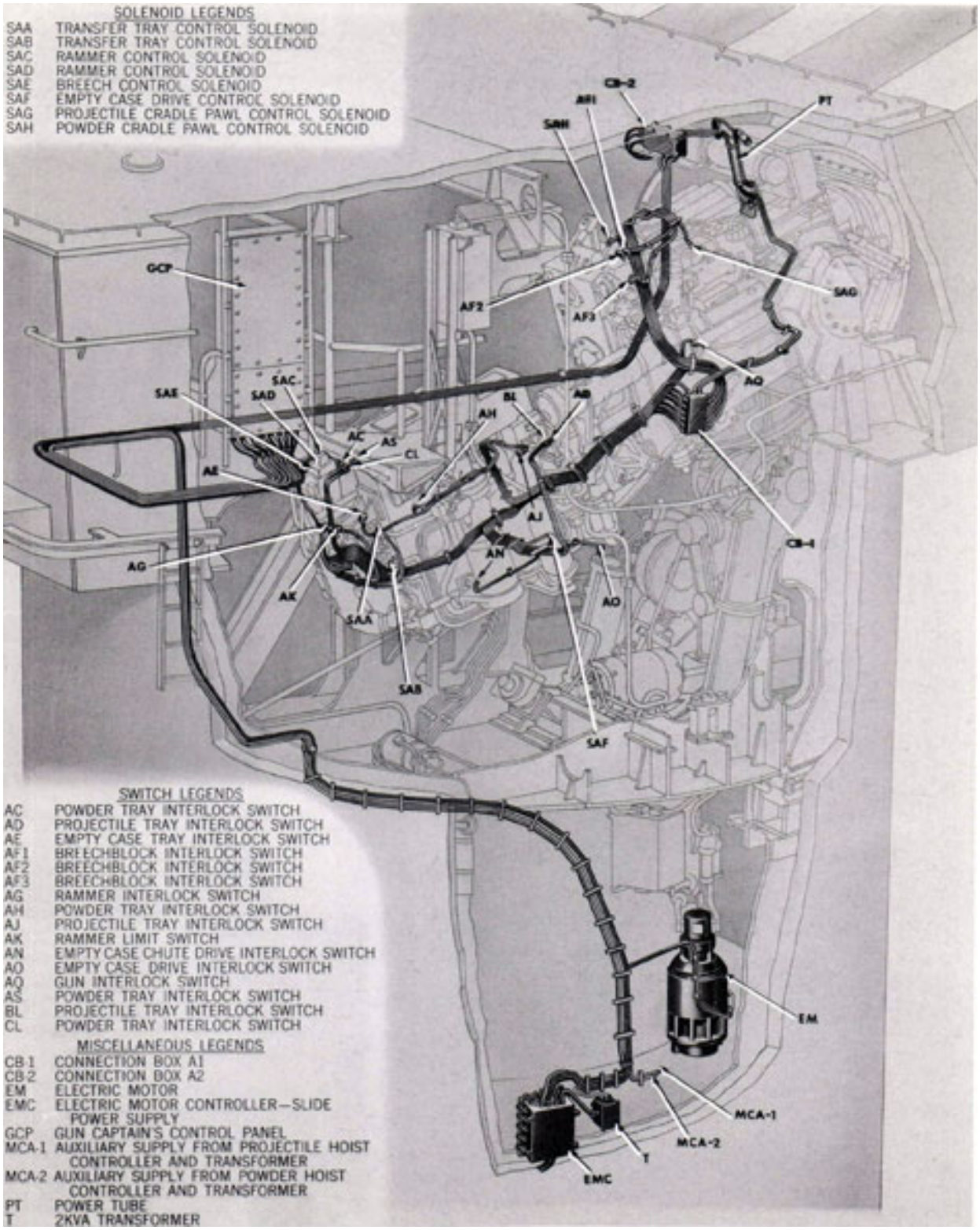



*Figure 27. Gun Control System. General Arrangement*

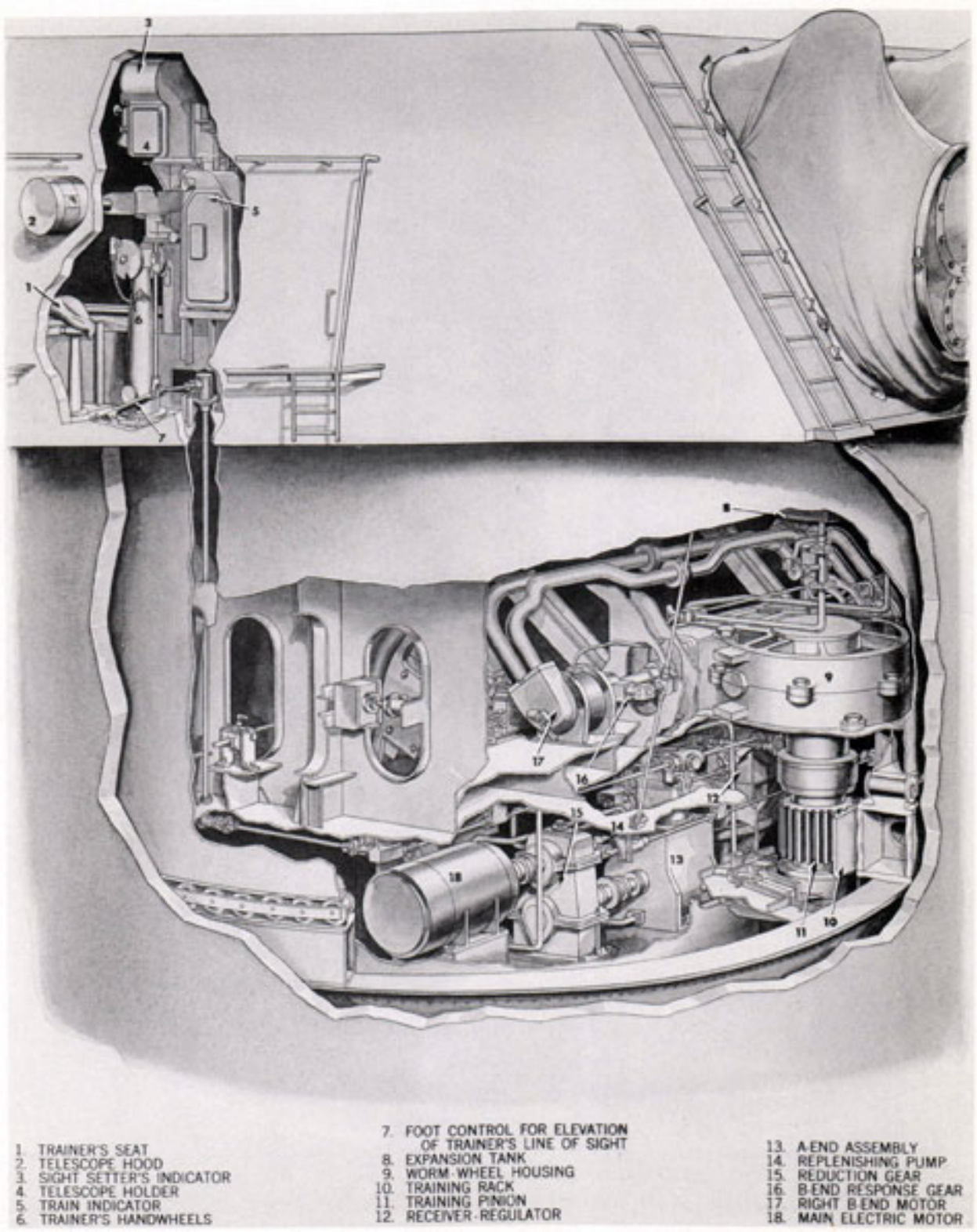



*Figure 28. Training Gear. General Arrangement*

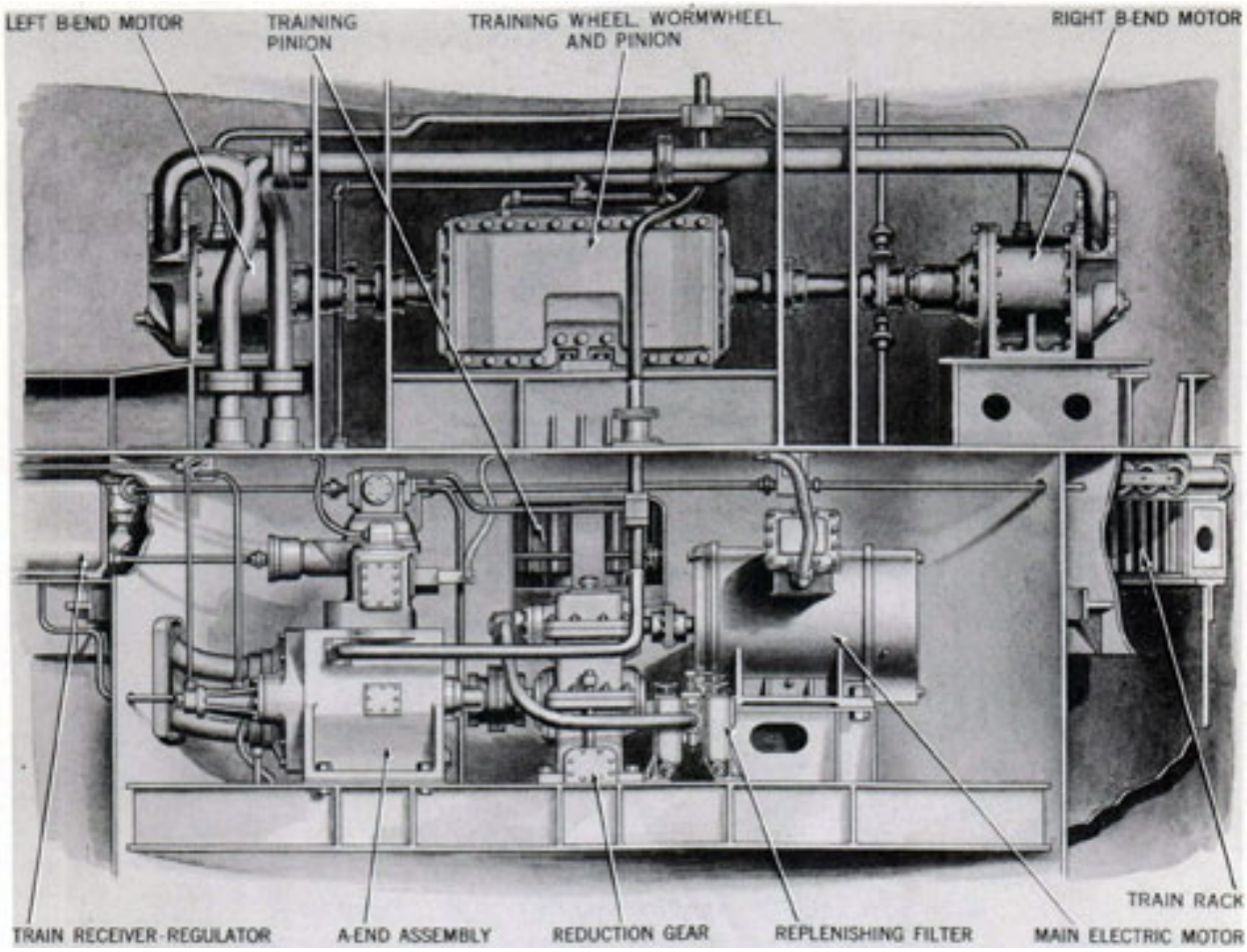



*Figure 29. Training Gear Power Drive. General Arrangement*

electric-hydraulic drive equipment, train receiver-regulator, and control station equipment for the turret turning system; and three elevating gear assemblies, three gun elevation indicator-regulators, and one pointer's control station equipment for the gun elevating system.

**Training gear**. The training gear is a worm, wormwheel, and pinion mechanism meshed with the large fixed circular rack on the lower roller track and driven by an electric-hydraulic power drive. Its installed arrangements at the front of the turret are shown in figure 28, and the components and arrangements of the power drive assembly in figure 29.

The drive consists of a 125-horsepower electric motor coupled to a large reduction gear which drives a Waterbury A-end pump assembly. The valve-plate of the latter is connected hydraulically to two Waterbury B-end motors by a system of large pipe manifolds-an arrangement that delivers equal volume and equal fluid pressure to both hydraulic motors. Motors are coupled at opposite ends of the driven worm. Thus drive torque is the same at both ends of the worm.

**Training gear control**. Hydraulic fluid delivery to the B-end motors is controlled by varying the displacement of the A-end pump. Three methods are provided for controlling this output. Two are hydraulic power servo control selections, the third is a manual mechanical control method.

The servo control methods are provided by the receiver-regulator instrument and its auxiliary hydraulic power supply unit shown in figure 30, and by a stroking cylinder device on the A-end pump. These units operate in response to signal inputs to the regulator instrument.

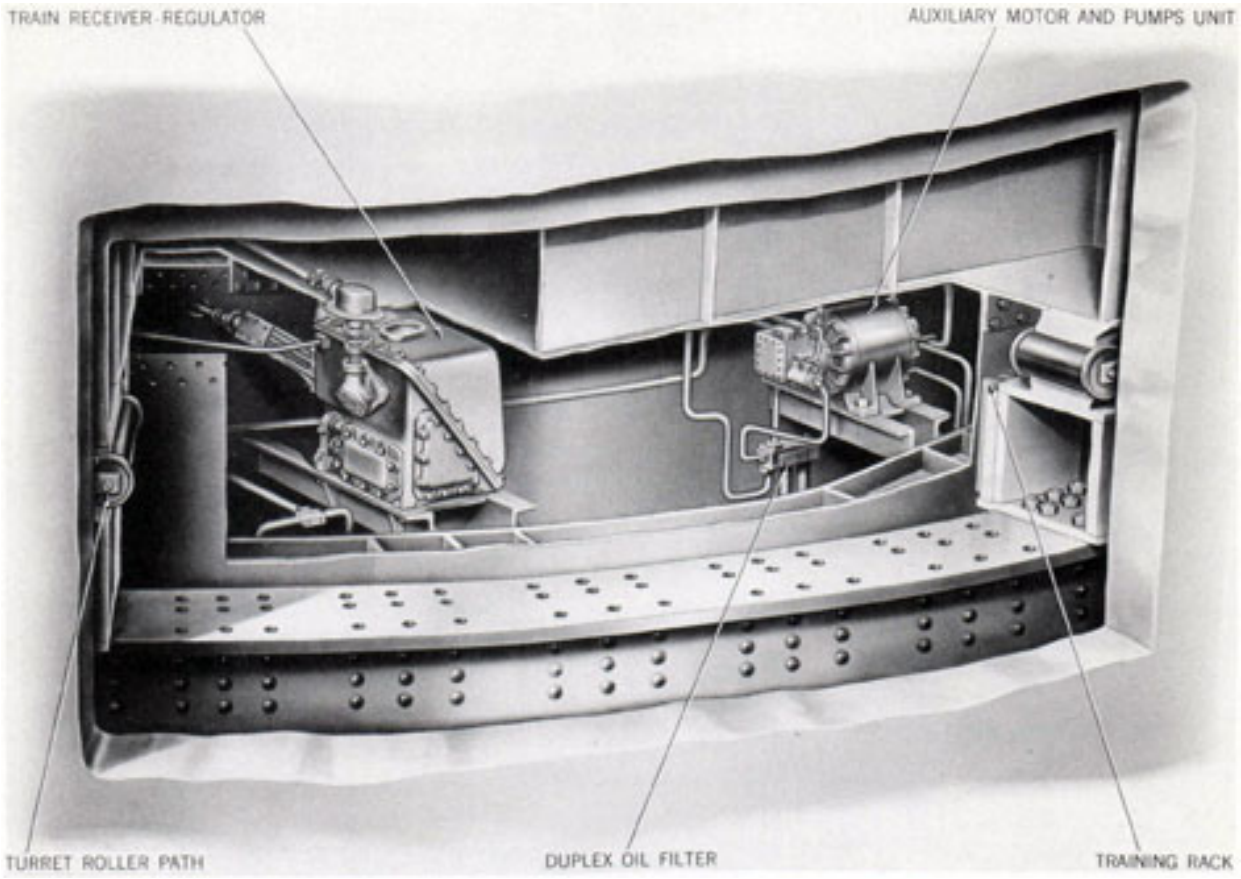



*Figure 30. Train Receiver-Regulator and Auxiliary Power Unit Turret Arrangement*

The latter amplifies the signal and ports an equivalent amount of servo fluid to the stroking cylinder to cause the A-end to deliver an equivalent amount of drive fluid to the B-end motors. This action can be controlled by receiving an electrical signal from a remote director or by receiving a mechanical signal from the trainer's handwheels. These methods are called AUTO and LOCAL control respectively.

The third method of control is called HAND. It does not use the servo control units. It controls the A-end pump output by mechanically stroking the pump tilting device through direct connection with the trainer's handwheels.

**Trainer's control equipment**. The control devices at the trainer's station that enable him to panel, the control selector, the handwheels, the train indicator, and the sight. The manner in which they are employed in the different methods of control is explained in Chapter 2; their arrangements are as follows:

The control and indicator panel is an electrical cabinet containing the power drive master switch and six indicator lights. By means of the master switch the main and auxiliary electric motors are started and stopped. Indicator lights show the conditions of power supply circuits for the regulator instrument as well as the power drive and include "ready," "neutral," and "stop" indicators.

The control selector is a manually operated lever that has three positions, designated, HAND, LOCAL, and AUTO, respectively. It actuates a

start and stop the drive, to select the method of control, and to control turret turning in LOCAL and HAND control are identified in figure 31. They are the control and indicator flexible cable that is connected to a device at the regulator which positions a selector valve of that instrument.



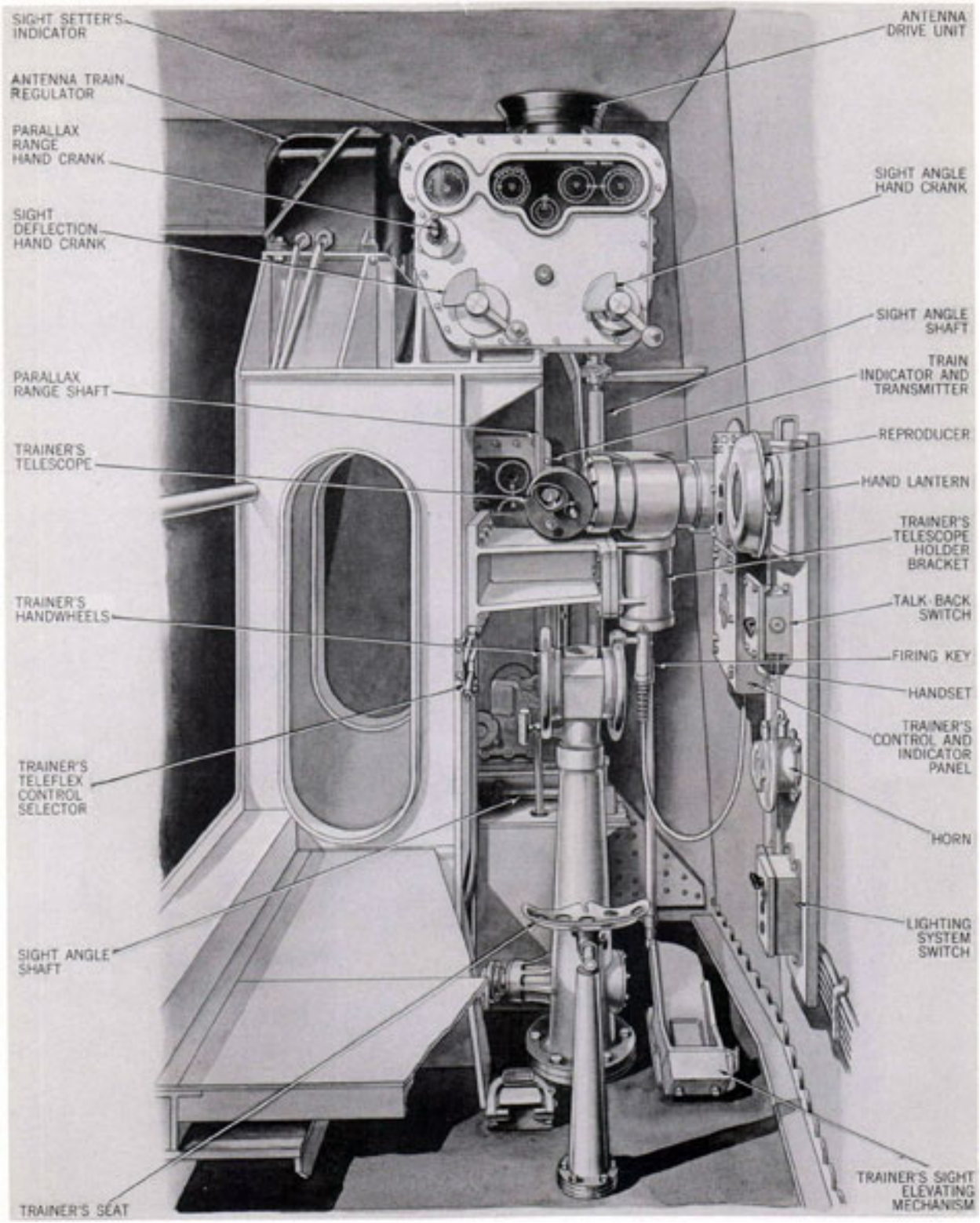



*Figure 31. Trainer's and Sight Setter's Station General Arrangement*

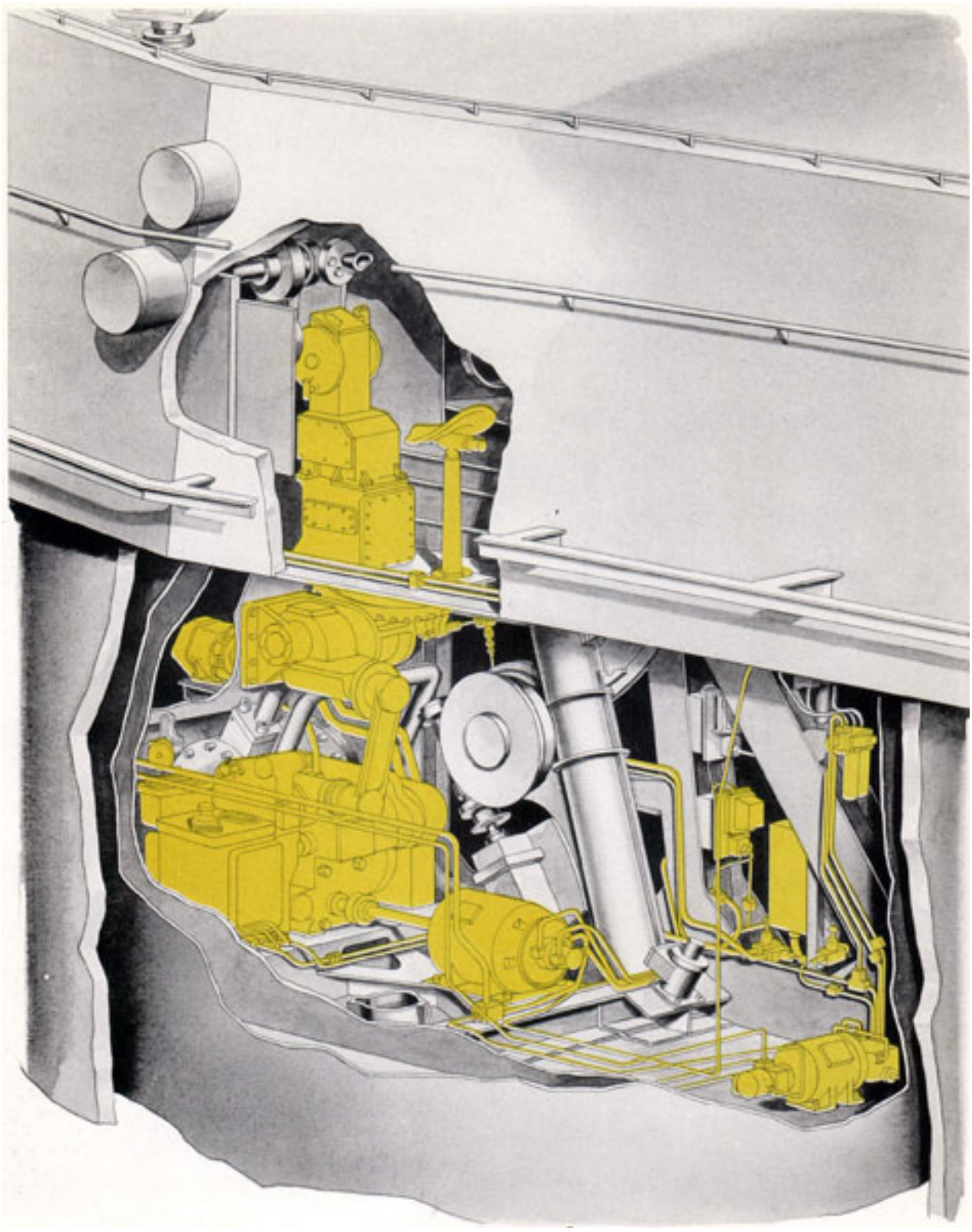


*Figure 32. Elevating Gear General Arrangement*

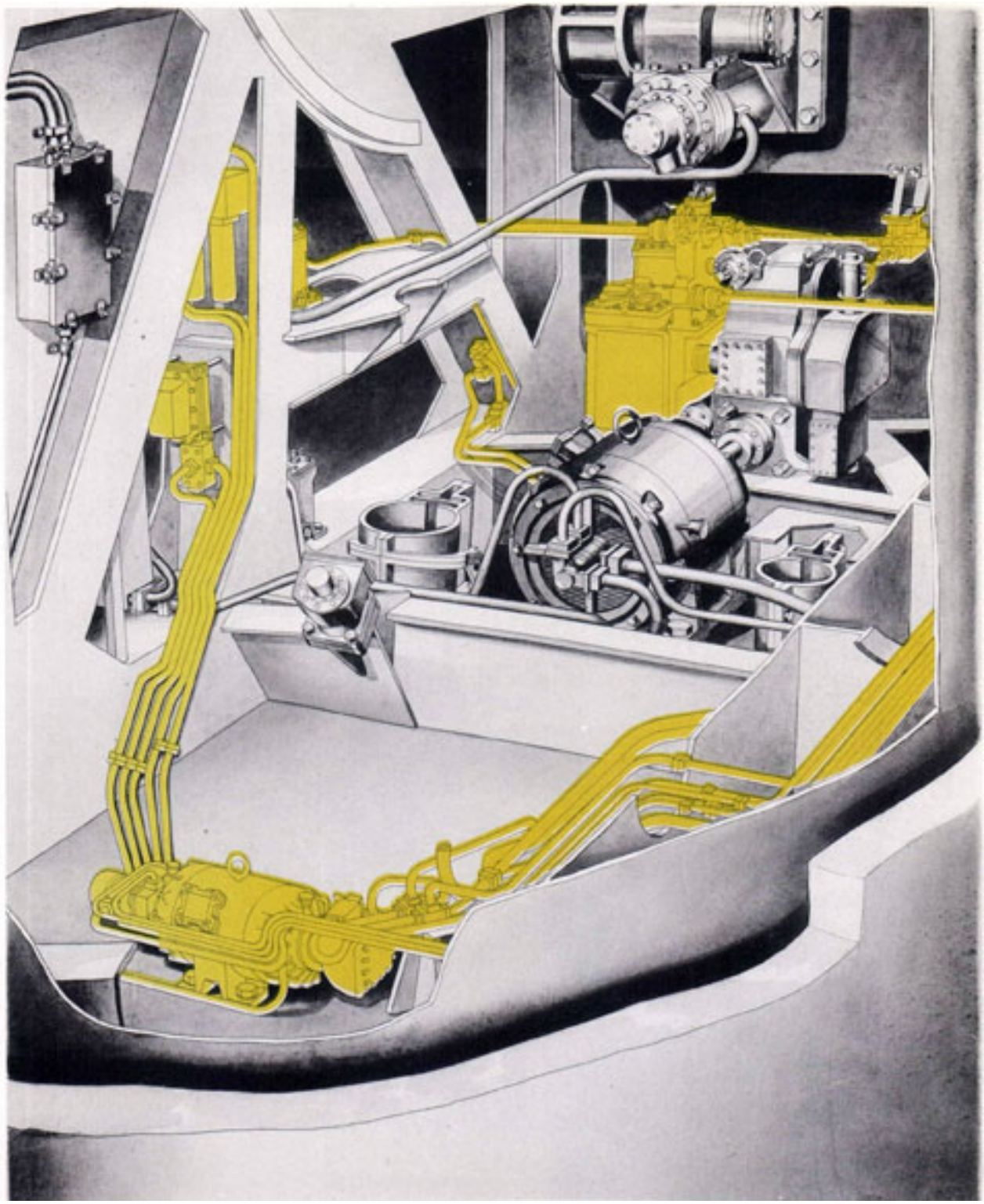


*Figure 33. Turret Arrangement of Elevation Indicator-Regulator and Auxiliary Power Unit*

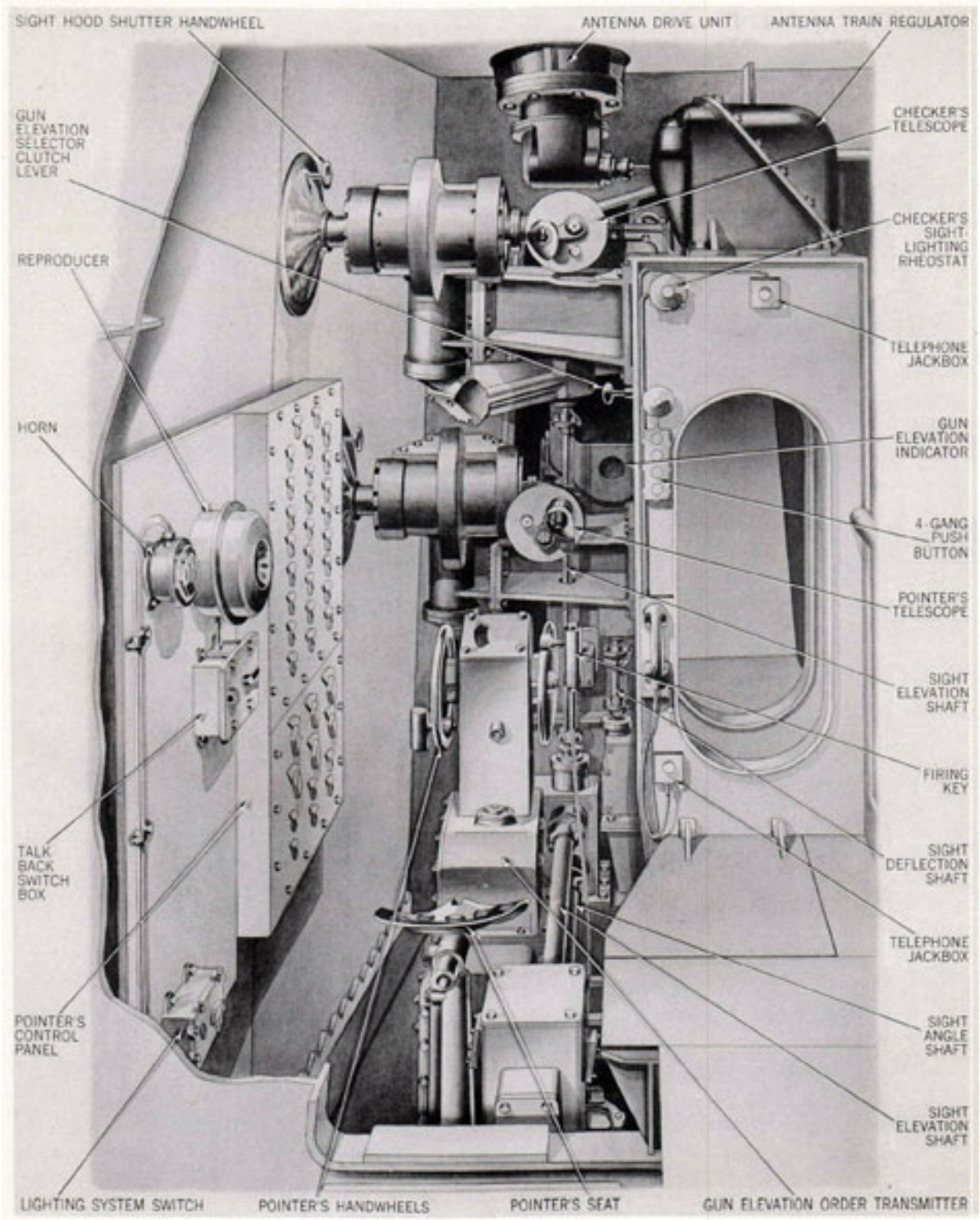



*Figure 34. Pointer's and Checker's Stations General Arrangement*

The handwheels are part of a conventional hand control gear that extends to mechanical inputs at the A-end assembly and the regulator. These are clutched and unclutched hydraulically for the respective control selections by shifting of the selector valve and other control valve units.

The train indicator is a gun order follow-the pointer dial indicating instrument providing turret train direction in LOCAL or HAND control. In addition to its conventional arrangements for visually directing trainer handwheel operations, it includes an electrical transmitter that is part of an alternative method of automatic drive control. This method is the radar system local train control arrangement described on page 49.

The trainer's sight equipment is part of the sight assembly described on page 45.

**Elevating gear**. Each of the three guns is independently driven in elevation and depression. The three mechanisms do not have mechanical cross-coupling, but their controls are arranged so that they are synchronized to operate together. Alternatively they can be controlled separately.

Each elevating gear is a worm, wormwheel, and pinion reduction gear meshed with the elevating arc of the slide and driven by an electric-hydraulic drive. The installed arrangements in the left and right gun pits, as shown in figures 32 and 33 respectively, are typical of all three assemblies.

Each drive consists of a 25-horsepower electric motor direct coupled to a Waterbury A-end pump assembly. The valve plate of the latter is connected hydraulically to a Waterbury B-end hydraulic motor by two drive pipes, and the B-end output shaft is coupled to the worm of the driven reduction gear assembly.

**Elevating gear control**. Hydraulic fluid delivery operating the slide to an unloading position, called UNLOAD control. Their hand control facilities are different, as explained below.

Elevating gear AUTO and LOCAL methods of operation are similar control actions. In both methods, electrical signals simultaneously control all three drives. Their only difference is the origin of the signals. In AUTO, the signals are received from a remote director, whereas in LOCAL the signals are transmitted from a device that is operated by the pointer's hand-wheels.

UNLOAD control arrangements separately control each drive through switching units of each gun captain's controls.

Elevating gear HAND controls are not pointer controls. They are emergency hand-wheel arrangements that are separate for each drive; they are located in the forward gun pits and operate similarly to the training gear hand method.

At the same gun pit stations are facilities enabling each drive to be controlled with servo power by using a small hand crank of the regulator instrument. This method functions the same as the training gear LOCAL control method, but is designated REGULATOR CHECKING control.

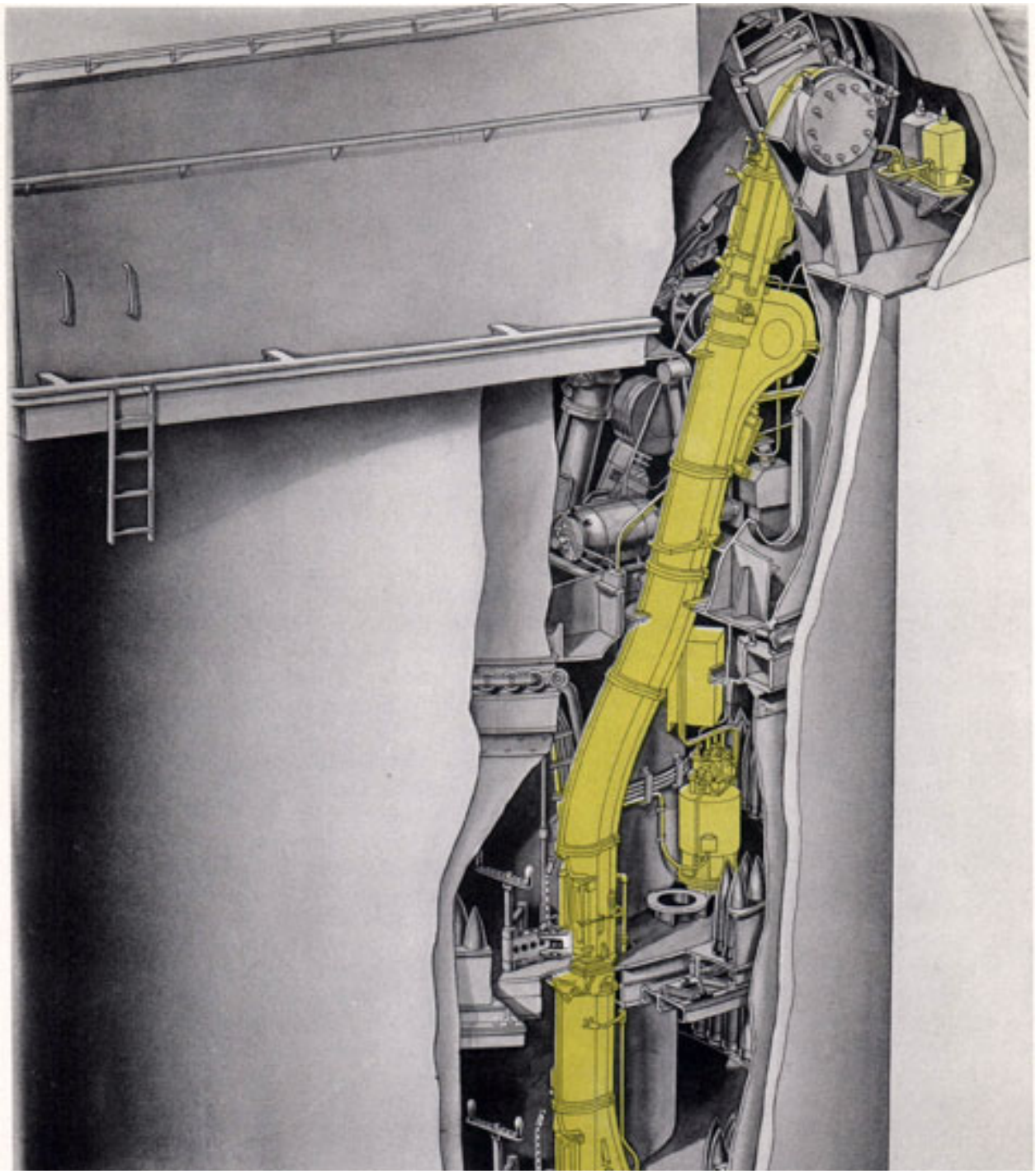
**Pointer's control equipment**. Figure 34 shows the controls at the pointer's station. These devices are similar to the trainer's controls, but their system arrangements differ as indicated in the paragraphs following. The manner in which they are employed in the different methods of control is explained in Chapter 2.

The pointer does not have a mechanical control selector device; instead, the control panel includes three switches that separately control the signal receiving circuit of each regulator. Each of these switches has three position selections, designated

to each B-end motor is controlled by separately varying the displacement of each A-end pump. Each drive has a servo control regulator instrument and an auxiliary hydraulic power supply unit for a stroking cylinder device on the A-end pump. These arrangements are similar to those of the training gear, and they provide similar servo control selections for AUTO and LOCAL control operation. In addition, however, they include provision for automatically HAND, LOCAL, and AUTO, respectively.

Other elements of the pointer's control panel are three vertical columns of indicator lights that show the conditions of readiness of the power and regulator electric supply circuits. Three switches separately control the illumination supplies for these indicators. Another series of three switches are the respective master switches for starting and stopping the main and auxiliary electric motors.





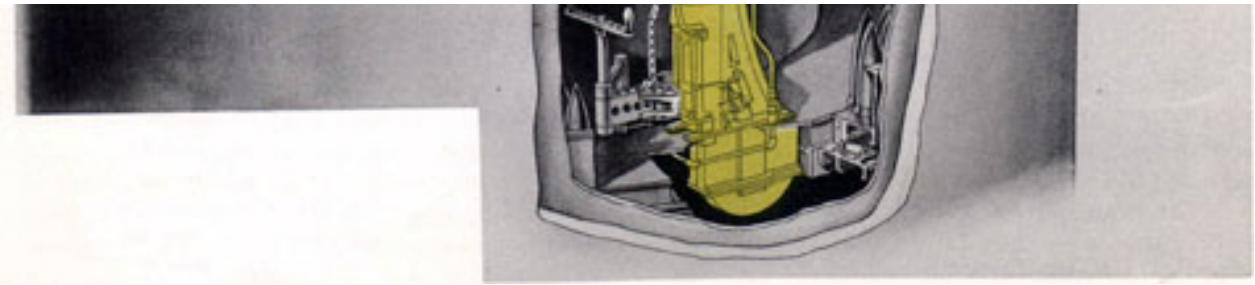


*Figure 35. Projectile Hoist General Arrangement*

**36**

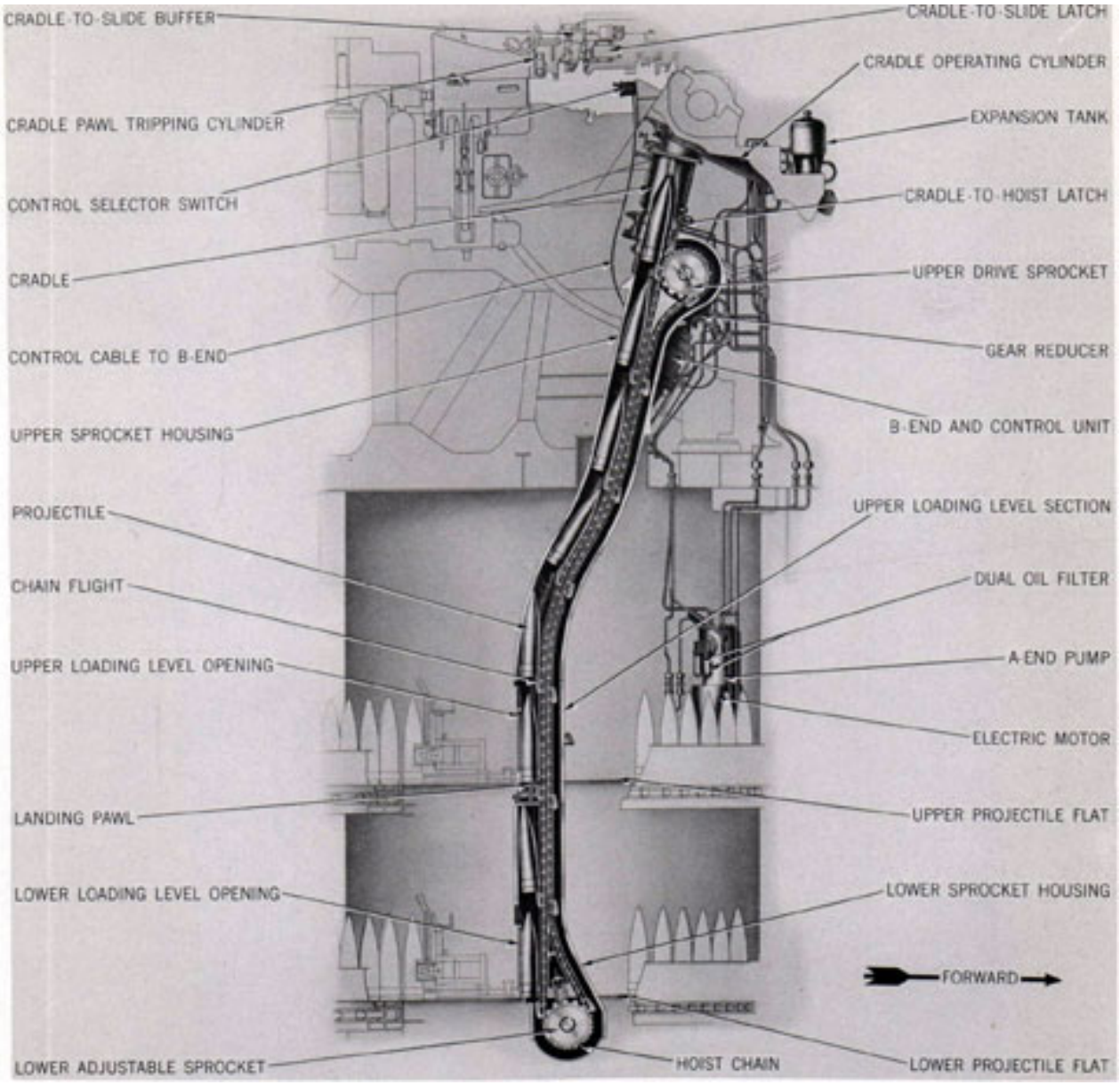



*Figure 36. Projectile Hoist Cutaway*

The pointer's handwheels are a manual drive for electric transmitter units of an instrument, called the Gun Elevation Order Transmitter, mounted under the handwheels. This is the LOCAL control unit for signal transmission to all three gun elevation indicator-regulators.

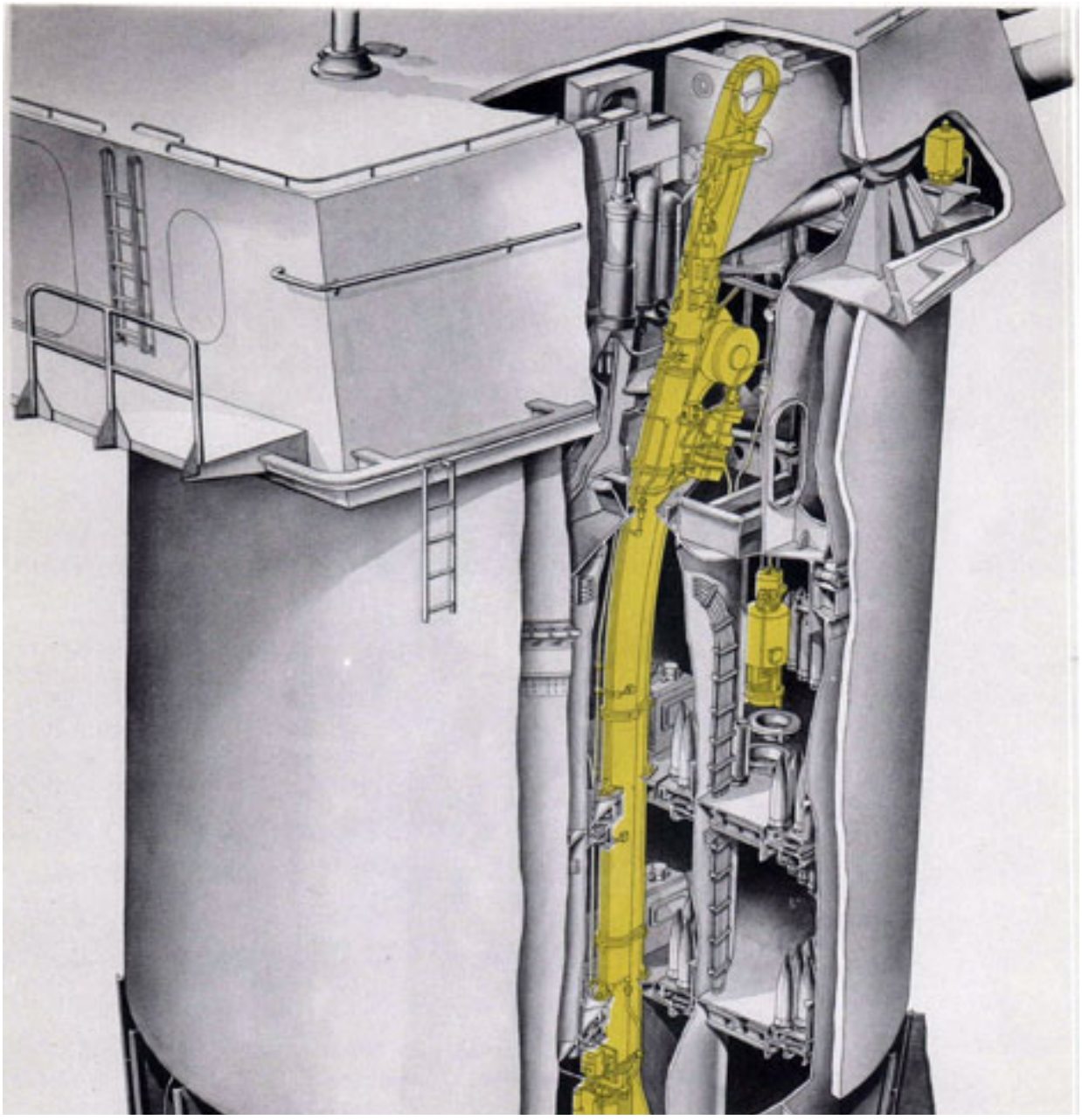
The gun elevation indicator is a gun order follow-the-pointer dial indicating instrument for gun laying direction in LOCAL control.

Pointer's sight equipment is part of the sight assembly described on page 45.

**Ammunition hoist equipment**

The transfer trays of each slide are separately served, automatically, with projectiles and powder cases by two ammunition hoists. These units make their deliveries without stopping the gun laying movements to bring the gun to a loading position (as required in all previous main battery installations) . The designs of the two hoists are similar, as shown in figures 35 to 38 inclusive. Each hoist consists of an endless chain conveyor, a cradle, and an electric





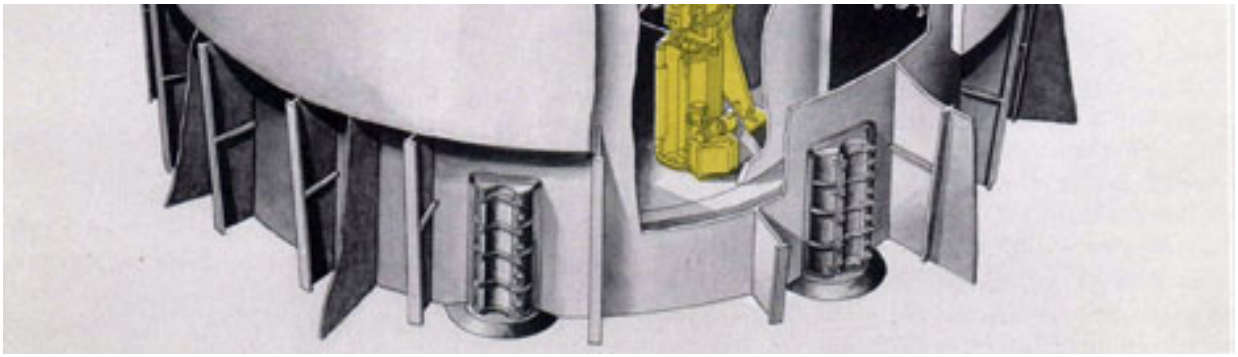
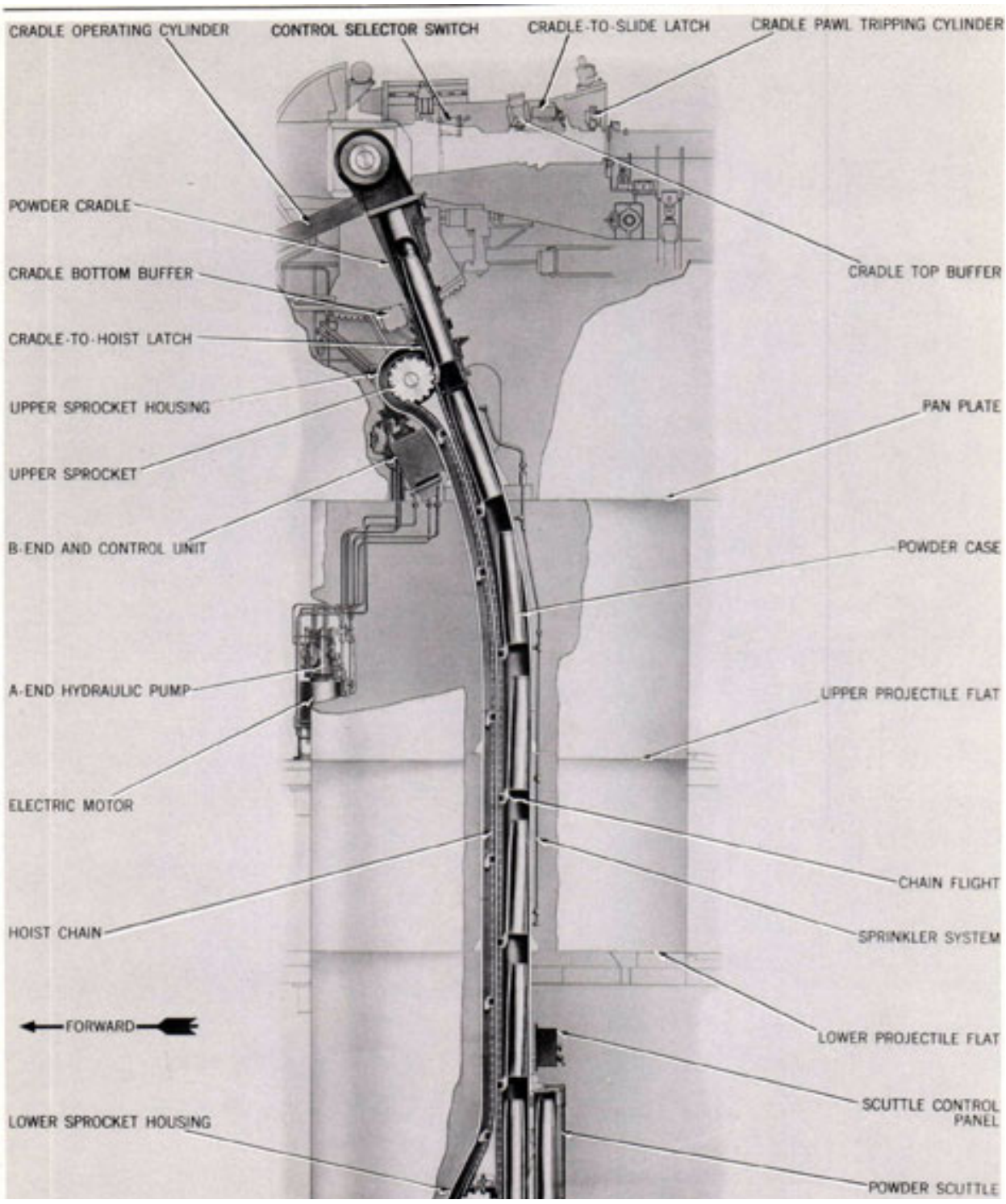


*Figure 37. Powder Hoist General Arrangement*

**38**



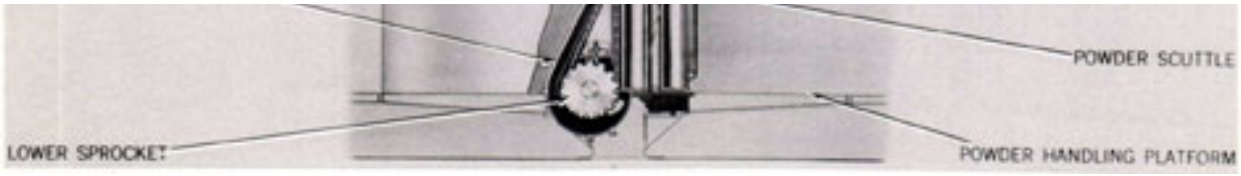



*Figure 38. Powder Hoist Cutaway*

**39**

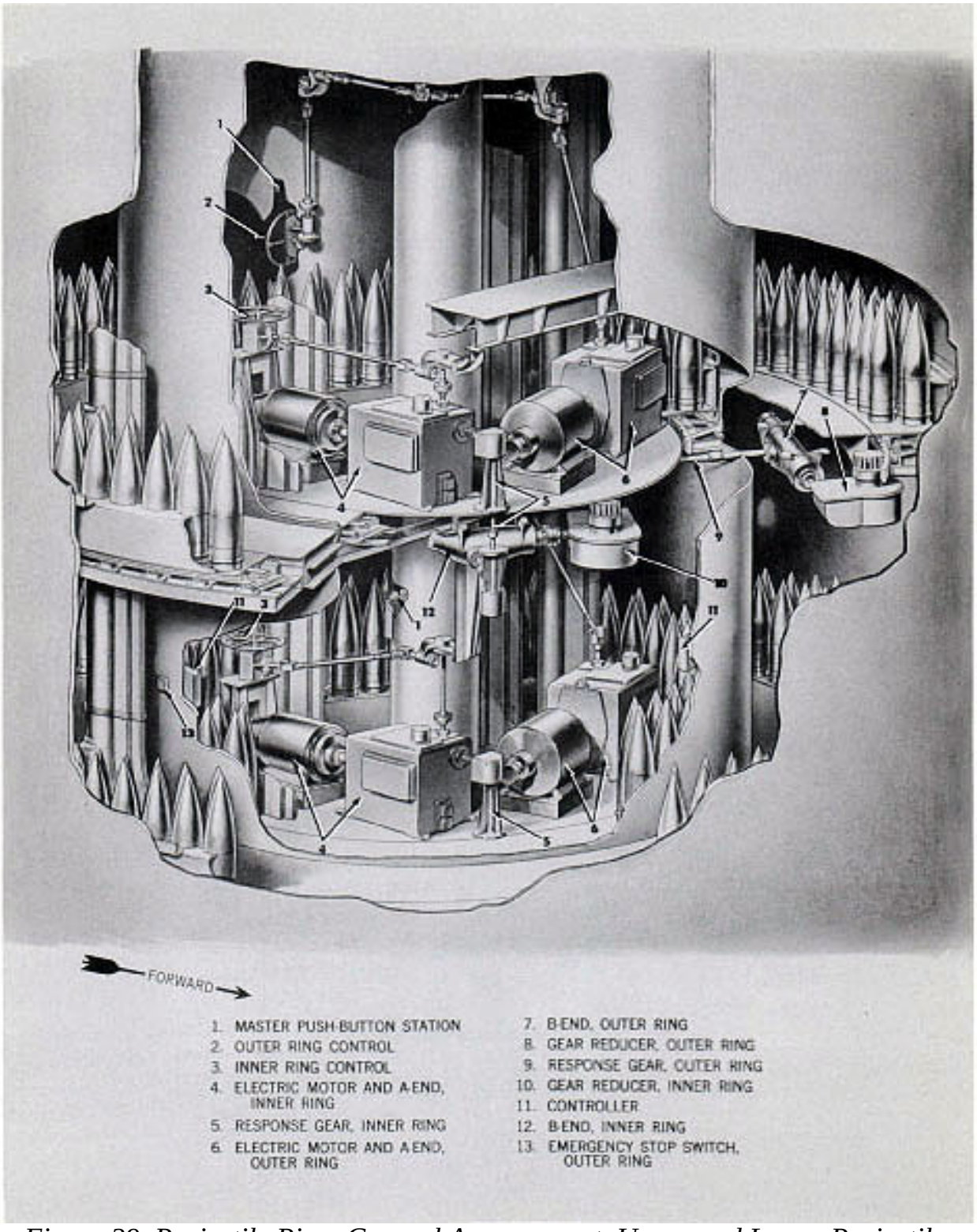



*Figure 39. Projectile Ring. General Arrangement, Upper and Lower Projectile*

hydraulic power drive. Their operating arrangements and differing details are indicated in the following brief description of each.

**Projectile hoists**. Each projectile hoist conveyor is a tubular unit that extends from the lower projectile flat into the gun pit at the side of its gun. It has a power-driven sprocket at the upper end and an idler sprocket at the bottom. Its endless chain has 16 flights or chain lugs for supporting projectiles. At each projectile flat, there is a loading aperture with shutter and control devices.

These loading aperture arrangements and control selecting devices enable the hoist to be simultaneously loaded on alternate ascending flights at both stowage flats, or to be loaded on every ascending flight at either flat. In either method of loading, the hoist automatically lifts its load one stage or flight distance when loading is completed, and the empty cradle is latched at the top of the hoist.

The cradle is a tubular unit suspended from a journal on the slide trunnion and arranged to swing between the top of the hoist and the side of the slide. In this oscillating movement its lower end is guided by an arc-shaped rail mounted on the gun girder. When it moves to the slide, it latches there and moves with the gun laying action. In this position it is aligned with the transfer tray when the tray is in its firing position. When it moves to the hoist, it latches so that it is held in alignment with the hoist.

The cradle has a pawl at the bottom and a large spring-ram device within. When the conveyor lifts a projectile upward, the ram is compressed

The controls include a manually operated selector. This is a remote switch and flexible cable unit located in the gun compartment. It is a three-position function selector through which the controls are set to hoist or lower projectiles or to stop cycling action (but not to stop the power drive electric motor). The lowering control of this device has two purposes: It enables the automatic cycling action to be reversed in emergency when a misfire or casualty occurs or "cease fire" is ordered and it is necessary to unload the gun. And it enables the hoist to be employed when stowing ammunition on the handling flats.

**Hoist power drive**. Each hoist is separately driven by a power drive. This consists of an electric motor and A-end pump unit mounted on the upper projectile flat, and a hydraulic pipe system connecting with a B-end hydraulic motor that is coupled to a worm reducer unit that drives the upper sprocket. The cradle is operated by a double-acting hydraulic cylinder.

**Powder hoist**. The powder hoist is like the projectile hoist, except that its cradle is larger, its conveyor is longer, it has only one loading level, and its loading aperture is fitted with an automatic scuttle.

The scuttle is a revolving flameproof cylinder device with two compartments. It is independently driven by an electric motor which operates an oscillating crank mechanism. This mechanism rotates the cylinder 180° when the inner compartment is empty and the outer compartment has been served with a powder case.

**Projectile stowing and handling equipment**

The two groups of equipment for stowing and handling projectiles are six power-driven assemblies installed in the projectile flats. These units are four projectile ring drives and two parbuckling

and the pawl moves beneath the bottom of the projectile, thereby latching the projectile in the cradle. In this position the fuze of High-Capacity projectiles is automatically set by a remotely controlled fuze setter located in the top of the cradle.

**Hoist controls**. The devices which control the cycling actions of the hoist and the cradle, and which operate the latches and pawl, are hydraulic valves and an installation of switches and solenoids. It is a system comparable to the slide equipment control system, and certain of its switches are included in the interlock arrangements and controls of the gun captain's control panel.

mechanisms. Their arrangements are shown in figures 39 and 40 respectively.

**Projectile ring drives**. Each inner and outer projectile ring of each projectile flat has an attached annular rack. This rack is driven by a spur pinion through a worm gear speed reducer and an electric hydraulic power drive. The ring, the power drive, and the controls permit the ring to be driven clockwise or counterclockwise.

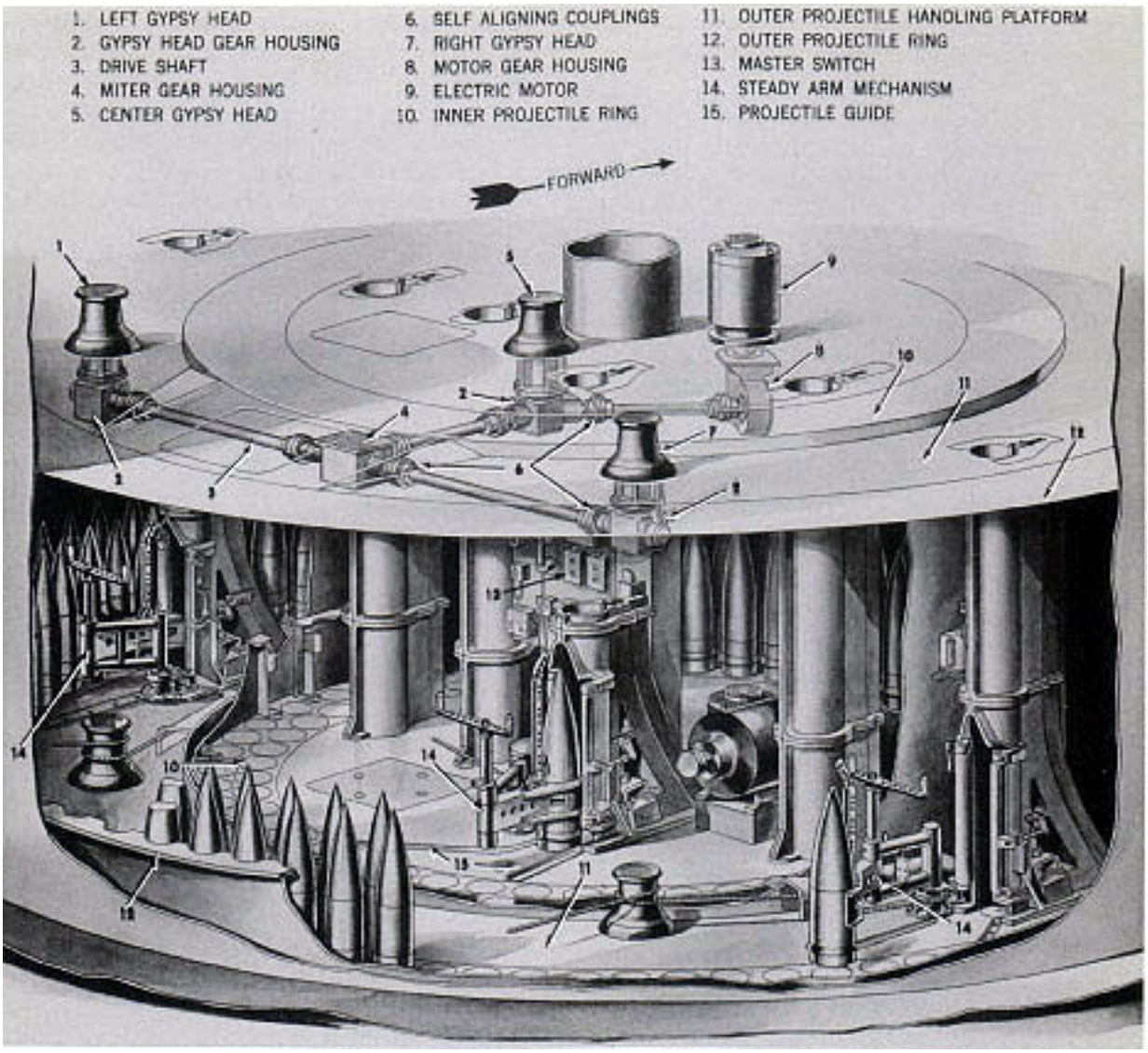



*Figure 40. Parbuckling Gear Arrangement Upper and Lower Projectile Flats*

All four power drives are alike, except for their controls. Each drive consists of a 20-horsepower electric motor, an A-end pump and control assembly, a B-end hydraulic motor and brake mechanism, and a manual control mechanism.

The A-end unit is a variable displacement pump with an automatic cycling control. This control device is a manually initiated type that operates the ring for a short arc of movement and then automatically decelerates, stops, and locks the heavy load. Inner and outer ring arcs of movement controlled by this device differ, but each controls its ring so that the arc of movement presents six projectiles within reach of the parbuckling steady arm mechanism.

The manual control mechanisms are hand-wheels with a system of gear boxes and shafts coupled to the A-end control input. Inner and outer ring designs differ, as shown in figure 39, because of the positions of the handwheels.

**Parbuckling gear assemblies**. The two parbuckling gear installations are identical. Each consists of a vertically positioned 7.5-horsepower motor which drives a system of gear boxes and shafts that operates three gypsy heads. These

are adjacent to the loading apertures of the three projectile hoists. They run at constant speed.

A pivoted mechanism called a steady arm is also mounted adjacent to each hoist. This device is a parbuckling auxiliary that is manually controlled and power-operated by the gypsy head snubbing rope. It operates to grab projectiles one-at-a-time from the projectile ring, and to guide and thrust them into the hoist.

**Fire control equipment**

The sights and gun attachments, and the control instruments listed on page 13 comprise the

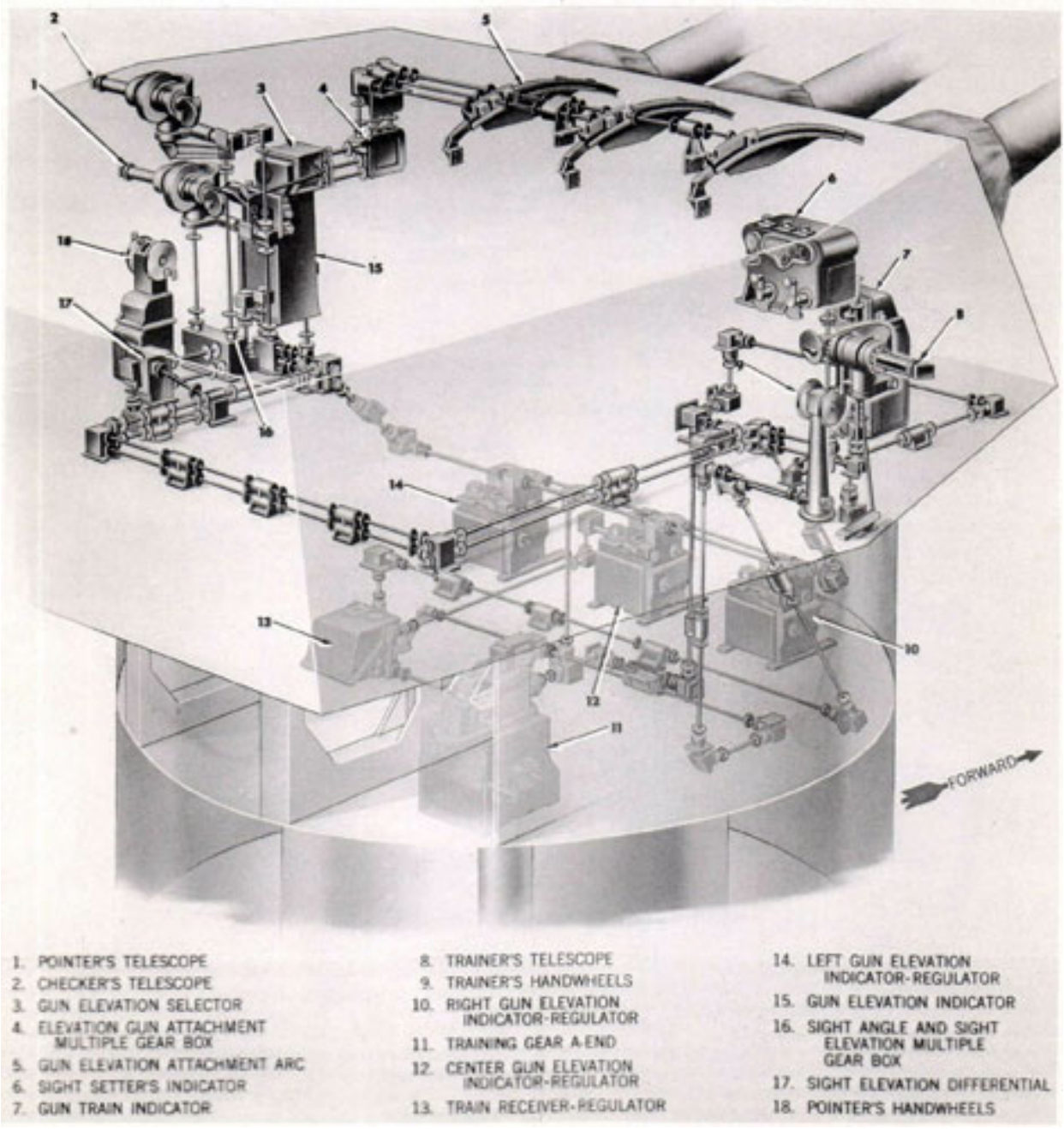



*Figure 41. Sights and Gun Attachments. General Arrangement*

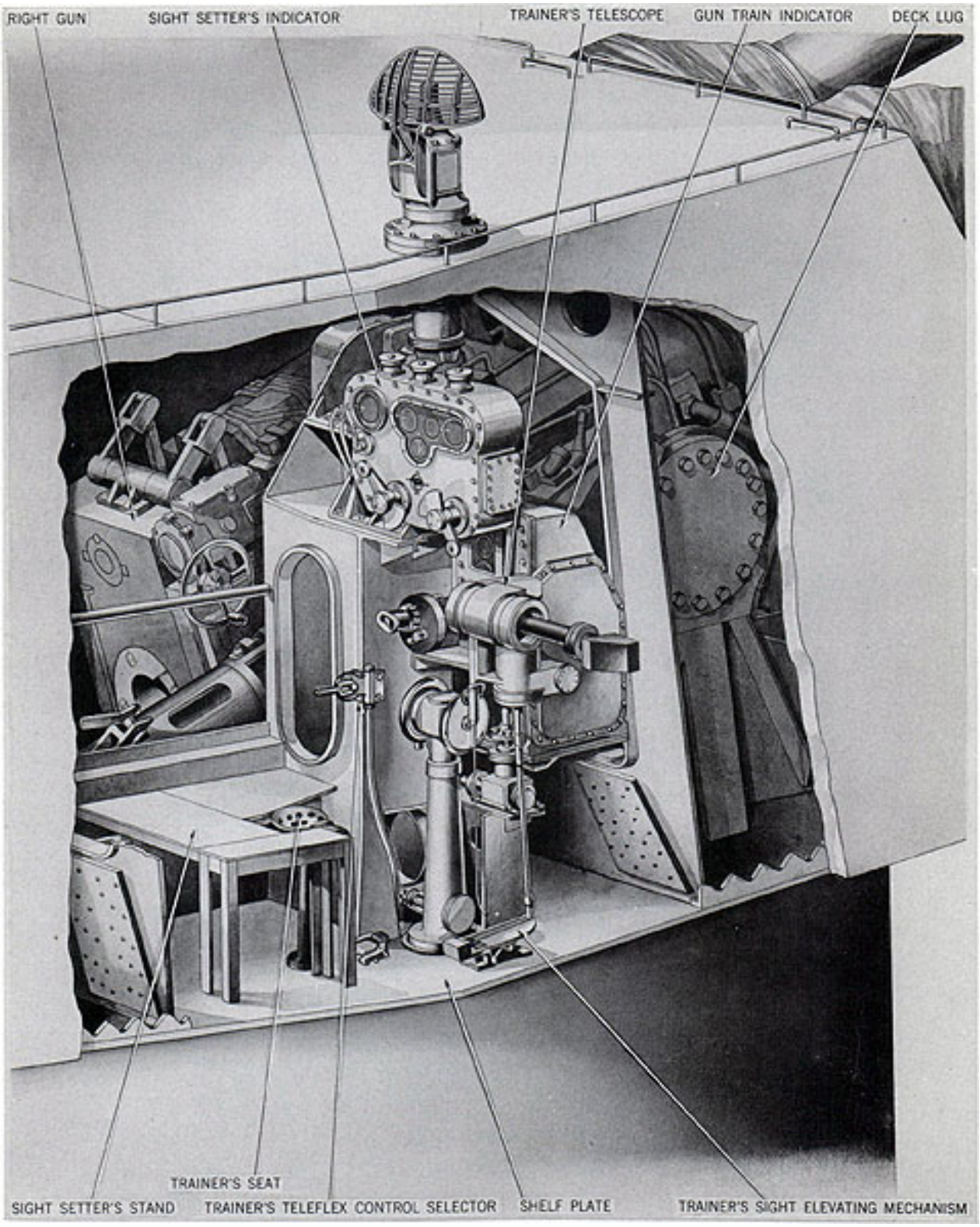



*Figure 42. Trainer's and Sight Setter's Station. General Arrangement. Right Side*

turret fire control installations. They are supplemented by switching and communications devices and an extensive system of wire circuits of Bureau of Ships design and cognizance.

**Sights and gun attachments**. Five assemblies of shafts and brackets that interconnect eleven instruments, as shown in figure 41, comprise the sights and gun attachments. These assemblies are three gun elevation attachments, a training gun attachment, and the sights. The associated instruments are: Three telescopes, a sight setter's indicator, gun elevation and train indicators, three elevation indicator-regulators, and a train receiver-regulator and a gun elevation selector.

Arrangements of this assemblage of instruments and signal transmission systems provide the following:

Manual input movements at the sight setter's indicator, made in response to synchro-received, dial-indicated orders, offset the lines-of-sight in deflection and depression from parallelism with the guns. These values simultaneously move the optics and also move input mechanisms at the regulators and elevation and train indicators. They are combined in these instruments with a third output of the sight setter's indicator, called parallax range, and with response values equivalent to turret turning movements and the elevating movements of a selected gun. These combined values are gun order correcting factors. They modify the gun orders in all methods of control by making local changes that correct the computed order for mechanical faults and that compensate for the differences in visual angles at the turret and at the controlling director.

Thus, in turret automatic control, the sight setter's indicator functions to alter the remote gun order and modify gun positions in both range and azimuth. It functions similarly in all variations of controlled by the sight setter's indicator, but the elevating movement is free under foot control by the trainer. This conventional arrangement enables the trainer to follow the target in elevation at will, as ship rolls, but compels him to operate his handwheels to turn the turret for every change in sight deflection input or change in ship course.

**Pointer's station**. The mechanical arrangements for moving the optics at the pointer's and checker's stations are the same values. Each instrument moves identically in response to sight setter offsets in sight deflection and sight angle. Both instruments also move identically in response to the movement of one gun.

Figure 43 shows the arrangements of the sights and of the elevation selector device at the pointer's station. It is an arrangement that operates to compel the pointer to manipulate his handwheels in order to hold his line-of sight on the target whenever the sight angle changes or the ship rolls. Thus, by reason of the offset value of the sight angle (gun order) , he is constantly holding the gun in correct range position.

**Turret officer's control equipment**. Figures 44 and 45 identify the control equipment installations of the turret officer's booth. They are optical, mechanical, and electrical devices for visual observation of fall of shot, for local communication, for local solution of firing problems, and for selection of alternative methods of control.

The equipment of this booth is arranged with the ship's director system so that the turret may be operated in any one of several basic types of control and their variations. These control methods are designated: PRIMARY, SECONDARY, LOCAL, and EMERGENCY. The master selector for all is the large cabinet called the turret officer's transfer switchboard. Through this unit the turret is placed in:

automatic control.

These correcting functions also occur when the turret is controlled locally by target sighting. In that method of control, all actions are controlled by the pointer's and trainer's station equipment.

**Trainer's station**. Figure 42 shows the sight arrangements at the trainer's station. The telescope at this station has common deflection

PRIMARY CONTROL, so that the gun and turret drives are remotely controlled by the main directors; or,

SECONDARY CONTROL, so that the gun and turret drives are remotely controlled by directors of the secondary armament; or,

LOCAL CONTROL, so that the drives are controlled by the target sighting actions described above; or,



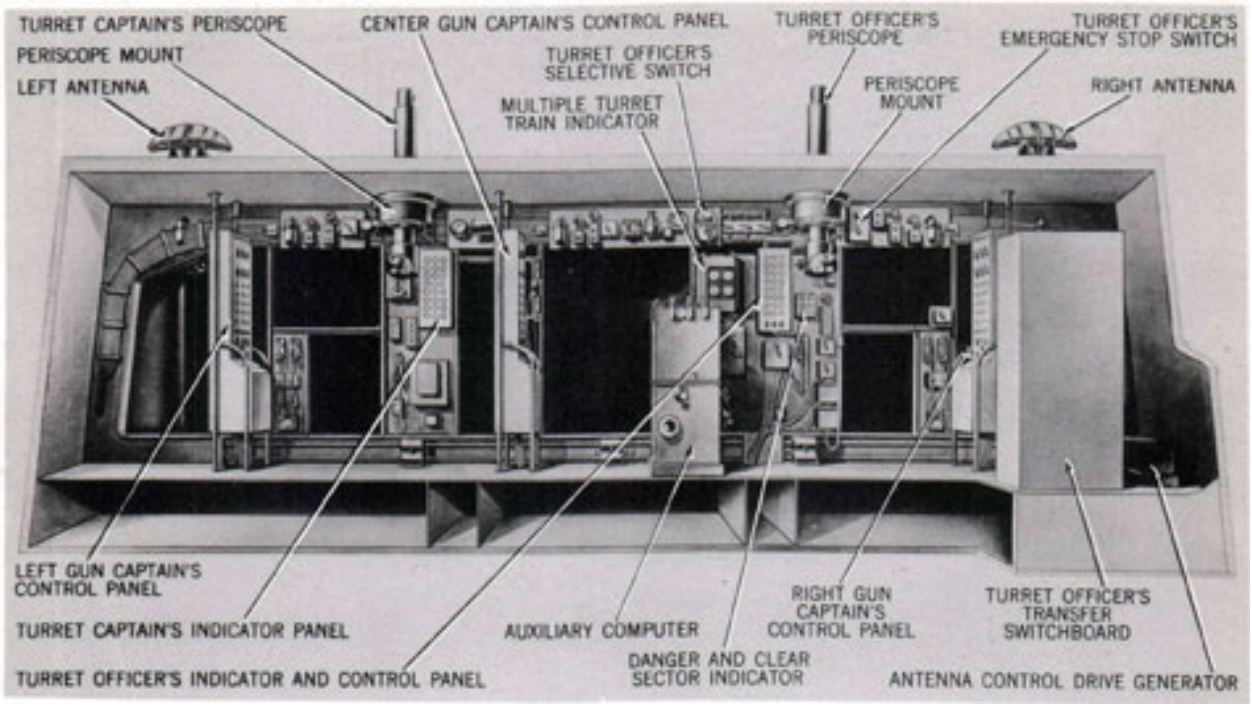



*Figure 43. Pointer's and Checker's Stations. General Arrangement Left Side View*

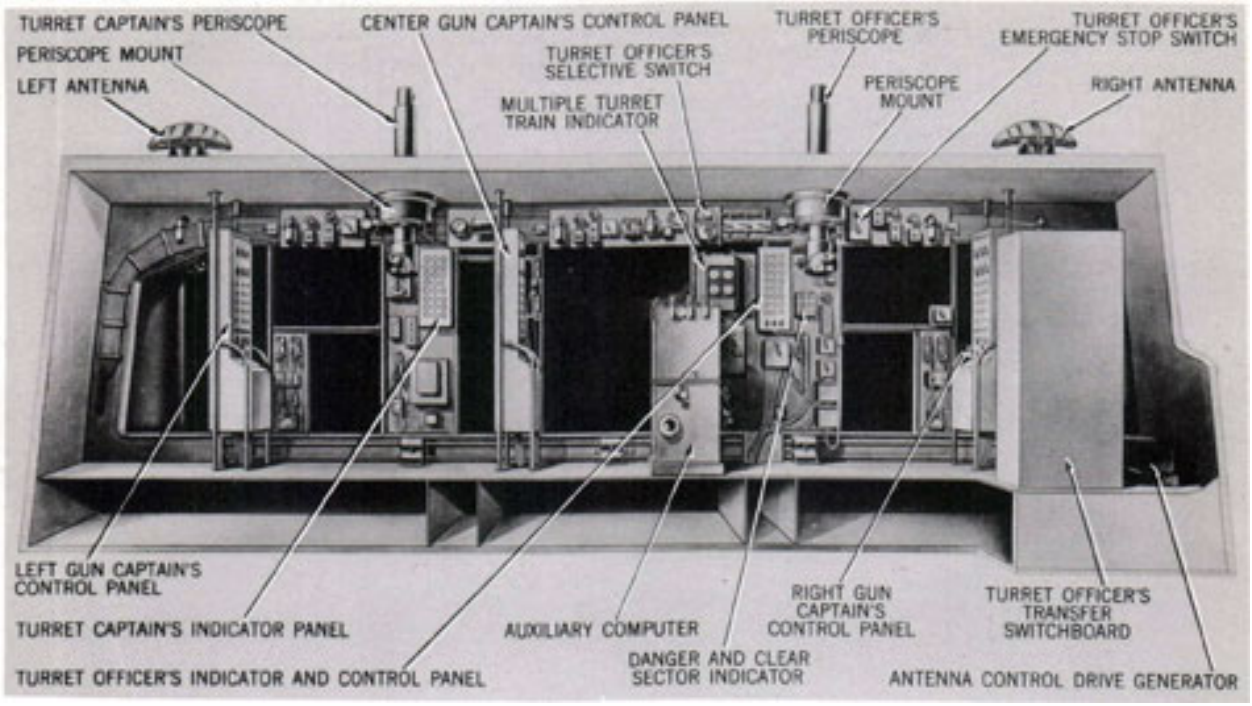



*Figure 44. Turret Officer's Booth. Fire Control Arrangement Forward Bulkhead*

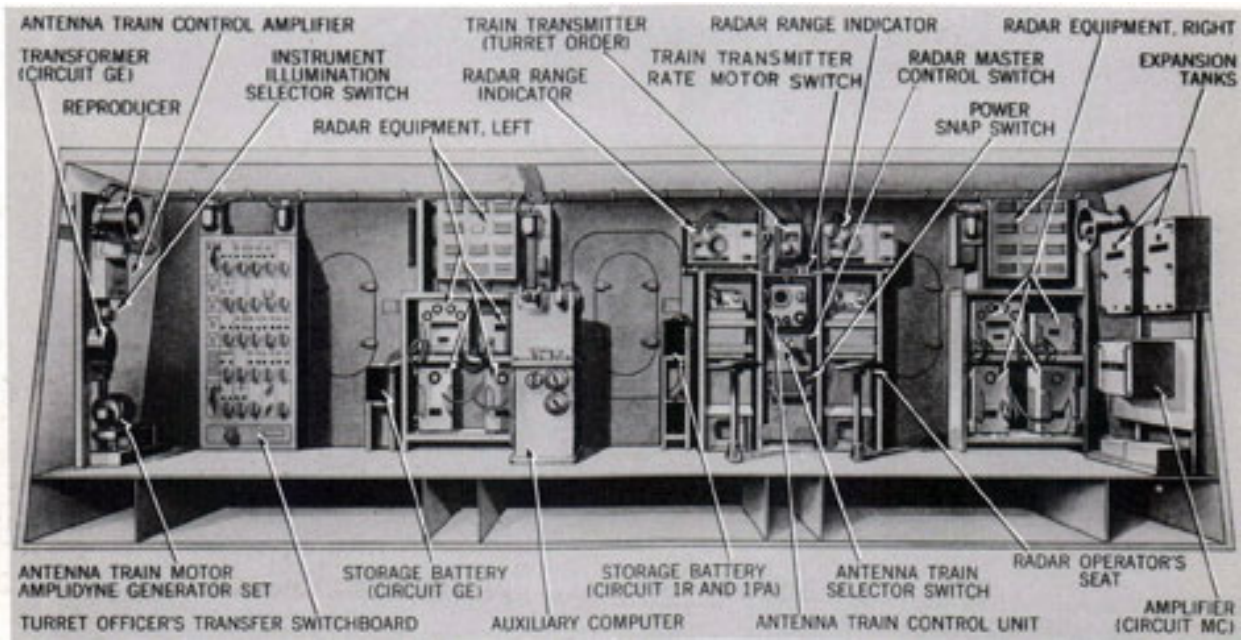



*Figure 45. Turret Officer's Booth. Fire Control Arrangement Rear Bulkhead*

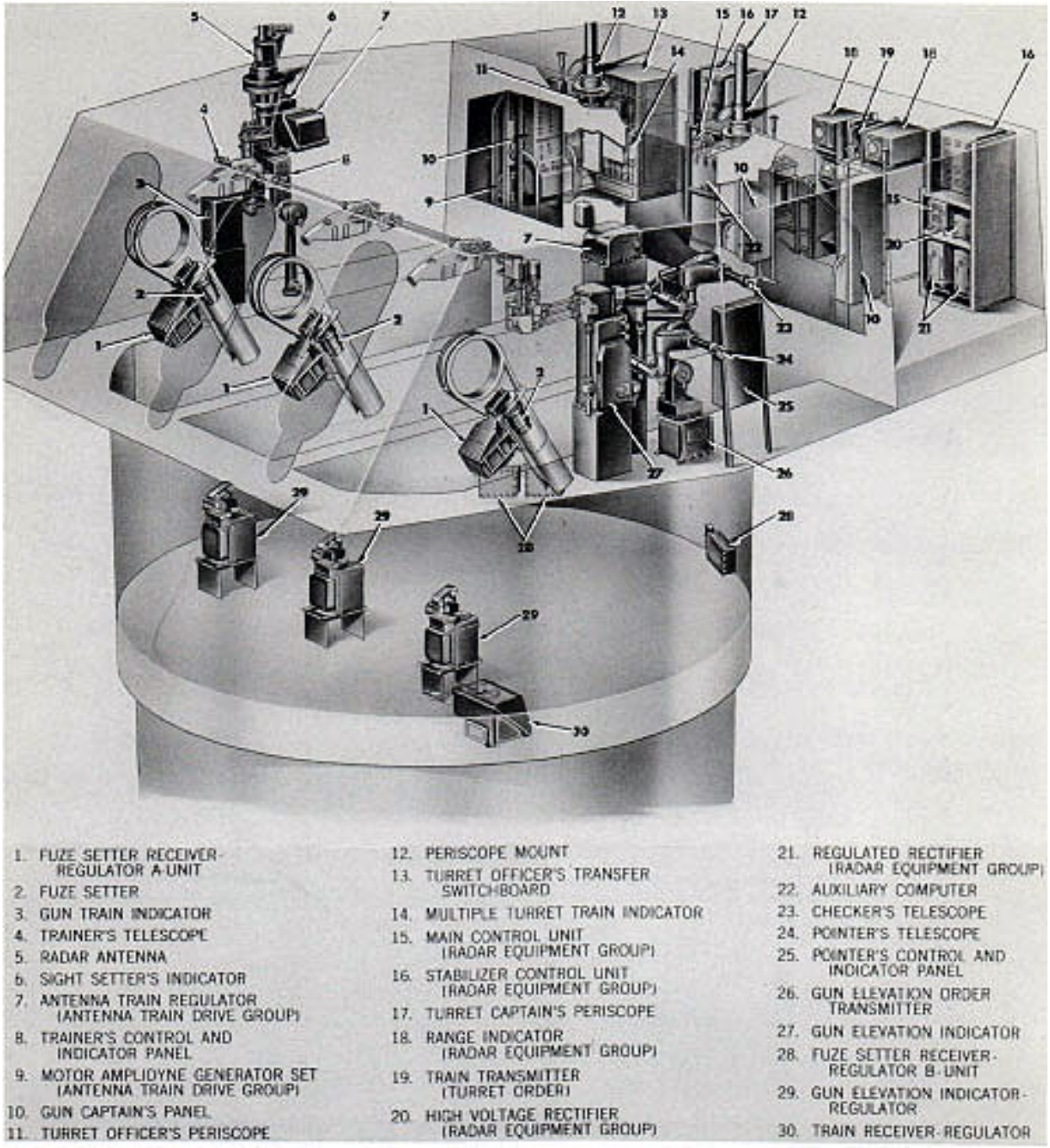



*Figure 46. Turret Fire Control Installation. General Arrangement*

HI-TURRET CONTROL, so that the drives of turret I are automatically controlled by signals transmitted from turret II.

Alternatives to these switching selections are included in the transfer switchboard to permit the following variations:

In primary control, the drives may be controlled automatically, called *Primary Automatic Control*, or they may be remotely directed in follow-the-pointer operation, called *Primary Indicating Control*. Either selection can be controlled from After Plot or Forward Plot, using

the forward or after aloft director.

In secondary control, the turret drives may be controlled by similar automatic and indicating control variations that employ different combinations of the secondary directors and plotting rooms.

Turret local control methods include "target-sighting" control, radar control, periscope control, and combinations of these. All use the local computer for solution of external ballistics, but turret I is excluded from radar control except *via* turret II.

Radar control arrangements are among the feature innovations of the turret. The installations are in duplicate. They include two complete radar control sets in the booth, and two antenna train drives, antennas, and drive regulators.

This installation enables the turret crew to ascertain target direction, distance, course, and speed. It is a range-finding system that completely displaces the optical range-finder of earlier turret designs. It is a system that provides new alternative methods of local control. These enable the radar signal beam to the target to be employed as a combination line-of sight and range data factor. From derived and computed data, transmitted to the sight setter and the turret train indicator, the antenna and the sights are offset identically in azimuth, and the sights are offset in elevation. This permits two methods of drive control: automatic train drive *via* radar operator's turret train order with conventional pointer target sighting control, or conventional target sighting control by both pointer and trainer.

**Fuze setting control**. Figure 46 shows the general arrangement of all fire control units to stop fuze setting and set SAFE position for return to stowage.

**Gun firing control**. The gun and powder ammunition designs provide for electrical firing only.* Powder cases do not include percussion primers, as a safety precaution, because of rough handling in automatic loading.

The electrical firing system includes other safety precautions and special arrangements. It is a selective firing control, as indicated in the diagram of figure 47, that interlocks with the gun loading and gun laying actions and permits remote or local firing. Safety features of this circuit, in addition to automatic interlock switches, include manually operated firing stop switches accessible to the turret officer, each gun captain, the pointer, and the trainer.

The automatic interlock devices consist of four switch operating mechanisms for the firing circuit of each gun. These block the firing until the transfer trays are in firing position, the breech is completely closed, and the gun is pointing into a safe firing zone. Their positions and identities are designated in figure 47. All these switches positively open the firing circuit when their mechanisms are actuated.

## AUXILIARY INSTALLATIONS

Power supply equipment and circuit installations-and also all turret heating, ventilating, sprinkling, illumination, communications, and air supply systems-are auxiliaries of the turret ordnance installations. These service facilities are units of Bureau of Ships design and cognizance. Their features and general arrangements are described in the remaining pages of this chapter.

### Power supply

Normal and emergency electric power is supplied to each turret from the ship's four main 450-volt, 3-phase, 60-cycle turbo generators. This power is supplied to each turret through feeder cables originating at connection

discussed above, and of the installations for automatic fuze setting and fuze setting control.

Each projectile hoist cradle includes a fuze setter. It is an automatic, power-driven and remotely controlled design that controls the fuze setting action of mechanical time fuzes. Orders received in the turret through the transfer switchboard are routed *via* the gun captain's control panels to amplifier cabinets located in the gun pits. These boost the power signals that operate the fuze setting motors, and their switching arrangements enable the gun captain

boxes in the wiring trunk located below the base casting. Cables lead upward through spacer

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* The gun has arrangements for attaching an accessory that permits emergency percussion fire, provided a special short-case powder charge is substituted for the normal charge.



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blocks in the central column to a wiring recess at the top of the column, just beneath the pan floor. Slack is provided in the cables at the bottom of the column to permit twisting and flexing of the cables during turret rotation. From the wiring recess, cables are routed to a manual bus transfer panel, located on the inner wall of the inner circular bulkhead at the right rear of the upper projectile flat. (See figure 17.) This panel is equipped with switches and indicating lights for selection of either normal or emergency power supply. From the manual bus transfer panel, power is supplied to five circuit breaker power panels, consisting of: three gun equipment power panels, one for each gun; a training gear equipment panel; and a miscellaneous equipment power panel. These circuit breaker power panels serve to supply power to all controller components of the power drives and the several auxiliary services, except the illumination system.

**Illumination supply**. Normal and emergency power for the illumination system is supplied to each turret from the 120-volt, 60-cycle ship's electric service system. The power is supplied to the turret by flexible cable, through the central column wiring tube, similar to the arrangements described in the preceding paragraphs. From the wiring recess at the top of the central column, the cable is routed to an automatic bus

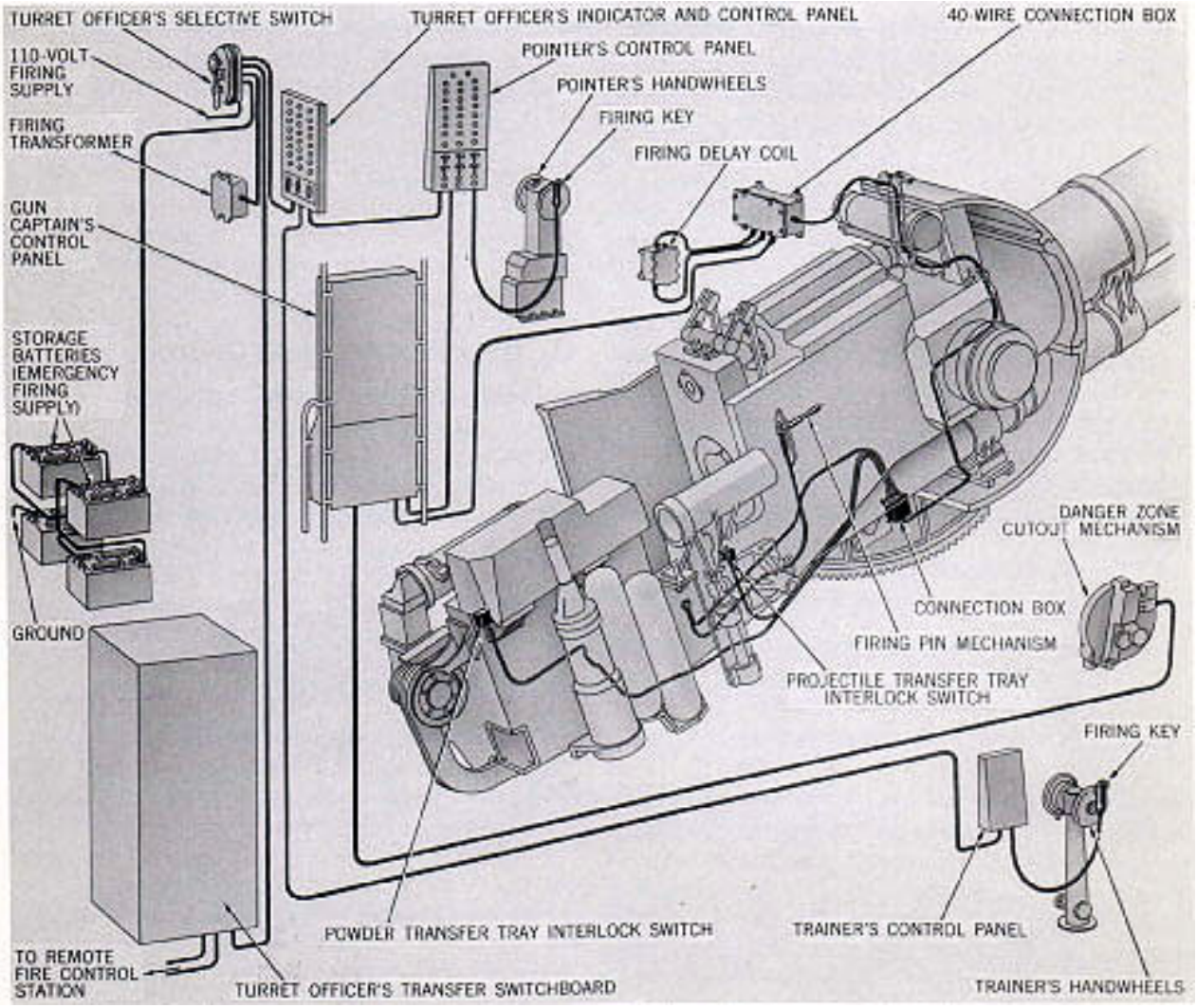



*Figure 47. Gun Firing Control System*

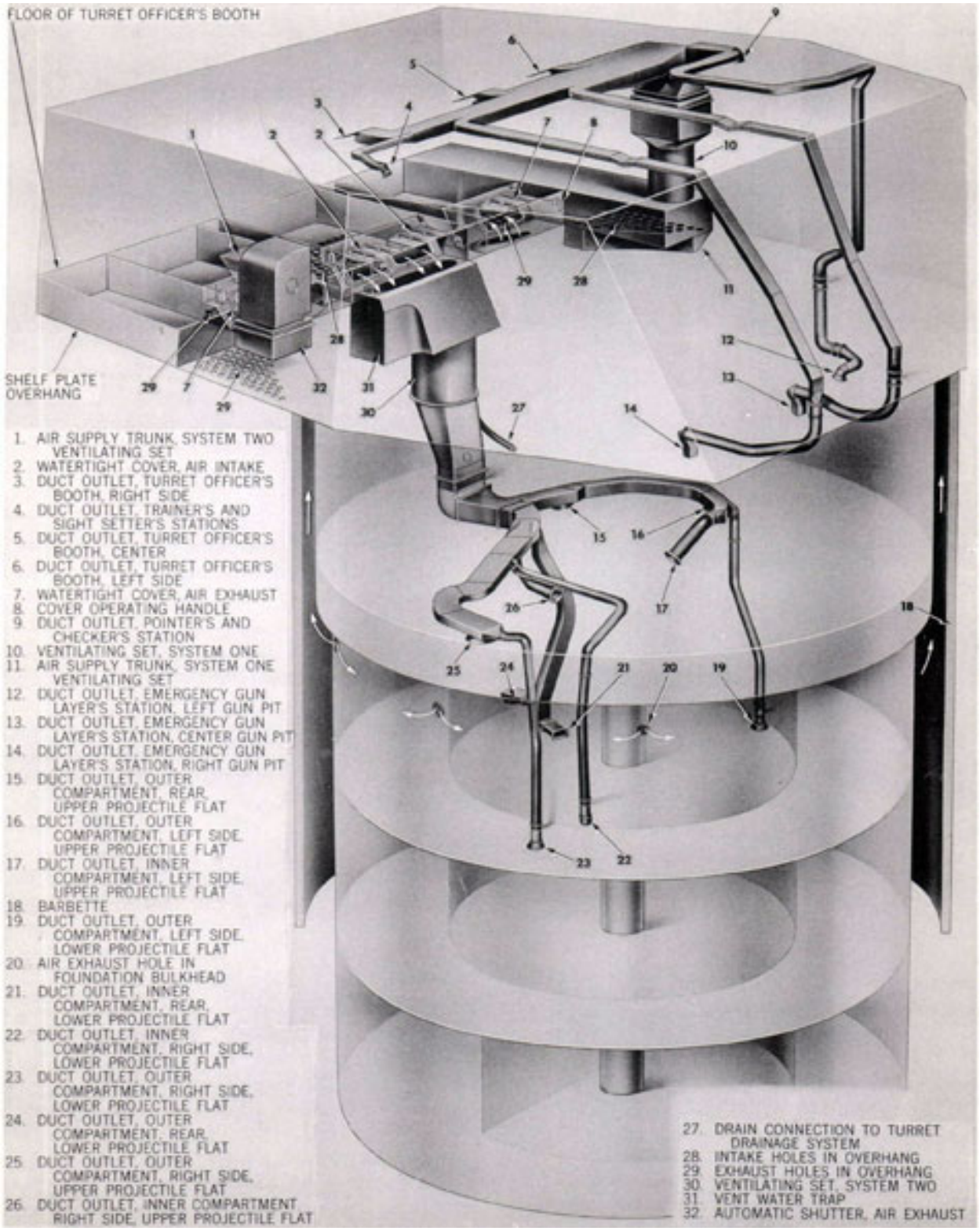



*Figure 48. Turret Ventilating System. General Arrangement*

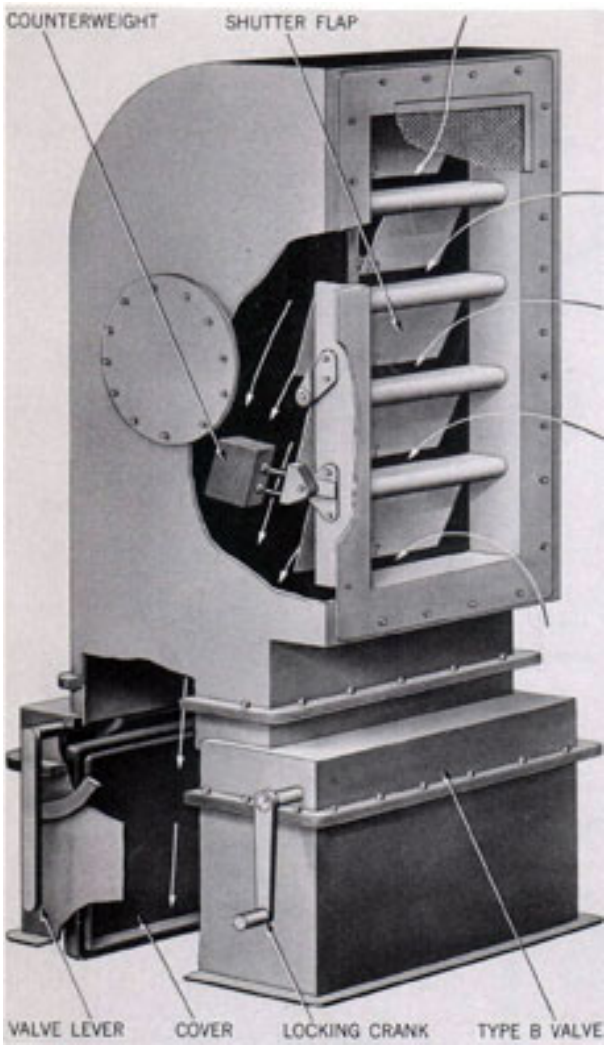



*Figure 49. Ventilating System Air Exhaust Automatic Shutter. General Arrangement*

transfer panel located on the inner wall of the circular bulkhead, to the left rear of the upper projectile flat. It operates automatically to transfer 120-volt supply from normal to emergency or *vice versa*, when required.

**Ventilating system**

Two self-contained ventilating systems supply fresh air under forced draft to all turret levels above the powder handling room. These, together with their related ducts, are illustrated in figure 48. One system consists of a 6,800-cubic-feet-per-minute electric motor-driven fan set, developing 4.2 inches total pressure. This set is vertically mounted in the left wing sight station, before and to the left of the partial bulkhead in the position shown on figure 14.

The other system consists of a 7,000-cubic feet-per-minute electric motor-driven fan set, developing 3.3 inches total pressure. This set is vertically mounted on the inner rear circular bulkhead at the pan level, to the left of the longitudinal centerline of the turret.

System number one supplies air to the gun house and the pan level. A main duct extends across the roof of the gun house. From this main duct, three evenly spaced smaller ducts supply air to the turret officer's booth; the left and right ducts supply 1,565 cubic feet of air per minute; the center duct supplies 1,570 cubic feet of air per minute. Three additional smaller ducts extend from the main duct forward along the roof of the gun house, and down into the left, center, and right gun pits. Each supplies 500 cubic feet of air per minute. Right and left small extensions of the main duct are directed to the right and left wing sight stations, each of which supplies 300 cubic feet of air per minute to these areas.

System number two supplies air to the inner and outer compartments of the upper and lower projectile flats. Two forked, main-supply ducts extend from the fan through the plate and into the upper projectile flat. From these ducts four outlets supply 1,000 cubic feet each per minute to the inner and outer compartments of the projectile flat. Four vertically mounted extensions of the main ducts extend downward through the upper flat to just within the lower projectile flat. Two of these ducts supply 500 cubic feet of air per minute to the inner compartment; the other two supply 340 cubic feet per minute to the outer compartment.

Both systems operate to maintain slight pressure in the areas supplied. This pressure is controlled by the exhaust arrangements. Air exhaust within the gun house is controlled to maintain air pressure at one-and-one-half inches water gage. This is obtained by

means of a spring- and weight-loaded automatic shutter, shown in figure 49, vertically mounted in the right wing sight station area, before the partial bulkhead. Air exhaust for both projectile levels is *via* screened openings cut through the upper



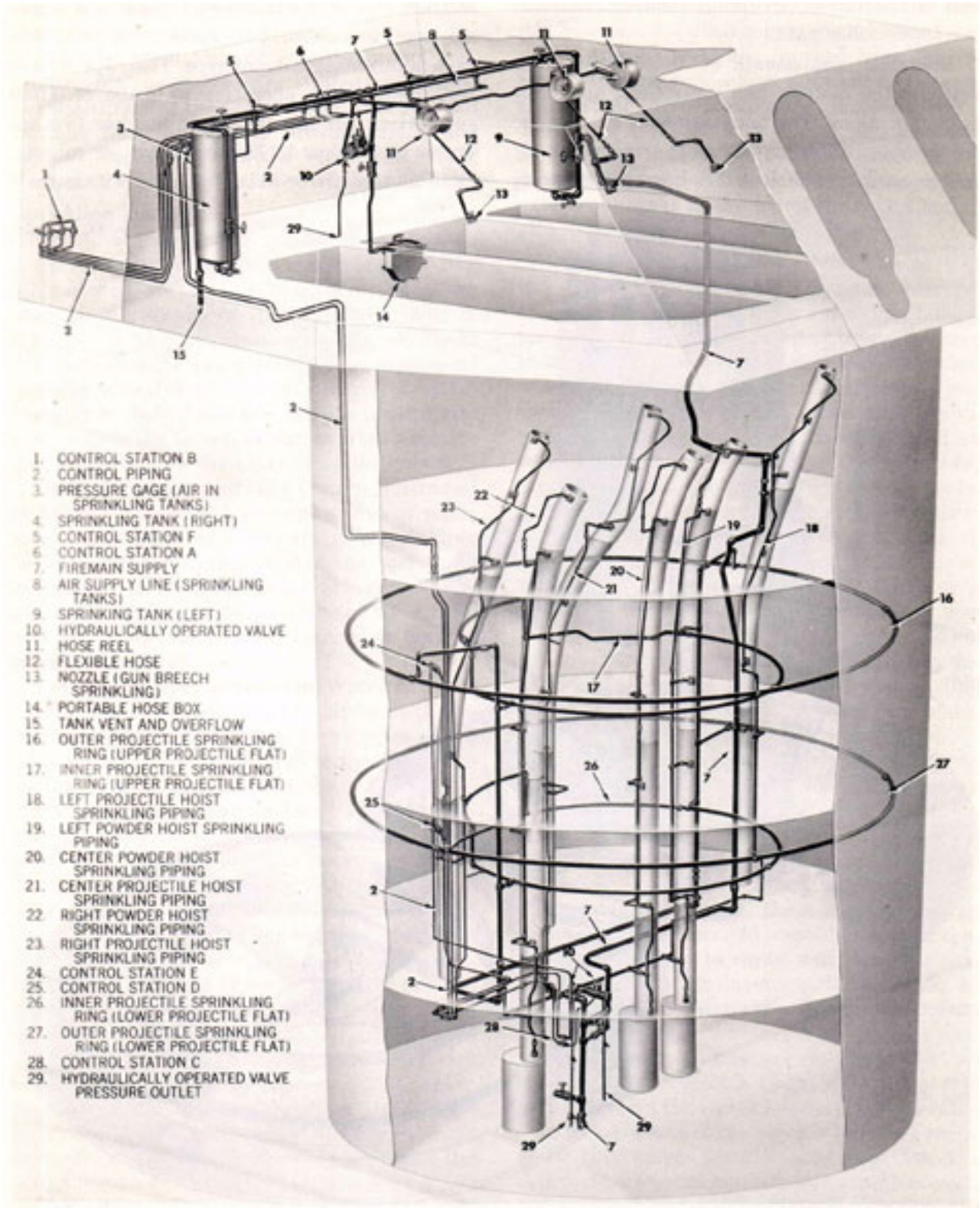



*Figure 50. Turret Sprinkling System General Arrangement*

end of the turret circular foundation, beneath the lower roller path.

Electrical components of these ventilating sets are the motors, two controllers, and push button stations. The arrangements are similar for each set, differing only as to size and speed; motor number one is a 7.5-horsepower unit; number two is 5-horsepower. Each is a squirrel-cage induction, two-speed, 440-volt, 60-Cycle alternating-current type. Their speeds differ, number one operating at 3,450 or 1,750 revolutions per minute, while number two operates at 1,750 or 1,175 revolutions per minute. Both motors are co-axially aligned within their

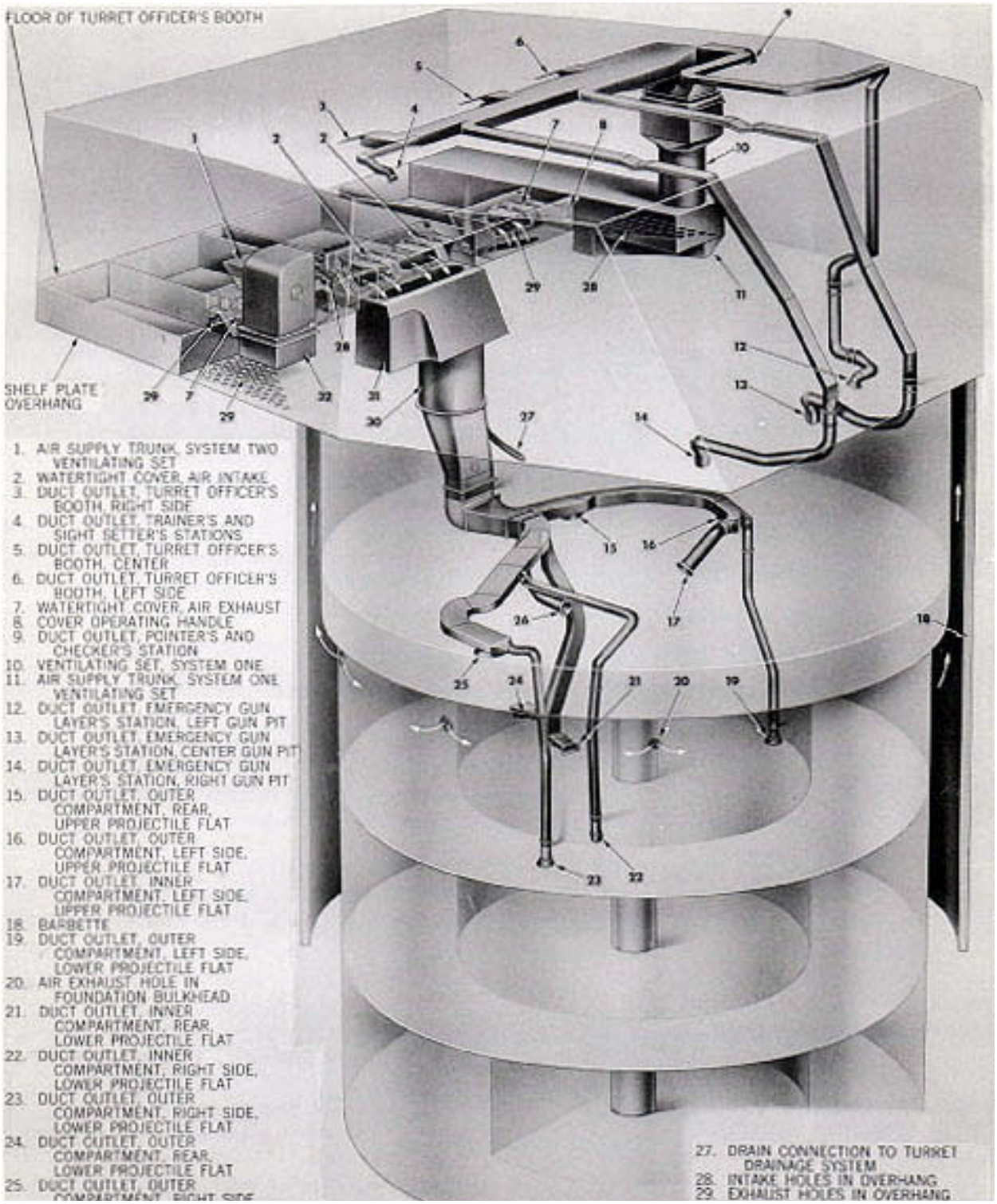



*Figure 51. Turret Sprinkling System. Rotating Fireman Connection General Arrangement*



respective sets, and each drives a multi-bladed fan mounted on its drive shaft.

Starting, stopping, and emergency run controllers for the motors are located on a panel in the left rear of the turret officer's booth. Push buttons for both motors provide HIGH and LOW speed EMERGENCY RUN and STOP control.

**Sprinkling system**

The turret sprinkling system is designed to provide a quick and efficient means of sprinkling all ammunition units in the turret-whether they be in stowage in the projectile rings, in transit via the ammunition hoists, or ready for loading at the gun breech. The arrangement permits selective or over-all control of sprinkling from both local and remote control stations within the turret, as well as from a remote control station on the exterior of the turret.

**General arrangement**. The system, illustrated in figure 50, includes a primary source of water supply from the ship's firemain; two sprinkling tanks for water storage within the turret; an air supply to maintain water pressure in the storage tanks; and an assortment of control and operating valves, and associated nozzles, piping, and tubing.

**Rotating firemain connection**. Water from the ship's firemain is led into the pit beneath the powder handling room in 2 1/2-inch copper-nickel alloy seamless tubing, secured to the deck. This tubing is then connected to the rotating fire-main Turret firemain tubing. Connected to the flexible hose is a 2 1/2-inch copper-nickel alloy tube, which extends vertically upward from the rotating firemain connection, adjacent to the central column, into the powder handling room. This riser is fitted with a control gate valve and a globe hose valve, both accessible in the compartment. From these valves the supply line extends to tanks at the top of the turret and to all sprinkling-head operating valves.

Sprinkling distribution system. The part of the system from the ship's firemain just described, is designated as wet sprinkling piping. Its extent with respect to other pipes is shown in figure 52. During normal turret operation, water is within this tubing at all times. All wet sprinkling tubing is copper-nickel alloy, seamless pipe and tubing. Fittings are flanged or socket-type, bronze, silver-brazed, and threaded bronze. Connected to this main is the dry sprinkling piping-the piping which actually leads to and sprinkles the various ammunition units. In normal turret operation, this piping contains no water. Only when the complete system, or a portion thereof, is operated does water flow through these pipes. All dry sprinkling piping is aluminum alloy seamless pipe. Fittings are threaded aluminum alloy. All dry sprinkling piping is coated, inside and out, with zinc chromate iron oxide primer or aluminum varnish.

The dry sprinkling piping for the ammunition hoists is connected to the firemain through a hydraulically operated control valve, within the powder handling room. Piping is mounted on the exterior of each hoist, and extends from the extreme lower to the extreme upper end of each hoist conveyor; there is

connection, shown in figure 51. This connection consists of two horizontally placed sheaves or reels; one sheave rotates with the turret, the other sheave is driven by a crossed wire rope from the first sheave. Tubing from the ship's firemain is connected to piping on the second sheave by means of a swivel joint. In turn, this piping is connected to a flexible, 2 1/2-inch wire-stiffened rubber hose, which winds around both sheaves as the turret turns. The winding of the hose on the sheaves is such that when turret rotation causes the first sheave to rotate in a clockwise direction the flexible hose is wound off the second sheave onto the first, and when rotation is counterclockwise the action reverses. Working water pressure of 100 pounds per square inch is maintained throughout the full arc of turret rotation by this device.

no sprinkling device on the cradle. At spaced intervals connecting pipes lead to spray nozzles in the conveyor tube. The arrangement is such that all projectiles or powder cases within the hoists can be sprinkled.

The dry sprinkling piping for the projectiles stowed on the projectile rings is also connected to the firemain through a hydraulically operated control valve within the powder handling room. From this valve, piping leads into both the upper and lower projectile flats, forming on each flat an inner and outer sprinkling ring. Rings are constructed of 1 1/2-inch standard aluminum alloy pipe, and are mounted above and encircle

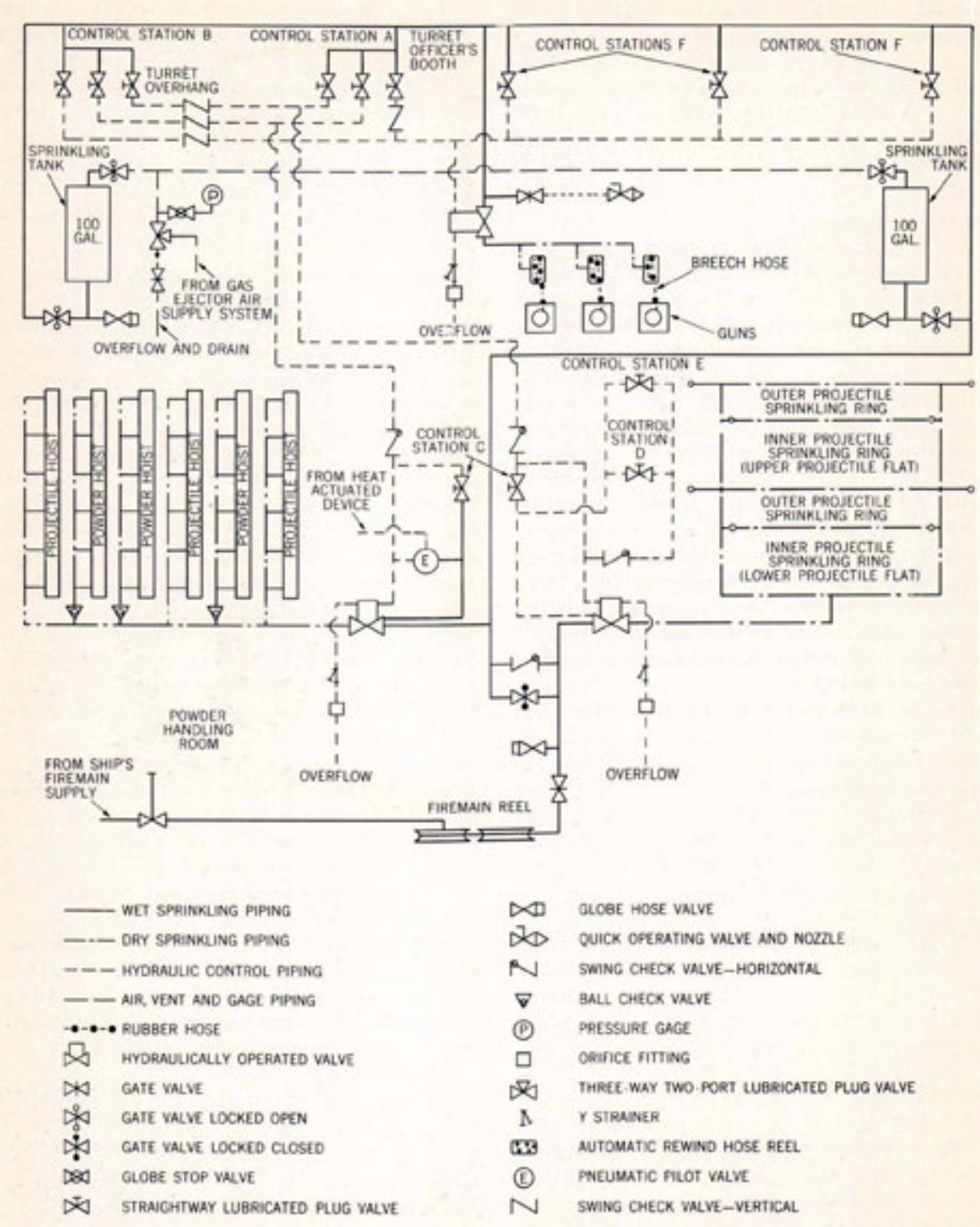



*Figure 52. Turret Sprinkling System. Arrangement of Vent and Gage Piping, Wet and Dry Piping, and Hydraulic Control Piping. Schematic*

the inner and outer projectile rings of each projectile flat. One hundred fifty drilled holes, equally spaced throughout 360°, are located in each outer sprinkling ring; 74 drilled holes, equally spaced throughout 360°, are located in each inner sprinkling ring. Spacing and number of the drilled holes in the sprinkling rings is so designed that each projectile in stowage will be sprinkled.

The dry sprinkling piping for the gun breeches is connected to the firemain through a control valve within the turret officer's booth. The installation consists of three spring-loaded hose reels, one for each gun, bracket-mounted to the center transverse girder, above and to the rear of each gun slide. Wound on each reel is a 12-foot long, 1/2-inch rubber hose, each hose being connected to the fixed dry sprinkling piping at the reel. From each reel, an unwound portion of the hose extends downward and is connected to a ball bearing swing joint, bracket-mounted on the respective gun slide side plate. Guarded 1/2-inch brass pipe, connected to the swing joint, is used to direct water flow through a nozzle bolted to the slide side plate. The arrangement is such that, as the gun is elevated, the hose unwinds downward from the reel; and as the gun is depressed, the spring-loaded reel winds the hose back on the reel.

**Vent and gage air piping system**. A third piping system, essential to operation of the turret sprinkling system, is a vent and gage air piping system, used to maintain air pressure on the water stored in the right and left 100-gallon sprinkling tanks. A schematic of this system is shown in figure 52. Air for this purpose is obtained from the gas ejecting main air supply system. The take-off piping from the main system is fitted with a gate valve, a pressure-reducing valve, dropping the pressure from 200 pounds to 100 pounds, and a relief valve set at 105 pounds. The piping leads into the turret officer's booth and is there fitted

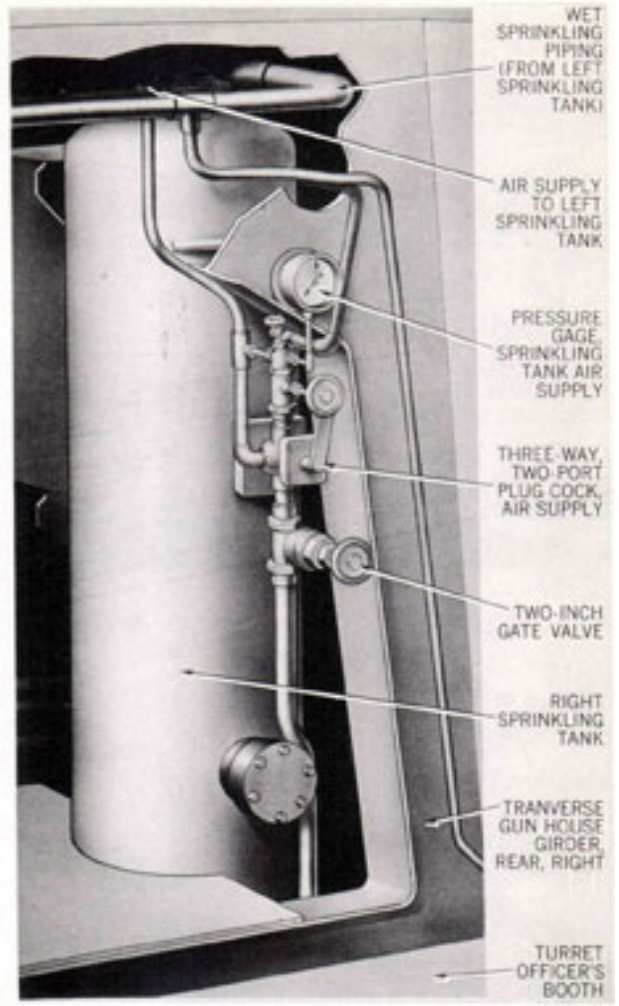



*Figure 53. Turret Sprinkling System Right Sprinkling Tank General Arrangement*

overflow, being fitted with a hose valve at this point. A 1/4-inch air-supply system leads to a system pressure gage within the turret officer's booth mounted on the partial bulkhead, right side.

**Hydraulic control piping system**. The fourth piping system within the turret sprinkling system is the hydraulic control piping system, shown on the schematic diagram of figure 52. This pipe system is an arrangement of hydraulically operated valves located to control sprinkling flow in parts of the dry pipe system. None of the sprinkling control cocks is located on the firemain; rather, each functions to operate a hydraulically operated control valve, which

with a swing check valve, a gate valve, and a three-way, two-port plug cock. From one port of the three-way valve, piping extends to both of the sprinkling tanks, with typical arrangements as shown in figure 53. Before entering each tank, the piping is fitted with a "locked-open" gate valve. From the second port of the three-way valve, piping leads to a tank vent and overboard



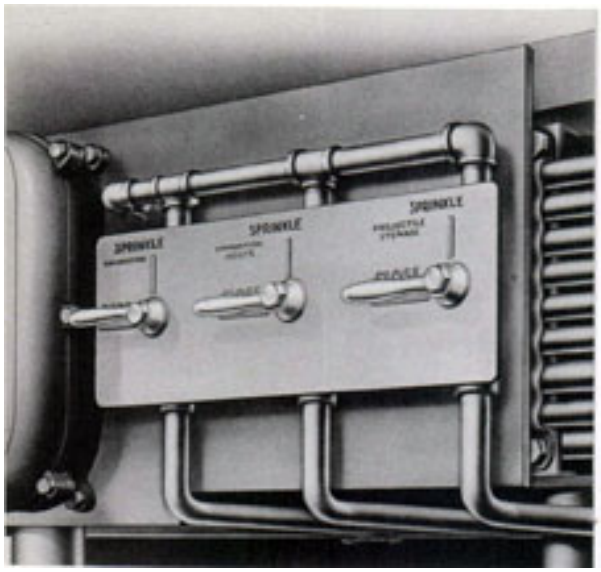



*Figure 54. Turret Sprinkling System Control Station A General Arrangement*

opens the system, permitting the flow of water from the firemain into the dry sprinkling piping. The hydraulic control piping system utilizes water in the wet sprinkling piping, under pressure, as a control fluid.

**Turret sprinkling control stations**. Selective control of the turret sprinkling system is provided at both local and remote control stations. These are designated alphabetically, and consist of stations A, B, C, D, E, and F.

CONTROL STATION A, shown in figure 54, is located within the turret officer's booth, right side, and has three valves on a single mounted plate on the partial bulkhead. All three valves are two-position valves, each being marked SPRINKLE

CONTROL STATION B is located on the turret overhang, within a glass-faced lock box. Three two-position valves are provided at this station. These valves, in marking, operation, and function, are identical to those at control station A. (See column 1.) They differ in that they normally will be operated in emergency only, and then by personnel on the exterior of the turret.

CONTROL STATION C is located on the left side of the instrument panel, in the powder handling room. It consists of two two-position valves marked SPRINKLE and CLOSE. Valve 1 controls projectile stowage sprinkling. Operating it will sprinkle all stowed projectiles. Valve 2 controls ammunition hoist sprinkling. Operating it will sprinkle all projectiles and powder cases within the ammunition conveyors.

CONTROL STATION D is located within the lower projectile flat. It comprises a single two-position valve marked SPRINKLE and CLOSE, and is mounted on the exterior of the circular bulkhead to the right of the arch. The valve serves to operate projectile stowage sprinkling on both projectile flats.

CONTROL STATION E is located within the upper projectile flat. It is otherwise identical to control station D.

CONTROL STATIONS F. There are three F control stations. All are in the turret officer's booth, one

and CLOSE. Valve 1 controls projectile stowage sprinkling. Turning it to SPRINKLE permits water to flow into the projectile sprinkling rings over the stowed projectiles of each projectile ring. Valve 2 controls ammunition hoist sprinkling. Turning it to SPRINKLE permits water to flow into the piping which sprays water within each of the projectile and powder hoist conveyors. Valve 3 controls gun breech sprinkling. When it is operated, it functions to send a jet of water in and around each gun breech.

adjacent to each gun captain's control panel. Each station comprises a single two-position valve marked SPRINKLE and CLOSE, mounted on the partial bulkhead. It controls gun breech sprinkling, any of the three valves serving to sprinkle all three gun breeches.

**Air control plug cock**. Adjacent to the sprinkling control station A is the turret officer's three-way air control plug cock. The cock is marked VENT and AIR SUPPLY. In filling the sprinkling tanks, before operation, the cock is set to VENT position. After water appears at the overflow, and as soon as both tanks are free of air, the cock is set to its normal AIR SUPPLY position. Should any sprinkling control cock be operated, water will be supplied from the sprinkling tanks or directly from the firemain, depending upon which is under the



higher pressure. Should air appear at the sprinkling nozzles, it indicates that the sprinkling tanks are empty. To continue sprinkling, it is necessary to shut off the gate valve fitted into the system just before the three-way valve, marked AIR TO SPRINKLING TANKS. This is necessary to relieve the air pressure within the system, which may build up greater pressure than firemain pressure, thus preventing filling or sprinkling. Sprinkling tanks are filled with water at all times, but air pressure is not placed on the tanks until preparing for battle condition.

**Valve label plates and instruction plates**. All valves are fitted with label plates, either directly on the body of the valve, when practicable, or on adjacent surfaces. Legends are black or red, depending upon the relationship of the valve to the sprinkling system; sprinkling positions are commonly red. Two sprinkling system instruction plates, similar in design to the label plates, are located in each turret-one in the turret officer's booth, close to control station A, the other in the powder handling room. The instructions on each plate are as follows:

## TURRET SPRINKLING SYSTEM

### INSTRUCTIONS

### TO PREPARE SYSTEM FOR OPERATION

1. OPEN FIREMAIN. CONTROL VALVE OPERATED IN POWDER HANDLING ROOM THEREBY SUPPLYING WATER TO THE ROTATING FIREMAIN CONNECTION LOCATED IN PIT. OPEN CUTOUT VALVE IN SPRINKLING SYSTEM RISER IN POWDER HANDLING ROOM.

2. OPEN VALVE IN THE 100 LB. AIR LINE TO THE AIR CONTROL COCK IN THE TURRET OFFICER'S BOOTH. ONE VALVE LABELED, "AIR TO SPRINKLING TANKS," IS LOCATED ON THE H.P. SIDE OF THE REDUCING VALVE ON PAN LEVEL, RIGHT SIDE, AND THE OTHER VALVE LABELED, "AIR TO SPRINKLING TANKS," IS LOCATED IN THE TURRET OFFICER'S BOOTH CLOSE TO THE AIR CONTROL COCK.

3. SET AIR CONTROL COCK IN TURRET OFFICER'S BOOTH TO VENT POSITION. AFTER WATER APPEARS AT OVERFLOW, KEEP COCK IN VENT POSITION UNTIL BOTH SPRINKLING TANKS ARE FREE OF AIR. THEN SET AIR CONTROL COCK TO AIR SUPPLY POSITION.

### TO SPRINKLE

TURN PERTINENT SPRINKLING CONTROL BACK TO SPRINKLE POSITION. NOTE: SPRINKLING WATER WILL BE SUPPLIED FROM THE TANKS OR DIRECT FROM THE FIREMAIN DEPENDING UPON WHICH IS UNDER THE HIGHER PRESSURE. THE APPEARANCE OF AIR AT THE SPRINKLING OUTLETS INDICATES THAT THE SPRINKLING TANKS ARE EMPTY. TO CONTINUE SPRINKLING FROM THE FIREMAIN, CLOSE VALVE IN TURRET OFFICER'S BOOTH LABELED, "AIR TO SPRINKLING TANKS."

### TO STOP SPRINKLING

RESET ALL SPRINKLING CONTROL COCKS TO CLOSE POSITION.

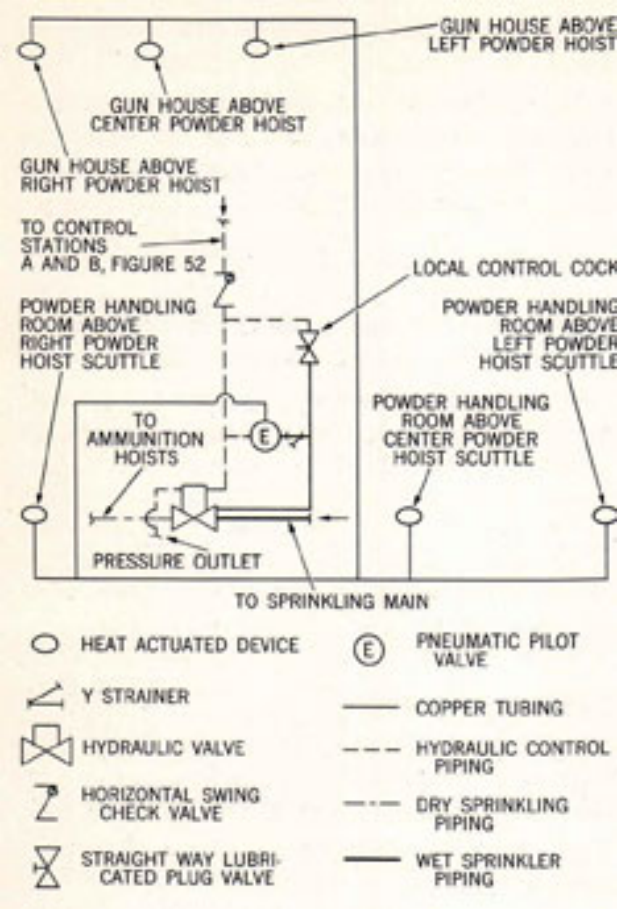



*Figure 55. Turret Sprinkling System Automatic Rate-of-Rise Devices Schematic*

**Testing system operation**. A combination flush-out and test plug assembly is provided to test the operation of the hydraulically operated control valves. The test should be performed at least once a week on all hydraulically controlled valves. To test, the cover must be removed from the bottom of the valve, and the test plug assembly screwed in all the way, until solidly engaged. With the test plug assembly installed, any one of the sprinkling control cocks controlling the valve may be turned to SPRINKLE.

**Caution**: Make sure that the proper control cock is operated. Should one be turned which operates another hydraulically controlled valve, sprinkling will ensue.

After opening the control cock, turn the pet cock at the bottom of the test plug assembly. If water flows, the valve is serviceable; if not, the valve should be replaced. To complete the test, it will be necessary to reset the open sprinkling control cock to CLOSE position, then remove the test plug assembly and install the bottom cover.

**Automatic rate-of-rise control devices**. Heat-actuated control devices are located within the turret which automatically function to operate the turret sprinkling system in the event of fire within the turret. Six heat-actuated devices are used, as shown on figure 55. Three are located across the roof of the gun house, three feet before the transverse centerline of the turret and over the guns. Three devices are located within the powder handling room equally spaced in the powder handling area.

All six devices are connected, by means of copper tubing, 1/8 inch in outside diameter, to the top of a pneumatically released pilot valve located within the powder handling room. The valve is fitted with two ports at its lower end. To one port is connected a 1/8-inch copper-nickel alloy tube, fitted with a strainer, which extends from and is connected to the firemain. To the second port is connected a similar 3/8-inch copper-nickel alloy tube, which extends and connects to the hydraulically operated valves. The arrangement is such that, when a pneumatic pressure is exerted upon the pneumatically released valve by any one of the six heat-actuated devices, the valve opens. This permits water in the tubing from the firemain to pass through the valve, and to continue on and open the hydraulically operated control valves. Water then flows from the wet sprinkling piping into the dry sprinkling piping, and sprinkling ensues.

Each heat-actuated device is a pneumatic thermostat, or heat conductor. It is a hollow brass chamber of approximately 14 cubic inches, with no moving parts. A wire guard protects it against injury. Heat absorbed as a result of a sudden temperature rise, such as might be experienced in

the case of a fire, is expanded within the chamber, developing air pressure which is conveyed by air tubing to the diaphragm of the pneumatically released pilot valve, causing it to trip. This valve will remain open until manually closed and reset.



**Communications**

The primary circuits which provide various types of communications within each turret, between turrets, and between the turrets and other ship stations are listed below. A brief description of each circuit follows the listing. Their extent and arrangements are indicated in figures 56 and 57.

| SYSTEM | CIRCUIT IDENTITY |
|---|---|
| Ready light | 1R |
| Salvo signal | 1VB |
| Cease-firing signal | 1U |
| Interior communication | IC |
| Depression and train stop signal | DS |
| Intra-turret emergency alarm | RA |
| Train warning signal | TW |
| Turret announcing:- | |
| Turret I | 11MC |
| Turret II | 12MC |
| Turret III | 13MC |
| Battle telephone | JA and XJA |
| Supplementary sound-powered telephone | XJ |
| Sound-powered telephone call bell | E |
| Automatic telephone | J |

**Ready light system (circuit 1R)**. The ready light system comprises a turret arrangement of indicating lights, dials, and switches which indicates loading and gun laying operations being is rung from any of several control stations within the ship.

**Depression and train stop signal system (circuit DS)**. Two indicator dials at each gun captain's control panel, and a 6-dial indicator for the turret officer, comprise a depression and train stop signal system which serves to indicate whenever a gun's line of fire is clear or nears the ship's structure. Indicators and lights are energized by cam-actuated switches which serve each gun in both elevation and train.

**Intra-turret emergency alarm system (circuit RA)**. The intra-turret emergency alarm system consists of electrically operated sirens, strategically located throughout the turret, which are activated whenever serious danger exists or serious casualty has occurred. Control stations for the siren contact makers are located within the turret, on the various levels.

**Train warning signal system (circuit TW)**. At times other than general quarters, the train warning signal system is used to warn ship's personnel on deck that the turret is about to train. It consists of a watertight warning bell, mounted on the exterior of the turret, which is energized by a snap switch within the turret officer's booth.

**Turret announcing system (circuits MC)**. The turret announcing system permits the turret officer and the turret captain to communicate with all principal stations within the turret. A control box within the turret officer's booth provides

performed, and the state of readiness of the guns. Included among the components that comprise the system are the turret officer's selector switch, turret officer's indicator panel, turret officer's 6-dial and 3-dial indicators, gun captain's control panels, pointer's indicator panel, pointer's foot-operated ready switch, trainer's dial indicator, and trainer's foot-operated ready switch.

**Salvo signal system (circuit 1VB)**. The command to fire is transmitted to turret personnel by the salvo signal system. It consists of vibrator-type horns located at appropriate positions within the turret, controlled either locally or from remote sources.

**"Cease firing" signal system (circuit 1U)**. The command to cease firing is transmitted to turret personnel by the "cease firing" signal system. It consists of a high-intensity type bell located in the turret officer's booth, which

communication with any or all stations, or a combination thereof. The system comprises an amplifier unit, reproducers, and portable microphones. Reproducers are of two types, one with a talk-back switch, and one without a talk-back switch.

**Battle telephone system (circuits JA and XJA)**. The battle telephone system, primary and auxiliary, provides a telephonic connection between certain key personnel within the turret, and the ship's main battery plotting rooms. Push-to-talk button handsets and headsets with breastplate supported and push-button controlled transmitters are utilized.

**Supplementary sound-powered telephone (circuit XJ)**. The supplementary sound-powered telephone system for the turret officer, comprises six local telephone circuits. Telephone

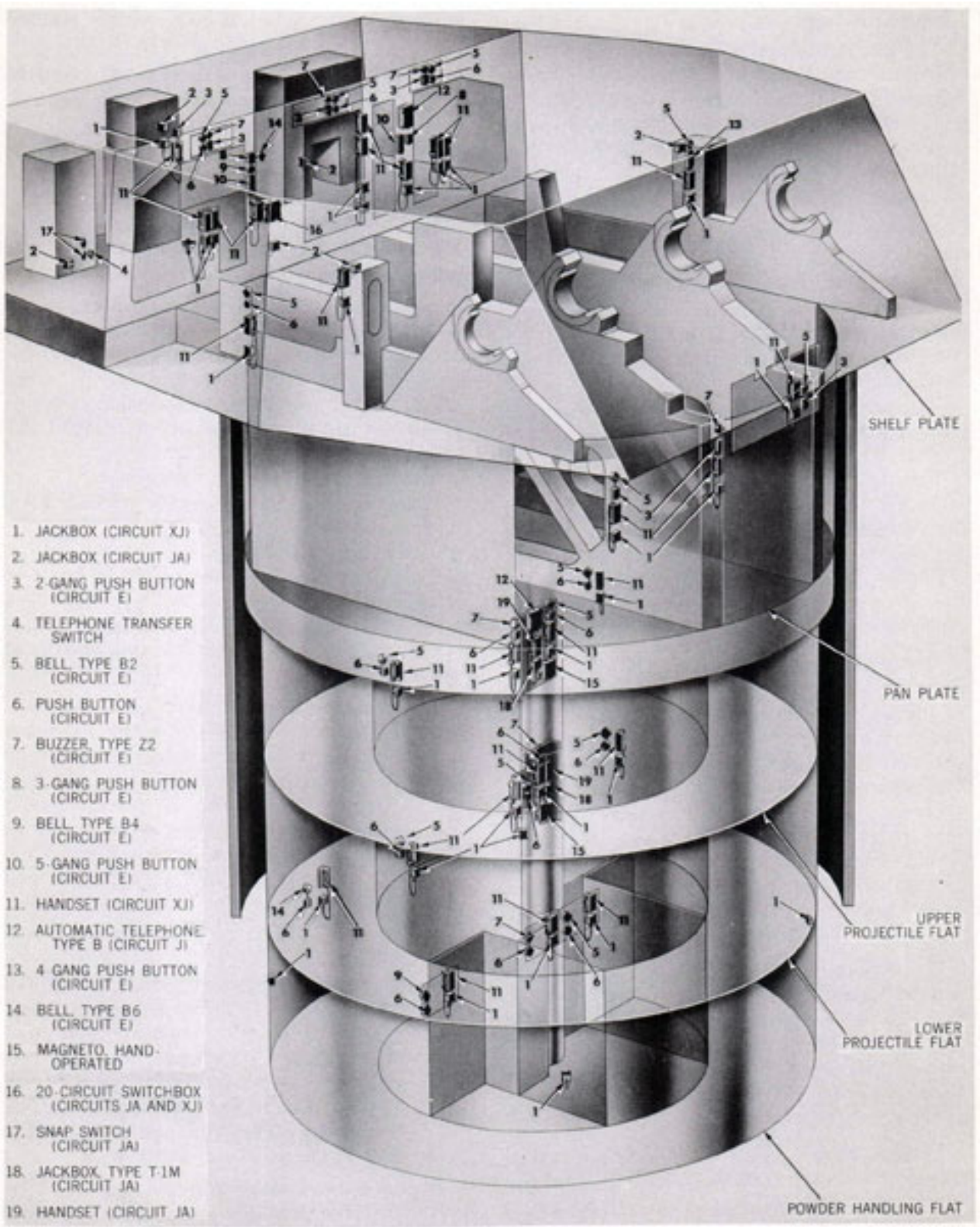



*Figure 56. Turret General Communications Arrangements*

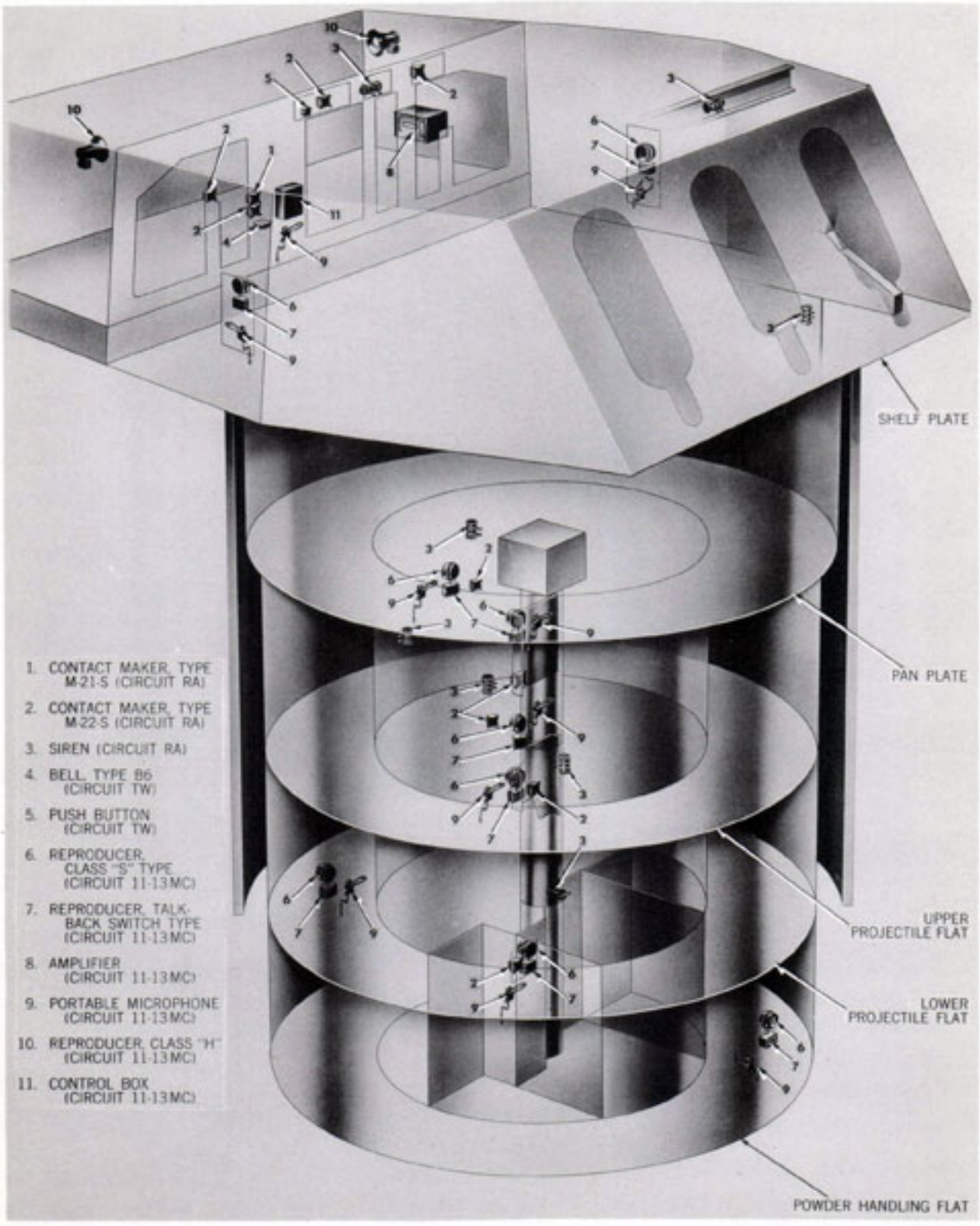



*Figure 57. Turret Interior Communications System. General Arrangement*

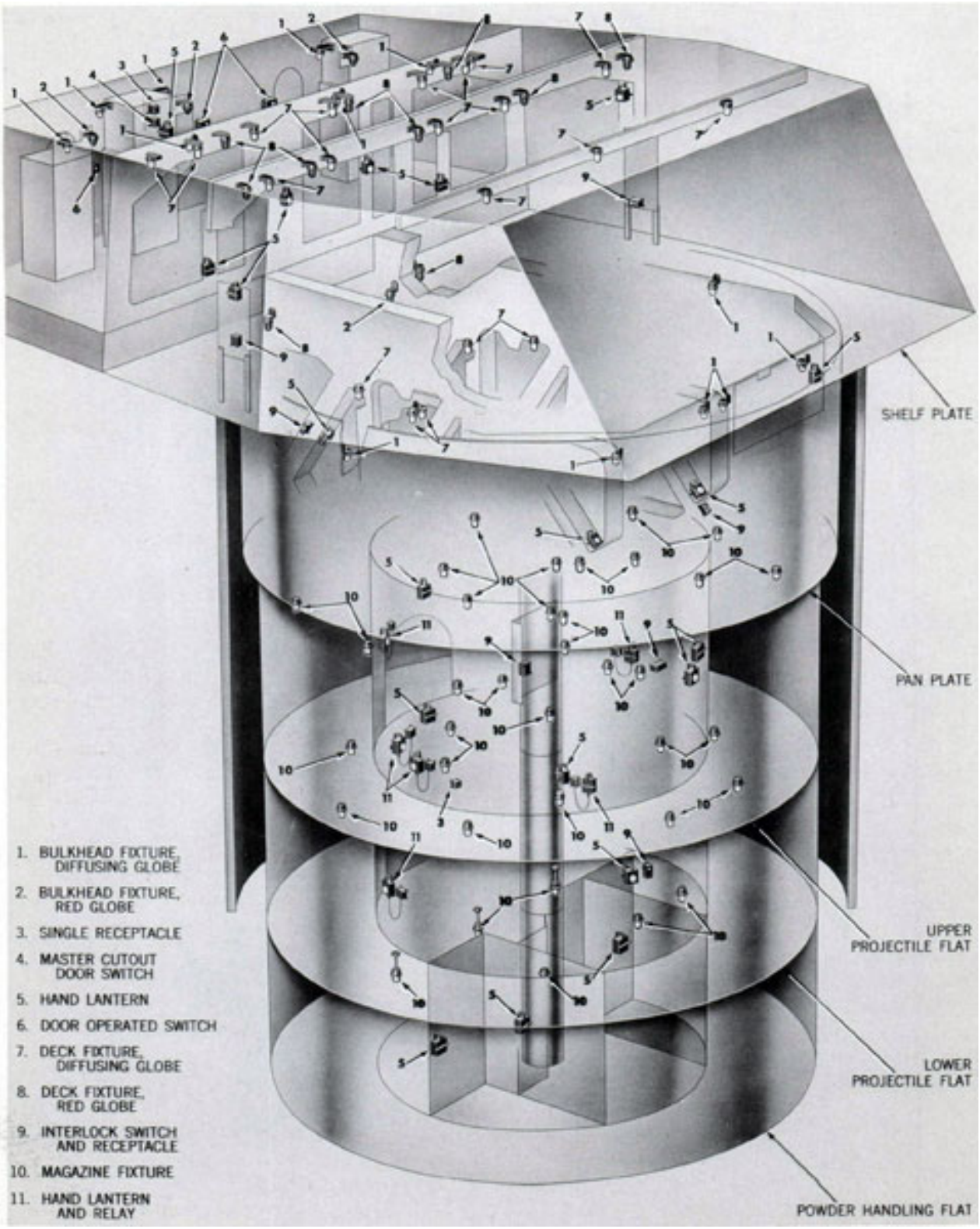



*Figure 58. Turret Illumination. General Arrangement*

equipment used is identical in design to that used for the battle telephone system. The circuits link the turret officer with the three gun captains, and with the men at the loading apertures of the projectile and powder hoists.

**Sound-powered telephone call bell system (circuit E)**. The sound-powered telephone call bell system comprises an audible call system which parallels most circuits of the turret officer's telephone system. It includes both high and low intensity bells, a low intensity buzzer, and associated push buttons, connection boxes, magneto, and wiring.

**Automatic telephone system (circuit J)**. The automatic telephone circuit is a conventional, dial-type telephone system, which connects the turret, through a central switchboard, to any similar dial telephone in the ship. Two telephones are located in the turret, one in the turret officer's booth, and one in the upper projectile flat.

**Illumination**

Turret illumination in each turret comprises a general turret lighting system for white or low-level red illumination, and an instrument illumination system.

**General turret illumination**. The general turret lighting system includes lighting fixtures, switch and receptacle units, door-operated switches, hand lanterns, relays, single receptacles, distribution boxes, an automatic bus transfer panel, and associated wiring, as shown in figure 58. Normal and

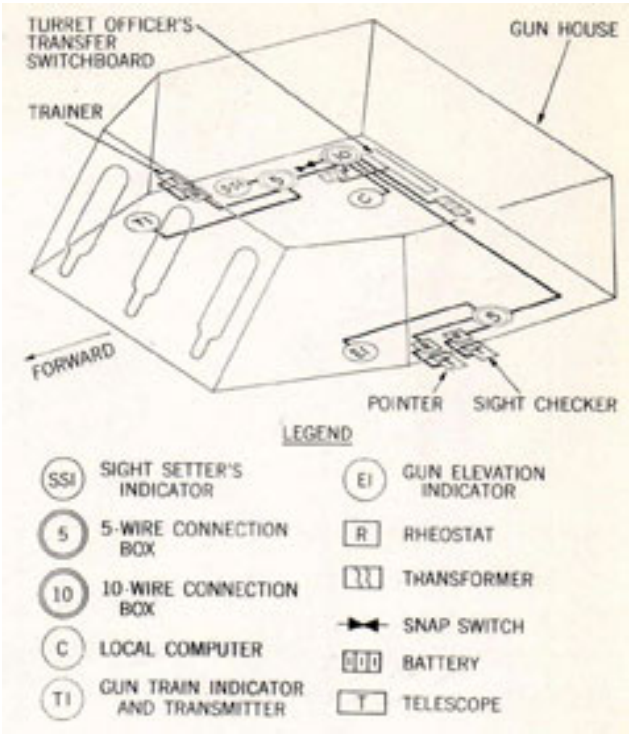



*Figure 59. Instrument Illumination Circuit Schematic*

portable devices. Distribution boxes with switches provide supply and individual light circuit control. Door-operated switches are fitted to the three access doors to the rear of the turret officer's booth; these are arranged to close all light circuits above the upper projectile flat when closed, and to open the same circuits when opened. A door-switch master cutout is also provided for control of the same circuits, and to serve as a master cutout for the three door-operated switches.

**Instrument illumination circuit**. The system that provides instrument illumination is a 6-volt circuit designated 8-inch Lighting Circuit Mk 8 Mod 0. This is a circuit that controls lamp wells and reticle lamps which illuminate indicating dials and telescope crosslines.

The circuit is arranged to be supplied from a transformer or storage battery. Its components are a transformer, storage battery, snap switch, three rheostats, branch boxes, and connection boxes, all arranged as shown in figure 59.

The transformer is a drum-shaped unit mounted in the turret officer's booth above the motor-generator amplidyne set. It steps down

emergency power supply for the circuit is derived from the 120-volt, 60-cycle ship's service system through an automatic bus transfer panel located in the upper projectile flat. The bus transfer panel functions automatically to switch from normal to emergency power, or vice versa, should failure occur in either power supply.

Diffusing globe deck and bulkhead fixtures are provided for normal illumination of the gun house and pan plate. Red globe deck and bulkhead lighting fixtures are provided for battle illumination of the same areas. Diffusing globe magazine-type fixtures are provided for illumination of all turret levels below the pan plate. Combination switch and receptacle units are installed at convenient locations for operation of trouble lights and various electrically operated

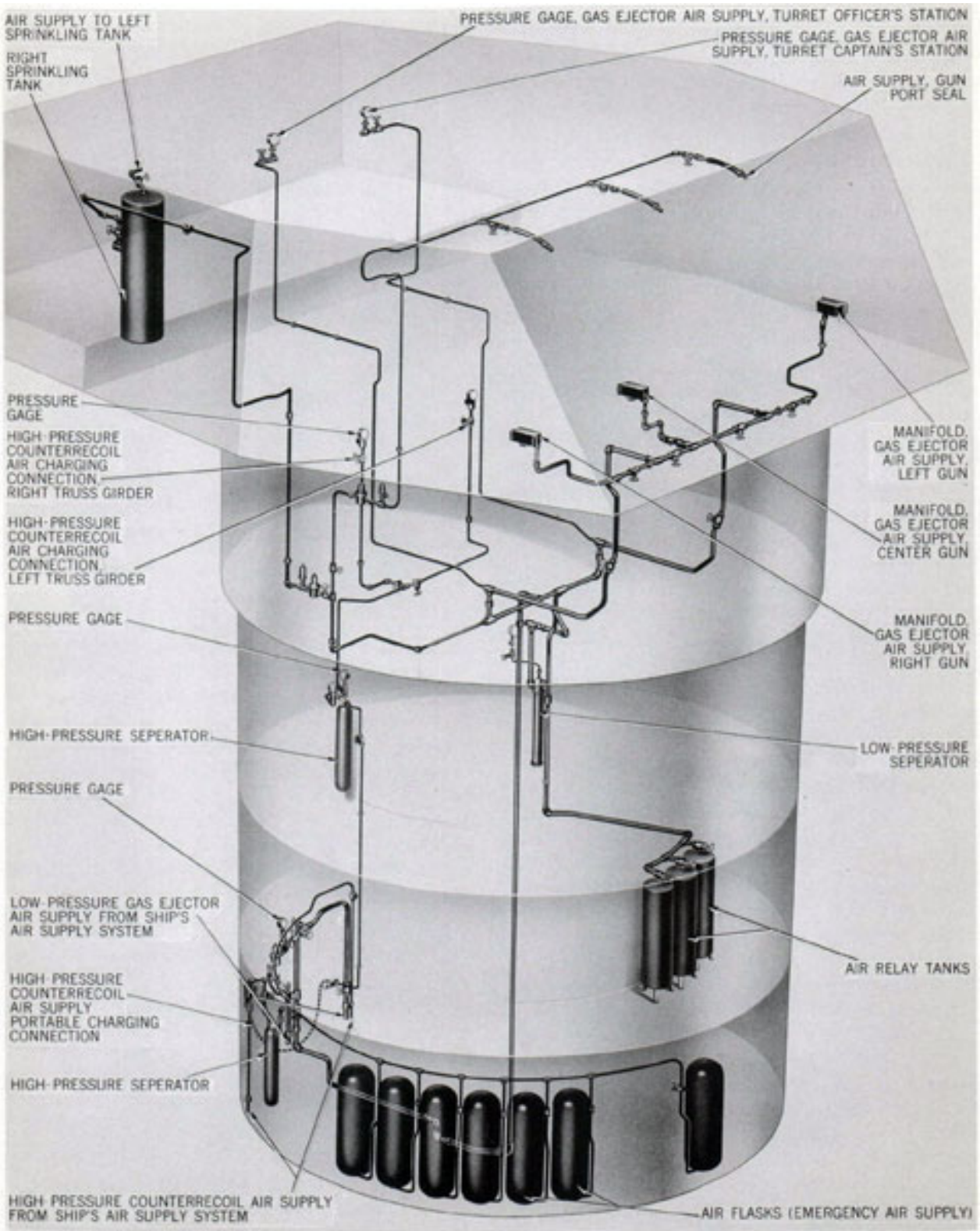



*Figure 60. Gas Ejector and Counterrecoil Air Supply Pipe System. General Arrangement*

120-volt alternating current supply to 6-volt alternating current and delivers this current to a multiple-branch light system through separate protective fuses.

The transformer supply is controlled by a snap switch located at the radar operator's station. This switch permits alternative supply from the storage battery. It closes all branches of the lighting circuit for either source.

The principal branches supplied are three rheostats located at the trainer's, pointer's and checker's sight stations. These control crossline illumination in the respective telescopes.

Other branches supplied are the light well lamps of the computer, sight setter's indicator, and gun elevation and train indicators. These instruments and the telescopes are the essential elements of the local fire control system. The system does not extend to other equipment requiring instrument dial illumination, such as: the elevation indicator-regulators, turret officer's indicators, transfer switchboard, and radar control instruments. These are illuminated by self-contained illuminating transformer and lamp circuits.

**Air supply services**

Two systems of pipe lines extend through the turret to supply compressed air. These are the gas ejector supply and counterrecoil supply systems illustrated in figure 60 and described in the paragraphs below.

**Gas ejector supply**. Air for the gas ejector air supply is furnished by the ship's intermediate-pressure air compressors. The general arrangement of this system, together with the counterrecoil air supply replenishing pipe system, is shown in figure 60. A schematic arrangement of the gas ejector system alone, is shown in figure

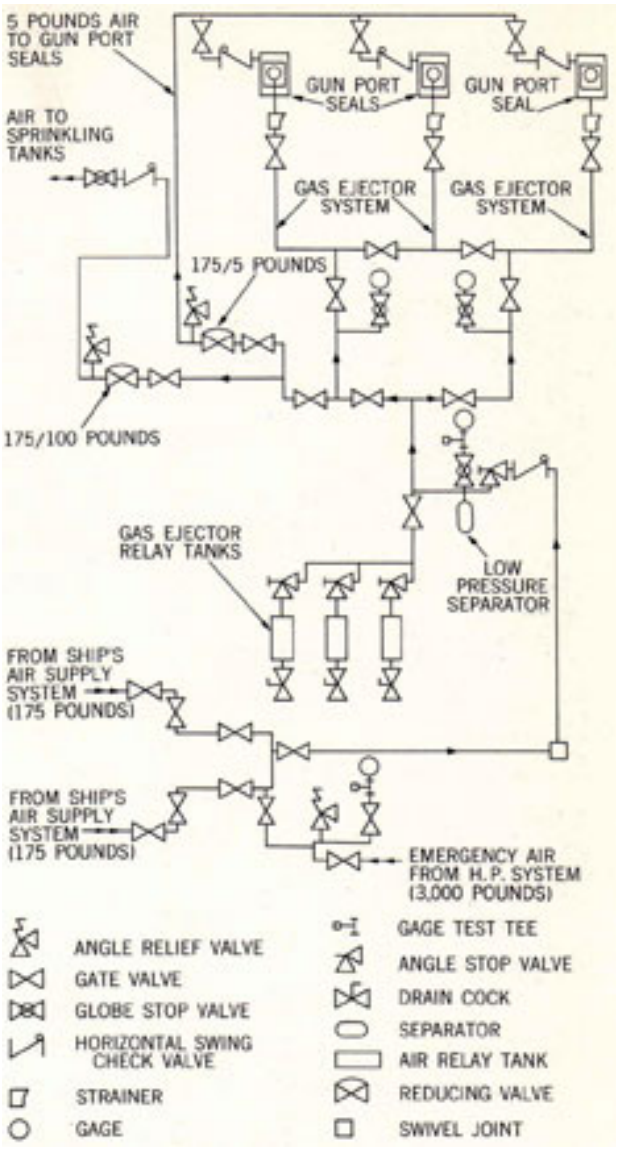


*Figure 61. Gas Ejector Air Supply System Schematic*

high-pressure air tubing entering the powder handling room. This connection is provided with a 3/8-inch by 2-inch reducing valve, reducing the high-pressure system from 3,000 pounds per square inch to 175 pounds per square inch; it also includes a relief valve set at 220 pounds per square inch. The reducing valve is automatically controlled, functioning to supply an alternate source of air from the high-pressure ship's air supply system, in the event of an emergency caused by failure of the low-pressure supply system.

61. Air is piped through the foundation bulkhead into the powder handling room in two 2-inch brass tubings. These enter on opposite sides of the powder handling room, then bend abruptly toward each other, partially encircle the fixed flat within the powder handling room, and join together to form a single air line. Stop valves are fitted to the lines before they join, and to the single line formed at the juncture. A connecting line connects the 2-inch gas ejector air supply line with the



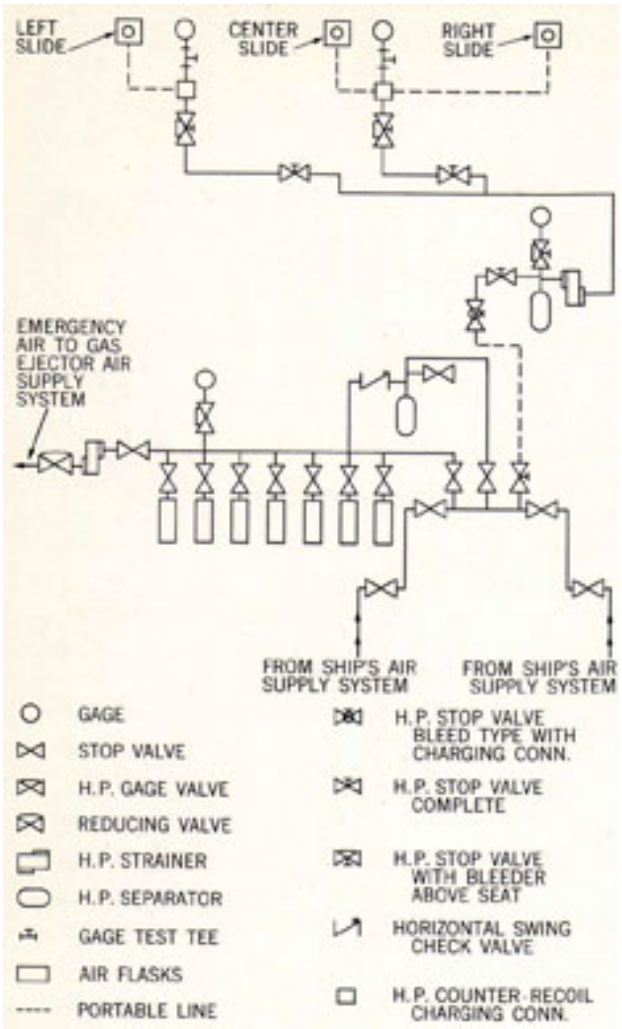



*Figure 62. Counterrecoil Air Supply System Schematic*

A single 2-inch gas ejector supply line extends vertically downward through the fixed flat within the powder handling room to the void beneath the room, then extends horizontally into the wiring truck beneath the base casting. At this point it is

left side of the central column, within the upper projectile flat. Before entering the separator, the air tubing is provided with a 2-inch horizontal swing check valve and a 2-inch angle stop valve. Mounted on top of the separator is a pressure gage graduated from 0 to 400 pounds per square inch.

Tubing from the separator extends to a tee, the lower port of which is fitted with a 2-inch brass tubing extending vertically downward, adjacent to the central column, through the upper projectile flat to the lower projectile flat, and through the circular bulkhead; and is there connected to three interconnected air relay tanks mounted in the outer compartment. This line is fitted with a 2-inch gate valve just beneath the tee at the separator, and is further fitted with a 2-inch angle stop valve at the point of connection with each tank. Relay tanks each have capacity of 7.5 cubic feet.

From the upper port of the tee at the separator, 2-inch brass tubing extends upward to a horizontally mounted tubing across the upper projectile flat. Connected to this supply line are air lines which serve the gas ejectors, sprinkling system, and gun port seals.

**Counterrecoil air supply**. Air for replenishing the counterrecoil and accumulator air supply is furnished by the ship's high-pressure air

fitted with a swivel joint to a vertical 2-inch pipe extending upward through the exact center of the central column wiring tube. Within the wiring recess at the top of the central column, the pipe is fitted with a 90° ell, and bends horizontally forward, on the longitudinal centerline of the turret, to the exterior of the wiring recess. At this point the pipe is fitted to a 2-inch brass tube that bends downward, around the central column, to a low-pressure air-water separator, mounted at the

compressors. The general arrangement of this system, together with the gas ejector air supply pipe system, is shown in figure 60. A schematic diagram of the high-pressure supply pipe system alone is shown in figure 62. This is a 3,000 pounds per square inch system. Air is piped through the foundation bulkhead into the powder handling room in two 3/8-inch copper tubings. These enter on opposite sides of the powder handling room, then bend abruptly toward each other, partially encircle the fixed flat within the powder handling room, and join together to form a single air line. A stop valve is fitted in one air line before the juncture, and a 3/8-inch bleeder-type stop valve is fitted into the single line formed at the juncture. Connections are provided between one of the air lines and a bank of air flasks mounted on the fixed flat. These have a total capacity of 165 cubic feet. Each flask is, connected to an interconnecting manifold. This manifold line is provided with a stop valve at either end to close off the



air flask system, and each air flask is provided with a stop valve at its point of connection, so that individual flasks may be closed from the system. An additional connection to the low-pressure gas ejector air supply system is provided with a 3/8-inch by 2-inch reducing valve, reducing the pressure for gas ejector supply purpose as previously described on page 67. The bank of air flasks is further provided with pressure gages and a 3/8-inch bleeder-type drain valve.

A portable pipe is used to connect the single high-pressure air line, on the fixed portion of the flat, to tubing mounted on the rotating portion of the powder handling room. The connection is fitted with a 3/8-inch bleeder-type stop valve, with a charging connection. From this connection, the 3/8-inch copper tubing extends vertically upward through the lower projectile flat and into the upper projectile flat, where it is connected to a high-

horizontally mounted line of the upper projectile flat. Connected to this tubing, and extending upward into the right and left gun truss girders, are two tubes which provide air charging connections for portable pipes for the three guns. Each extension is fitted with a stop valve, and terminates with an air charging connection bleeder valve and pressure gage.

**Hydraulic equipment filter system**

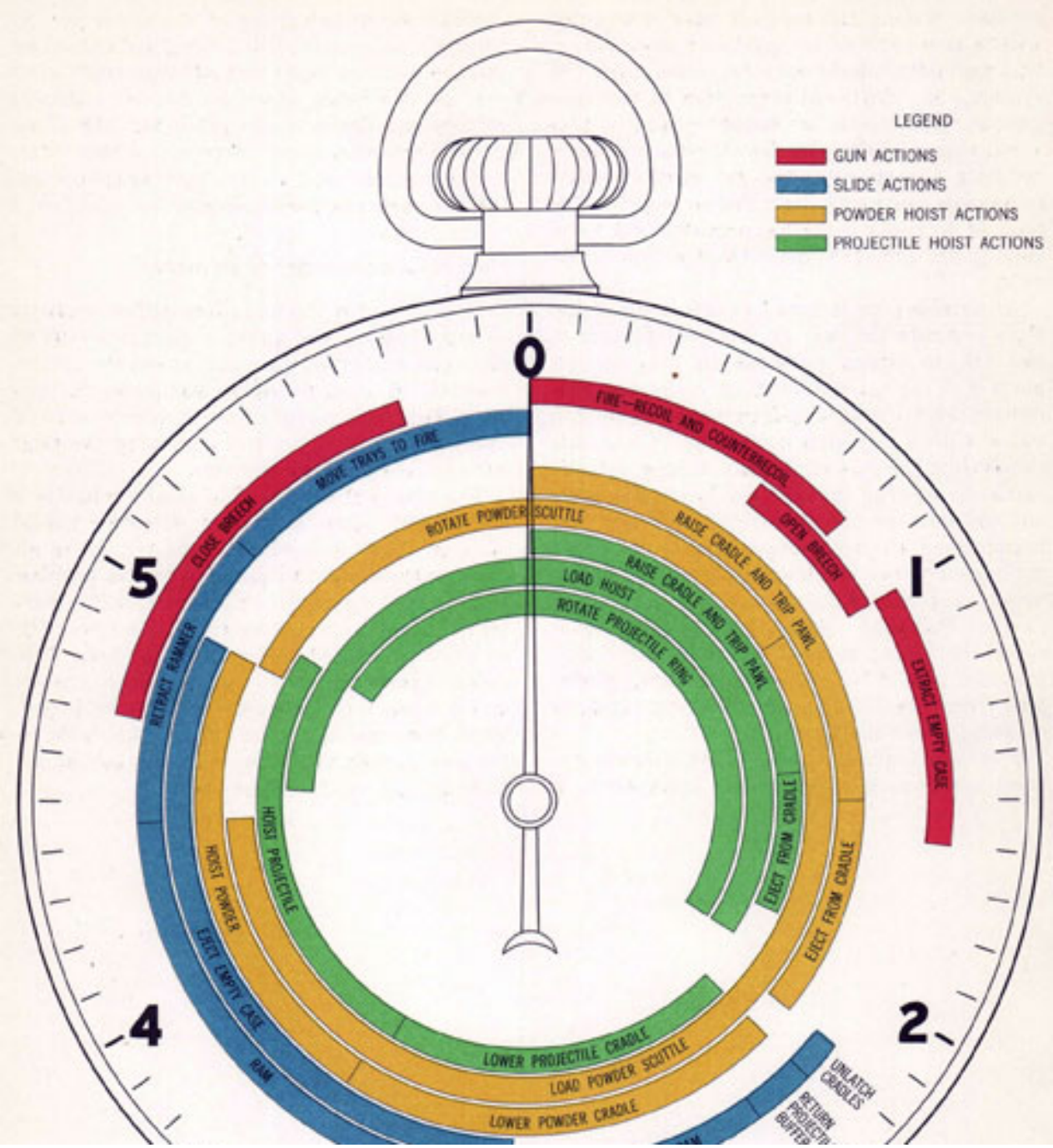
In addition to the extensive airline systems described above, the turret is equipped with an elaborate system of pipes and valves that interconnects all ordnance equipment hydraulic systems. This is an installation for maintenance of hydraulic fluid. It permits clarifying the fluid without dumping the systems.

pressure air-water separator mounted in the outer compartment of the upper projectile flat, right side, against the circular bulkhead. Before entering the separator, the tubing is fitted with a 3/8-inch high-pressure stop valve. A pressure gage, graduated from 0 to 5,000 pounds per square inch, is mounted above the separator.

From the separator, the tubing extends upward and through the circular bulkhead to a

The principal unit of this arrangement is a commercial pump and filter assembly called Skinner Filter Model 3112, type HB. It is located on the powder handling flat at the position indicated on figure 21. It is permanently connected to the hydraulic system drain lines with an arrangement of valves and pipe lines. The valves enable any drive system to be drained into a sump tank, all other systems being isolated from the operation. Sump fluid can be pumped though the filter and back to the expansion tank of the power drive.





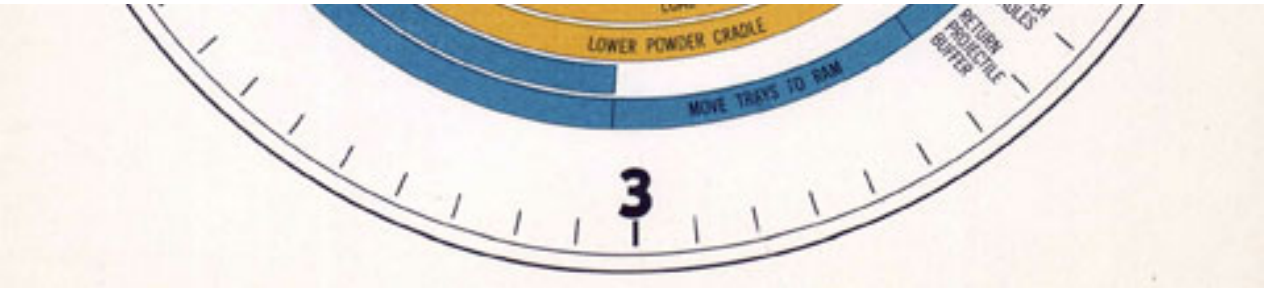



*Figure 63. Firing Cycle Operation*

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Next Part

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# Chapter 2

# TURRET OPERATION

## INTRODUCTION

This chapter is a guide to turret operation. It is arranged so that it may aid in organizing the crew. Each crew station is separately described; the equipment used and the duties of the station are defined.* These duties are explained or identified with respect to the functional activities of equipment-a station or compartment-and with respect to methods of control of equipment and of the turret. In the instance of certain key stations, the duties include alternative activities concerning different methods of control or emergency or casualty operations.

### Station activities and turret control methods

**Classes of operations**. All station activities are associated with one of four functional classes of operations. These are:

Ammunition service to the guns
Gun operation
Gun laying
Controlling gun fire

Ammunition service to the guns and gun operation are the same in all methods of turret operation. But the other two classes of operations vary in different methods of remote and local control.

REMOTE CONTROL is a general method of turret control that governs turret fire by electrical signals originating from stations remote from the turret.

LOCAL CONTROL is a general method applying to several variations of control by the turret crew fire control selections identified by the following terms:

PRIMARY SURFACE CONTROL
PRIMARY AA CONTROL
SECONDARY SURFACE CONTROL
SECONDARY AA CONTROL
LOCAL RADAR CONTROL
LOCAL SIGHT CONTROL
HI-TURRET CONTROL
HAND (EMERGENCY) CONTROL

PRIMARY SURFACE CONTROL is a remote control method employed against surface targets. It is turret control by a main director in combination with main plotting room equipment. It has two variants: "automatic" and "indicating." In the automatic variation, the turret is controlled without crew assistance. The other directs the crew in "follow-the-pointer" operation. In both variants, the guns are fired by remote switch at the controlling director.

PRIMARY AA CONTROL is a remote control method employed against air-borne targets. It is turret control by a main director in combination with main plotting room equipment. It includes "automatic" and "indicating" variations as in Primary Surface Control. In both variations, it provides automatic fuze setting. In Primary AA Control, all guns are fired by remote switch at the Controlling director.

SECONDARY SURFACE CONTROL is a remote control method that is identical to Primary Surface Control, except for the controlling director. It employs a secondary battery director in combination with main plotting room equipment, routing signals via secondary plot.

with facilities at hand.

There are eight principal variations of these basic methods of control. They are turret

SECONDARY AA CONTROL is a remote control method that is identical to Primary AA Control except for the controlling director. It employs a secondary battery director in combination with main plotting room equipment, routing signals *via* secondary plot.

* Ships should not consider the descriptions of duties of turret personnel to be rigid or definitive. Variations therefrom are within the discretion of the operating forces, provided existing regulations are observed.



| *Crew Name* | *Station* | *Location* |
|---|---|---|
| Turret Officer | *Right Turret Control* | |
| Turret Captain | Left Turret Control | |
| Talker: JE (Computer To Sight Setter) | Computer | |
| Talker: JW (Radar Range) | Radar | |
| Talker: JW (Local Computer) | Computer | |
| Computer Operator | Computer | |
| Radar Operator | Left Radar | Turret Officer's Booth |
| Radar Operator | Right Radar | |
| Electrician | Roving | |
| Gun Captain* | *Right Gun Control Panel* | |
| Gun Captain* | *Center Gun Control Panel* | |
| Gun Cap-Ain* | *Left Gun Control Panel* | |
| Gun Captain's Assistant** | Roving | |
| Gun Captain's Assistant** | Roving | |
| Trainer | *Train Control Handwheel* | Right Sight Station |
| Sight Setter | *Sight Setting Indicator* | |
| Pointer | *Elevating Control Handwheel* | Left Sight Station |
| Checker | Left Sight (Drill Fire Only) | |
| Outer Ring Operator | Outer Ring Control Handwheel | |

| | | |
|---|---|---|
| Inner Ring Operator*** | Inner Ring Control Handwheel | |
| Projectile Man • | *Right Steady Arm Mechanism* | |
| Projectile Man • | *Center Steady Arm Mechanism* | Upper Projectile Flat |
| Projectile Man • | *Left Steady Arm Mechanism* | |
| Parbuckler • | *Right Gypsy Head* | |
| Parbuckler • | *Center Gypsy Head* | |
| Parbuckler • | *Left Gypsy Head* | |
| | | |
| Outer Ring Operator | Outer Ring Control Handwheel | |
| Inner Ring Operator | Inner Ring Control Handwheel | |
| Projectile Man | Right Steady Arm Mechanism | |
| Projectile Man | Center Steady Arm Mechanism | |
| Projectile Man | Left Steady Arm Mechanism | Lower Projectile Flat |
| Parbuckler | Right Gypsy Head | |
| Parbuckler | Center Gypsy Head | |
| Parbuckler | Left Gypsy Head | |
| Electrician | Roving | |
| | | |
| Petty Officer In Charge | Hoist Communications | |
| First Powderman, Right | *Right Powder Hoist* | |
| Second Powderman, Right | Right Powder Hoist | |
| Third Powderman. Right | Magazine Scuttle | |
| First Powderman, Center | *Center Powder Hoist* | Powder Handling Room |
| Second Powderman. Center | Center Powder Hoist | |
| Third Powderman, Center | Magazine Scuttle | |
| First Powderman. Left | *Left Powder Hoist* | |
| Second Powderman, Left | Left Powder Hoist | |
| Third Powderman. Left | Magazine Scuttle | |

* And Ammunition Supply Talker
** Goes Out On Gun Girder Only When Specifically Directed By Turret Officer: Returns Immediately Upon Completion Of Assignment
*** And Transfer Switch Man
• Emergency Gun Layers (Any Two): For Right And Center Forward Gun Pit Stations: Emergency Gun Layer For Left Gun Pit Station Is Assigned From The Gun House Crew, The Only Access To The Station Being Via The Left Shelf Plate Hatch

*General Notes*:

1. Projectile Men And Parbucklers Will Alternate
2. When Emergency Elevating Controls Are Manned. Upper Flat Ammunition Handlers Are Assisted By Lower Flat Crew, After Lower Flat Ammunition Is Exhausted
3. Stations Underscored Are Manned By The Condition Watch

*Figure 64. Turret Personnel Organization*



LOCAL RADAR CONTROL iS a local control method available to turrets II and III, for use against a surface target. It is independent turret control, deriving target bearing and range by turret radar equipment. It controls the turret train drive in automatic operation, and the gun laying drives in pointer target sighting control. It fires all guns by a designated local switch.

LOCAL SIGHT CONTROL is a local control method available to all turrets for use against surface targets. It is independent turret control, deriving target bearing and range by any available telephone communication or by visual estimate, locally. It controls turret train and gun laying by target sighting control. It fires all guns by designated local switch or switches.

HAND (EMERGENCY) CONTROL is a local control method available to all turrets for use against surface targets. It is independent gun laying control. It derives target bearing and range by any available communication or locally by

installations, and the crew arrangement; and by drilling each member of the crew in his duties.

**Firing cycle**

The significance of turret rapid fire and the importance of teamwork in the ammunition service are indicated by the diagram of figure 63. In continuous automatic fire, each of the three guns of the turret is firing every six seconds. During this period, many ammunition service actions and gun loading actions take place. Most of these actions depend upon completion of a prior action, and the final action, gun firing, is dependent upon smooth coordination and rapid completion of all. Lag or delay in any action will stop or retard gun firing. Figure 63 identifies each action, shows its time interval, together with the period that it overlaps other simultaneous actions, and indicates its dependence on other interlocking movements.

The firing cycle is the key operation of turret rapid fire. Three-fourths of the turret organization directly

visual estimate. It controls turret train by target sighting control. It controls gun laying by separate control of each elevating drive. It fires all guns by pointer target sighting control.

HI-TURRET CONTROL is a remote control method for controlling turret I against a surface target. It provides "automatic" or "indicating" control of turret I by gun order transmission from turret II; turret II transmits these orders automatically while operating in Local Radar Control. It requires supplementary telephone transmission of sight and parallax data. Hi-Turret Control is an approximation of Primary Surface Control.

**Objectives**. In all operations and in each method of control, the primary purpose of the new turret design is to increase the rate and accuracy of fire in comparison with equivalent installations of earlier heavy cruisers; and, secondary, to attain this rapid continuous fire with safety. Both safety and rapidity of equipment actions are design features of the hoists, guns, gun laying drives, and all control arrangements. But speed and safety are dependent in large measure on crew teamwork, alert, smart operation, and good maintenance. These personnel factors can be obtained best by understanding the station equipment, the turret contribute to its efficient performance, and all other of the crew are indirectly associated, depending on the method of turret control.

**Personnel organization**

The tabulation of the facing page (figure 64) identifies the members of the turret organization. Forty-four men are required to man the battle stations, and forty-five when training the crew in loading drill and target firing. Twenty-seven men of this complement, located in the levels below the gun house, operate the ammunition service to the guns; six others, stationed in the gun house, control and maintain gun operations; these thirty-three men are identically employed in all methods of turret control.

The balance of the organization consists of two gun laying operators and ten turret control-men, all stationed in the gun house. These twelve men have varying duties, depending on the method of turret control. All are engaged when the turret is locally controlled in drill operations. But when operating under remote control, only one of these men, the sight setter, is actively engaged; all others are at "stand-by': operation. This and other control duty variations are explained in the descriptions of personnel duties starting on page 77.

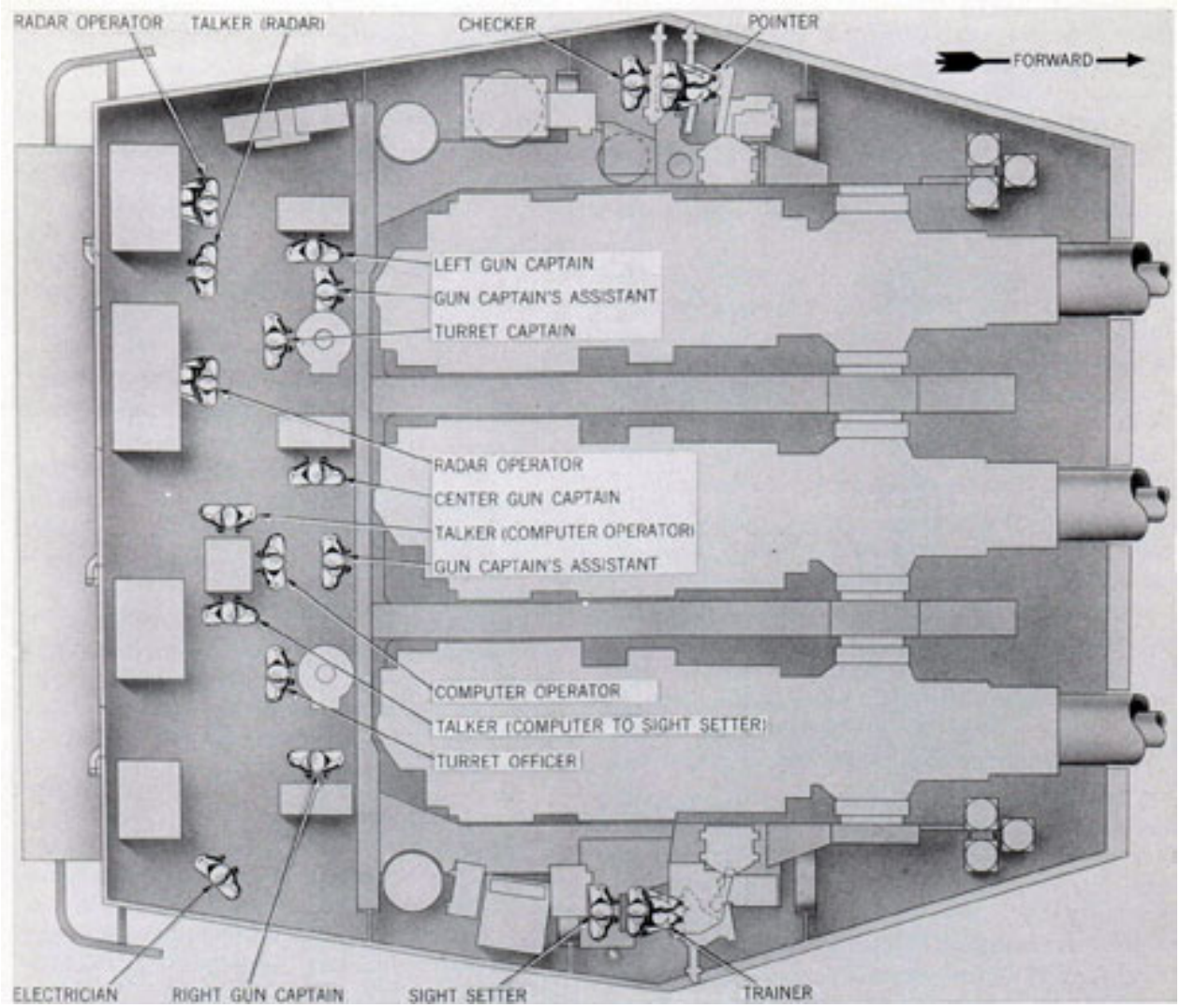



*Figure 65. Turret Personnel Arrangement. Gun House Stations*

**Crew stations**

In normal turret operation when the turret is controlled locally or from remote director, crew stations are manned in all levels of the turret except the pan floor. The manned levels are isolated; all intercommunicating hatches are closed and secured. This divides the manned spaces into four compartments with personnel arrangements as illustrated in figures 65 to 68 and as described in the next paragraphs.

**Gun house crew**. Eighteen members of the crew are located in the gun house as identified in figure 65. Functionally this staff is divided into three groups. These comprise ten turret controlmen, two gun laying operators, and six gun operators.

The ten turret controlmen are the turret officer, turret captain, computer operator, two radar operators, three talkers, sight setter, and checker. The checker is a member of the crew in training operations only; his station is not manned in battle action.

The two gun laying operators are the pointer and trainer.

The six gun operators are the three gun captains, their assistants, and the electrician. This electrician is stationed in the gun house for

general maintenance of the control and communications circuits, but his principal responsibility is trouble correction and aid in maintaining continuous operation of the guns.

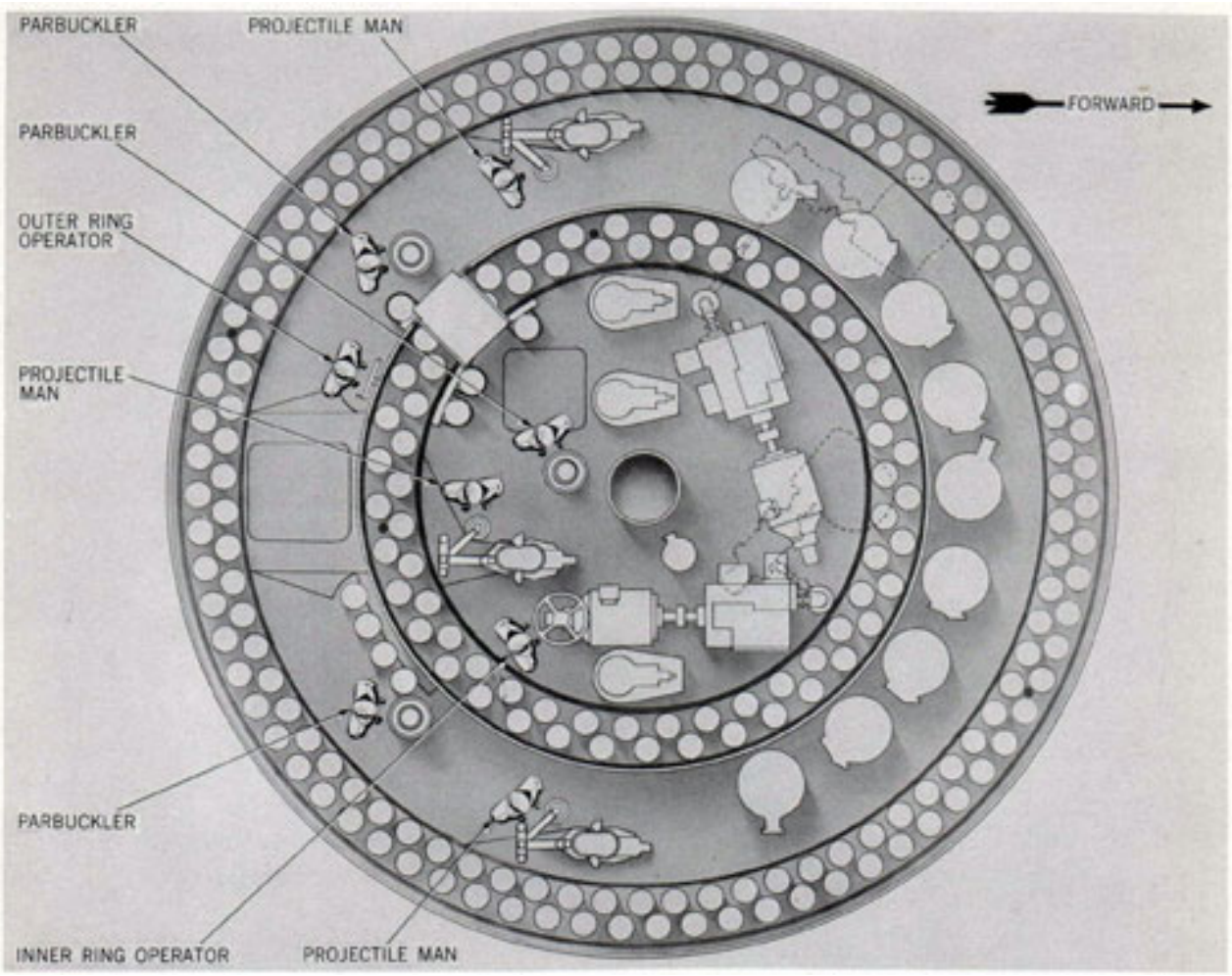



*Figure 66. Turret Personnel Arrangement. Upper Projectile Flat Stations*

**Upper projectile flat crew**. Eight members of the turret organization are stationed in the upper projectile flat, three in the inner compartment, two at the rear right and three at the rear left of the outer compartment; all as identified in figure 66. They are all engaged in supplying projectiles to the hoists, the men in the inner compartment exclusively serving the center projectile hoist while the men in the outer space are a team with right and left sections serving the wing hoists and with the ring operator maintaining supply to both.

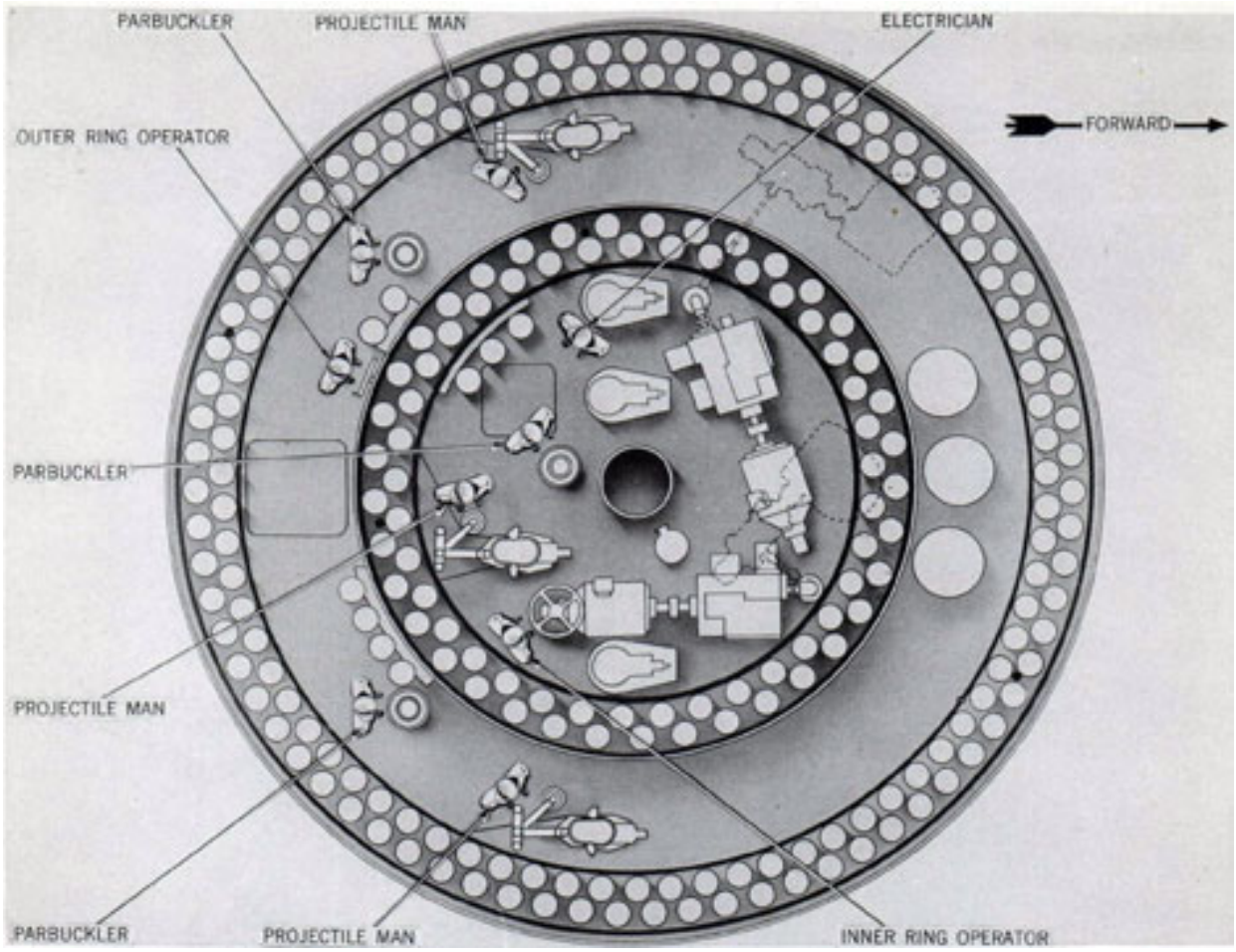



*Figure 67. Turret Personnel Arrangement. Lower Projectile Flat Stations*

**Lower projectile flat crew**. Nine men comprise the organization of the lower projectile flat. Their station arrangements are shown in figure 67. Eight members of this group have identical duties to those of the eight men on the flat above. The ninth man is the power-supply electrician and general assistant for maintenance of ammunition service.

**Powder handling room crew**. Figure 68 shows the station arrangements of the remainder of the turret organization. Ten men conduct the powder transfer service; three men serve each hoist under supervision of a petty officer.

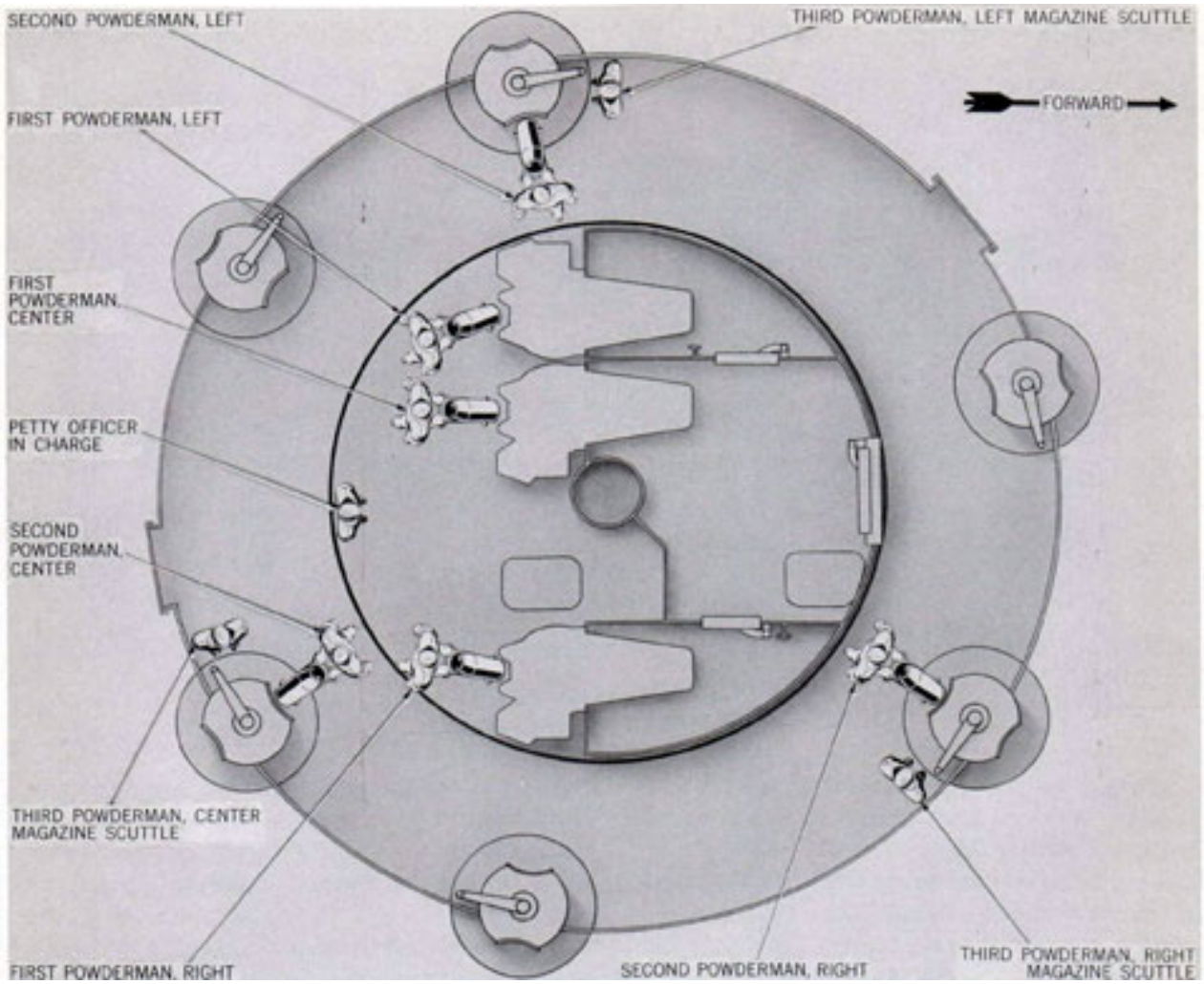



*Figure 68. Turret Personnel Arrangement. Powder Handling Room Stations*

**PERSONNEL DUTIES**

**Turret officer**

**Duties**. The turret officer is the supervisor of turret operations. He directs the entire crew. He organizes and trains the operators of all stations for performance of their duties in all types of control. His operations are directed by the control officer, when the turret is to be operated in automatic or indicating control. He sets the turret transfer switchboard and other necessary controls for remote direction and control. His main duties, in either of these methods of control, are: general supervision of turret operation, coordinating and directing the work of the turret crew, and observing the fall of-shot through the periscope or on the radar screen. He is prepared to take control, in the event of failure of director control, and to direct target firing after shifting to local control.

In local control, the turret officer assumes full control of turret fire, designating the target and directing and coordinating all turret operations. He observes the fall-of-shot through the periscope or on the radar screen, and constantly gives spot correction orders to the computer operator.

**Equipment used**. The turret officer's control station and the equipment used by him, both at the station and adjacent thereto, are illustrated

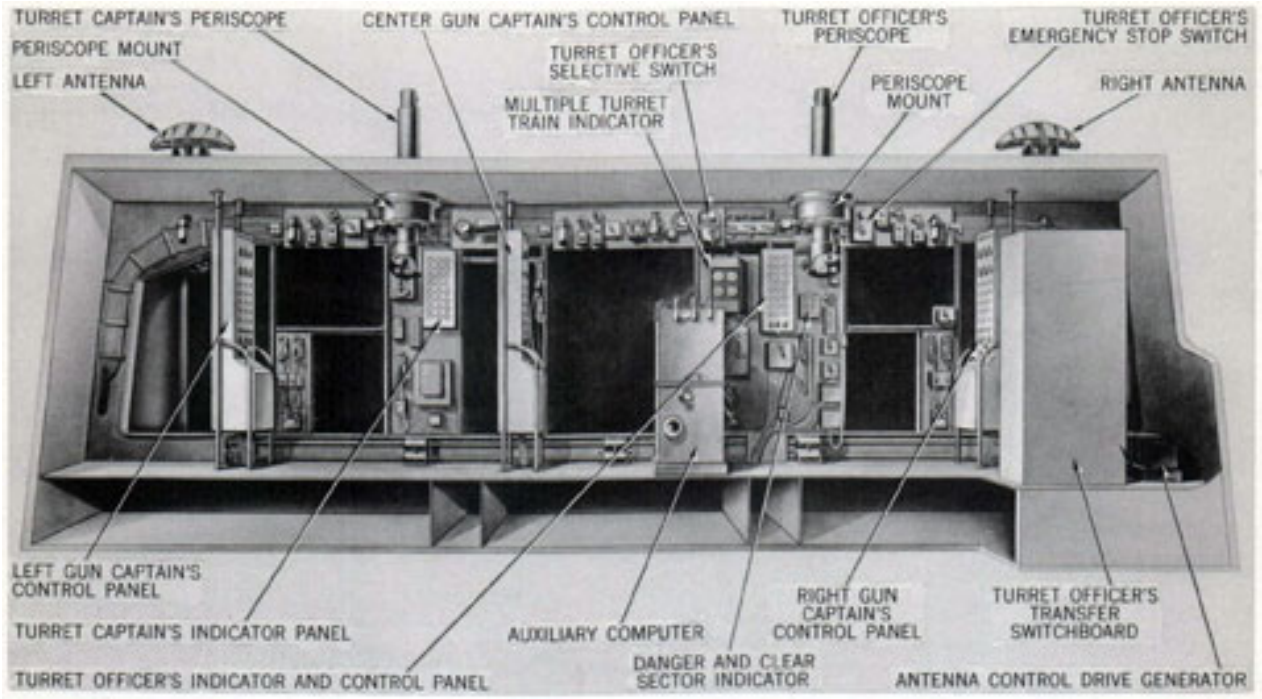



*Figure 69. Turret Officer's Booth. Fire Control Arrangement. Forward Bulkhead*

in figures 69 and 70. His major piece of equipment is his transfer switchboard, consisting of 25 rotary switch elements, lights panels, and warning buzzers, used to route electrical control signals from the plotting room in control of the turret to units within the turret. He may use a periscope or radar screen to observe the target and fall-of-shot. He has a selective switch, enabling him to select the remote or local firing key, and to choose whether the source of power to energize the firing circuit shall be electric current from alternating current ship supply or local storage battery. He has an emergency stop control, which controls emergency stopping of the elevating and training gears. In addition, he has at his disposal an indicator panel which indicates visually the state of loading or firing readiness of each of the three guns; a six-dial danger and clear sector indicator which serves to indicate when any of the guns' line of fire closely approaches ship's structure; and a multiple turret train indicator which indicates turret train order and the actual angle of turret train. He has sprinkling system control valves for selective control of emergency sprinkling of the gun breeches, ammunition hoists, and projectiles in stowage. He has various types of communication equipment which he uses to maintain communications between himself and personnel of the plotting room, control stations, and other ship stations; and also with personnel within the turret.

**Turret captain**

**Duties**. The turret captain is the assistant supervisor of turret operations. He helps to organize and train personnel for performance of their duties in all types of control. He complies with the orders of the turret officer, assisting him in the setting of controls for remote direction or remote control and helping him to shift to local control when the director system does not function. He is commonly delegated as overseer of gun operations, directing and coordinating the work of the three gun captains. In addition, he is always ready to take over turret supervision in event of incapacity of the turret officer.

He mans his periscope, observing the fall-of shot, and is prepared to give spot corrections to

the computer operator, when directed by the turret officer.

**Equipment used**. The turret captain's control station and the equipment used by him are illustrated in figure 69. His equipment includes the left periscope; an indicator panel exactly like the turret officer's except that it has no switches; an 8-circuit lighting distribution box for control of lighting within the gun pits and at other points about the pan plate; and elements of the interior communication equipment.

**Talkers**

Three telephone talkers are stationed in the turret officer's booth to transmit, orally, supervisory directions and fire control data. Their station assignments are: radar operator's range data talker, computer operator's range talker, and computer operator's sight setter talker.

**Duties**. Duties of all talkers are basically the same. They receive telephone communications from within and without the turret and relay them to the personnel to whom they are assigned, and they transmit orders via telephone to other personnel as directed.

The radar operator's talker transmits range information from the radar operator to the computer operator. He receives instructions from the turret officer for further transmission to the operators.

The auxiliary computer operator's sight setter talker transmits sight deflection and sight angle orders to the sight setter. The computer operator's range talker receives range information from the radar operator's range talker, which he relays to the computer operator.

**Equipment used**. Talkers use push-to-talk button telephone handsets or telephone headsets with breastplate-supported and pushbutton-controlled transmitters.

**Computer operator**

**Duties**. The computer operator is solely responsible for the operation of the auxiliary computer. The position of the instrument and of the operator's station are shown in figure 70. He is at stand-by duty in any of the methods of remote control, fully prepared to take over computation of the fire control problem, should turret control be switched to local. While in standby duty, if range can be received from the radar operators, he computes the fire control problem as an exercise and check.

In turret local control, the computer operator computes the fire control problem for all movements of target and ship and for wind across

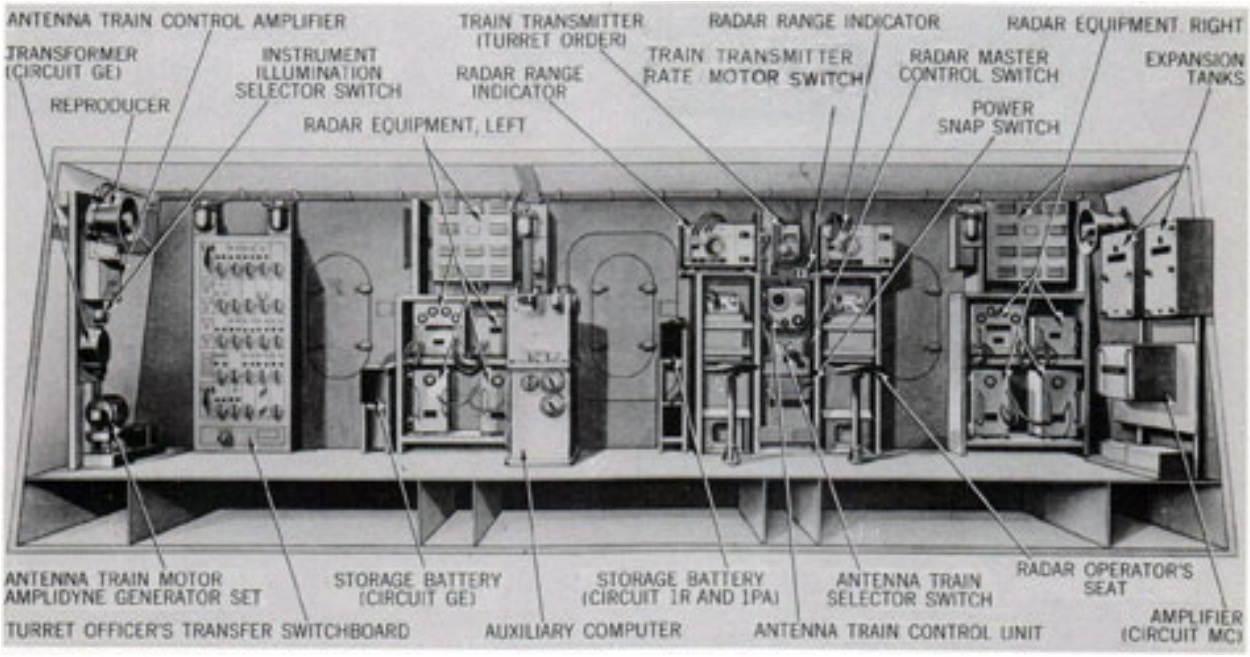



*Figure 70. Turret Officer's Booth. Fire Control Arrangement. Rear Bulkhead*



the line-of-sight. He introduces certain hand inputs into the auxiliary computer which, along with the electrical inputs from the plotting room, produce the values for sight deflection and sight angle. These values are indicated on counters at the computer. He transmits these values, *via* his talker, to the sight setter for setting into the sight setter's indicator.

**Equipment used**. The only equipment used by the computer operator is the auxiliary computer shown in figure 70.

**Radar operators**

**Duties**. Two radar operators, one stationed at the left radar set and one stationed at the right radar set, shown in figures 70 and 71, have identical duties. In turret automatic and indicating control, both are at stand-by duty. Ordinarily this means that both operators are tracking the target, ready to assume control of turret train and to provide target range and bearing if the turret is shifted to local control.

In local control, the controlling radar operator uses the train transmitter (turret order) mounted between the radar sets .to train the turret in order to maintain the antenna on the target. He manipulates three hand cranks: one for introducing turret train angle, which is transmitted to the gun train indicator and to the train receiver-regulator; another for determining radar range of the target; and a third for radar antenna train. The last is used only when initially training to the target bearing.

In local turret control, either the left or the right radar operator assumes control of turret train. The choice is determined by the target position, the radar antenna being selected which is not affected by gun position or by interference with the ship's structure.

The radar operator verbally relays the target range and bearing *via* the range talker to the computer

*Figure 71. Radar Operator's Stations*

operator at the auxiliary computer, so that sight angle and deflection information, in turn, may be relayed to the sight setter.

While tracking the target with the antenna (by the antenna train control unit), the radar operator also trains the turret (by the turret train transmitter at his station), to bring the guns to the same bearing as the beam of the radar antenna. In the meantime, the sight setter cranks in sight angle to correspond with sight angle data received from the auxiliary computer, and at the same time *he sets the deflection dials at zero deflection*.

When turret train and antenna train are matched, and the sight setter's deflection dials are at zero, control of antenna train (with respect to turret bearing) is shifted to the sight setter, who offsets the antenna in deflection to correspond to the value of deflection derived from the auxiliary computer.

As the antenna revolves to its offset position, the radar operator trains the turret so as to hold the target in the antenna beam. Thus, the guns are trained to the correct angle of deflection. Thereafter, while the turret tracks the same target, the radar operator continuously operates the range unit crank and the turret train order transmitter crank.



---

**Equipment used**. The equipment used by the radar operators includes the two radar scope installations, the train transmitter (turret order), the antenna train drive control unit, and the radar range unit, all shown in figure 71.

**Electrician (turret officer's booth)**

**Duties**. The electrician in the turret officer's booth is the general utility trouble-shooter for turret electrical equipment. He is primarily concerned with maintaining performance of turret electrical

In preparing for action, he starts the power drives for the slide equipment and hoists of his gun, and closes their respective control circuits. He directs the gun captain's assistant in stowing the slide securing devices, in setting the hoist control selectors, in releasing the gun locking device, in initial opening of the breech, and in appropriately setting the by-pass and accumulator valves of the slide and the air supply valve of the gas ejector. He directs the ammunition supply crews to fill his hoists when so ordered by the turret officer. He personally verifies the charges of the counterrecoil and recoil

equipment in the turret officer's booth and the gun room, except fire control and radar gear. He acts as a roving trouble-shooter during turret operation, making circuit continuity checks, replacing fuses and indicator lamps, and otherwise repairing and replacing electrical elements in any instance of malfunction or failure of gun controls, transmission circuits, communications, battle illumination, and the ready light system. In battle, his foremost duty is as an additional aide for the gun captains.

**Equipment used**. In performance of his duties, the electrician employs the tools and accessories of the electrical test and service maintenance outfits. His roving battle station includes servicing of all electrical installations of the gun house and gun pits. This includes the electrical equipment of the guns, the elevating gear drives, the hoists, all receiving, transmitting, and indicating units of the booth, and the sight stations, except fire control and radar equipment.

**Gun captains**

**Duties**. Each of the three gun captains is directly responsible for master control and supervision of a gun. He manipulates the power supply and master switching controls which govern operation of the ammunition hoists, fuze setter, and his gun. He directs the activities of the gun captain's assistants in correcting malfunctions of the gun. As ammunition supply talker, he directs powder and projectile handling room service to the hoists. He participates in and supervises all service maintenance, preparation for fire, and securing of his gun at "Cease fire." He has emergency stop and unload control of gun laying, for his gun, as well as emergency firing control.

mechanisms.

During gun firing operation, he observes the continuity of automatic gun loading-firing actions, and is constantly ready to stop the actions of gun and hoists and of gun laying in the event of any malfunction or at occurrence of "Cease fire" order.

After all firing operations, he works with the gun house and hoist crews to unload the gun and hoists; to clean, preserve and stow all gun and hoist units.

**Equipment used**. Each gun captain uses telephones and the control panel for his gun. Equipment of a typical station is shown in figure 72. All the switches and indicating lights essential to the duties described above are identified in this illustration.

**Gun captain's assistants**

**Duties**. The two gun captain's assistants are stand-by aides to correct the malfunctioning of any gun. They assist during preparation for fire and when securing the guns. Each is responsible to the gun captains and the turret officer for the performance of his assigned duties within the gun room.

In preparing for action, he casts loose the slide securing devices, releases the gun locking device, sets the hoist functional control selectors, releases the turret centering pins, and positions the fuze setter retractor lever latch. During the initial stages of first-round operation, he manually trips the breech bolt to open the breech, and appropriately sets the by-pass and accumulator valves of the slide and the air supply valve of the gas ejector.

During firing, he stands by to assist the gun captain and turret officer as they direct. He is

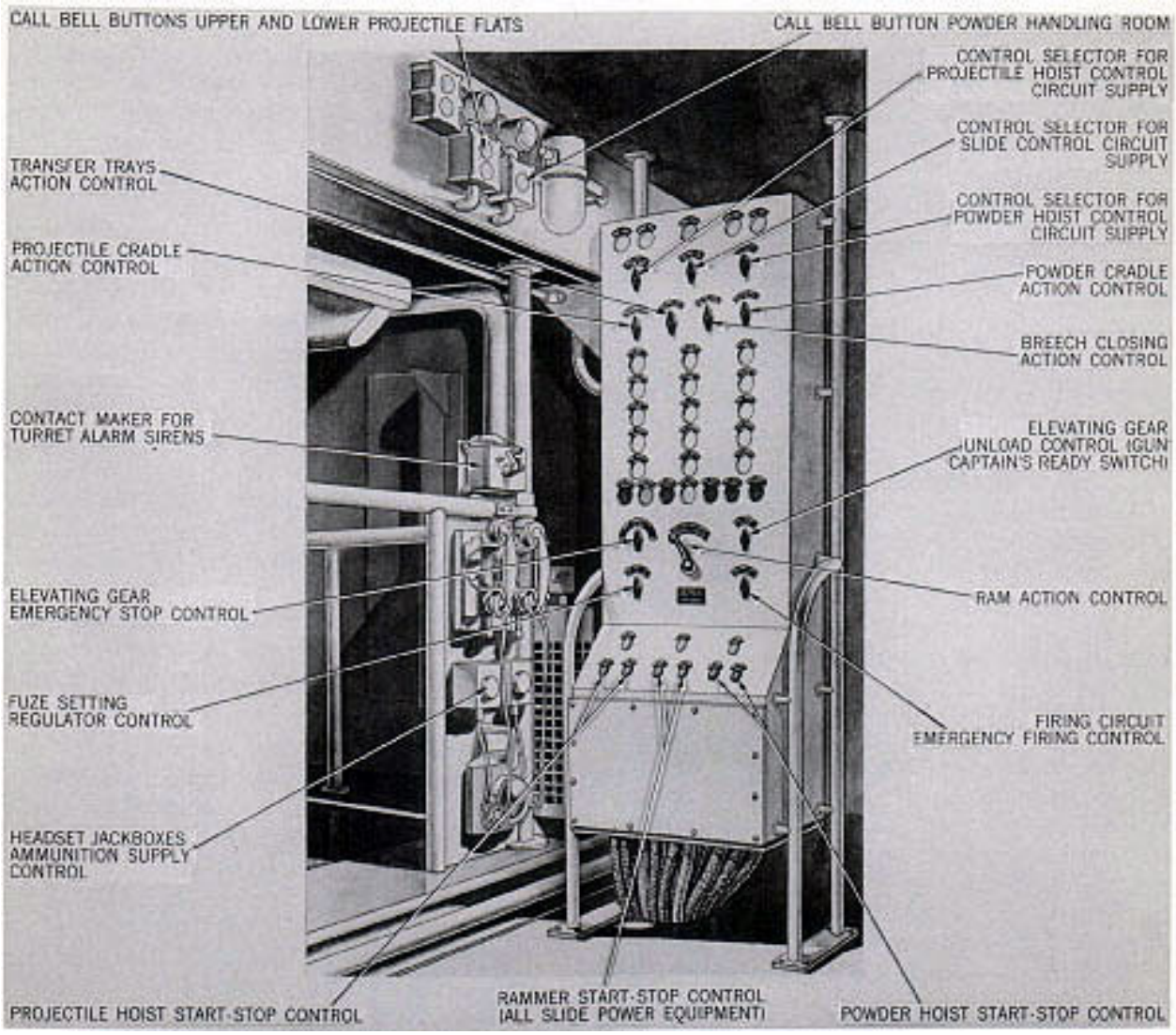



*Figure 72. Gun Captain's Control Station. General Arrangement*

prepared for any emergency within the gun room, and holds himself ready to go out on the gun girder or within the gun pits to take remedial measures in event of a casualty to the equipment.

In emergency, during gun casualty operation, he performs or assists in manual case extraction, manual ejection, and the operations necessary to resume normal fire.

At "Cease fire" he assists in the unloading of gun and hoists and the cleaning of equipment, as well as checking, lubricating, and preserving the guns. He assists in ammunition stowage, when the gun hoists are being used to lower ammunition to the projectile flats.

**Equipment used**. Each gun captain's assistant performs various starting, unloading, and misfire correcting operations on the guns and their related equipment within the gun room. In securing after firing, he uses the standard and special tools and equipment necessary.

**Trainer**

**Duties**. The trainer is directly responsible to the turret officer for the supervision of operation and control of the training gear. He manipulates the power supply and master switching controls, shown in figure 73, which govern selection of control of turret train.

In starting operations, the trainer positions

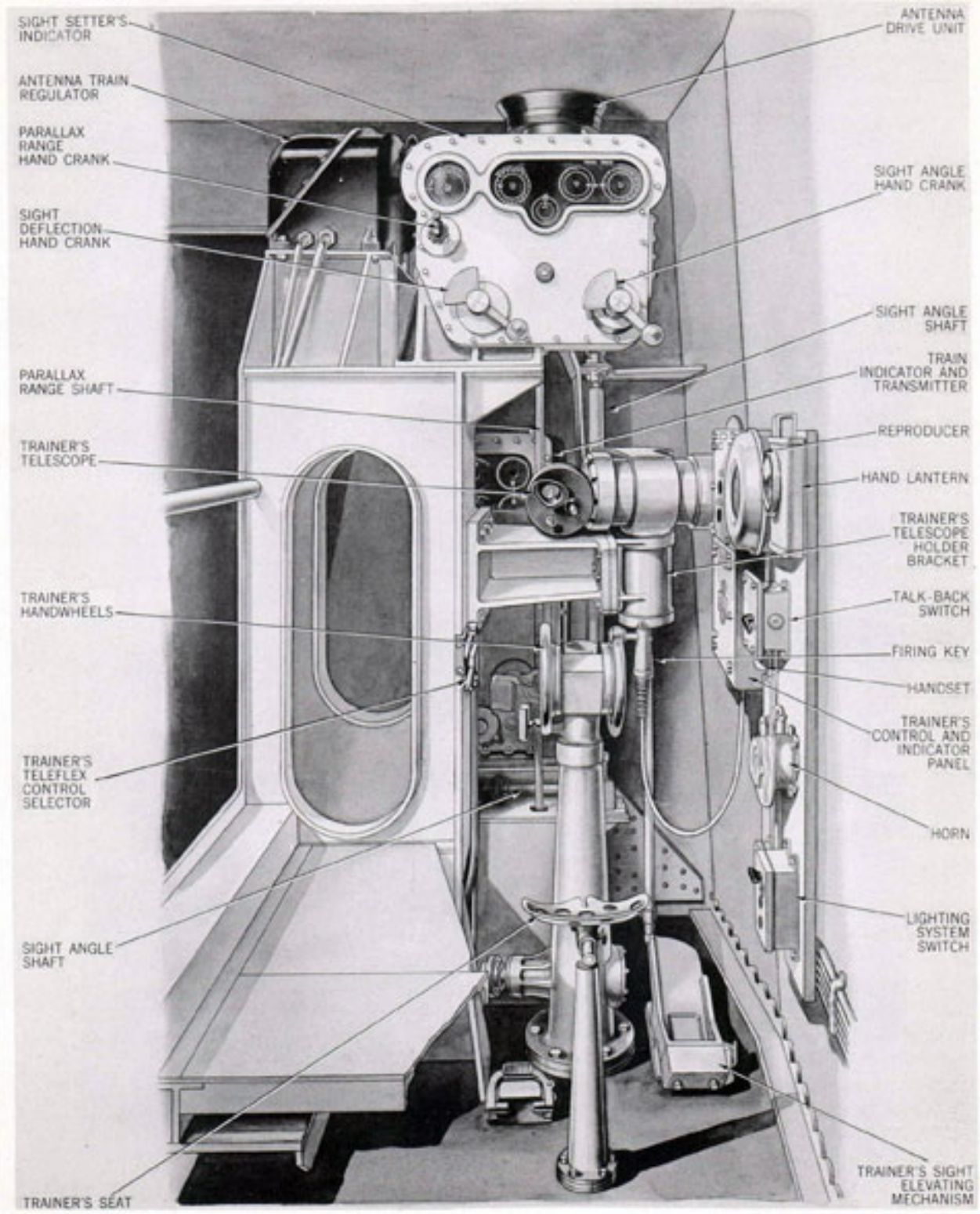



*Figure 73. Trainer's and Sight Setter's Stations General Arrangement. Rear View*

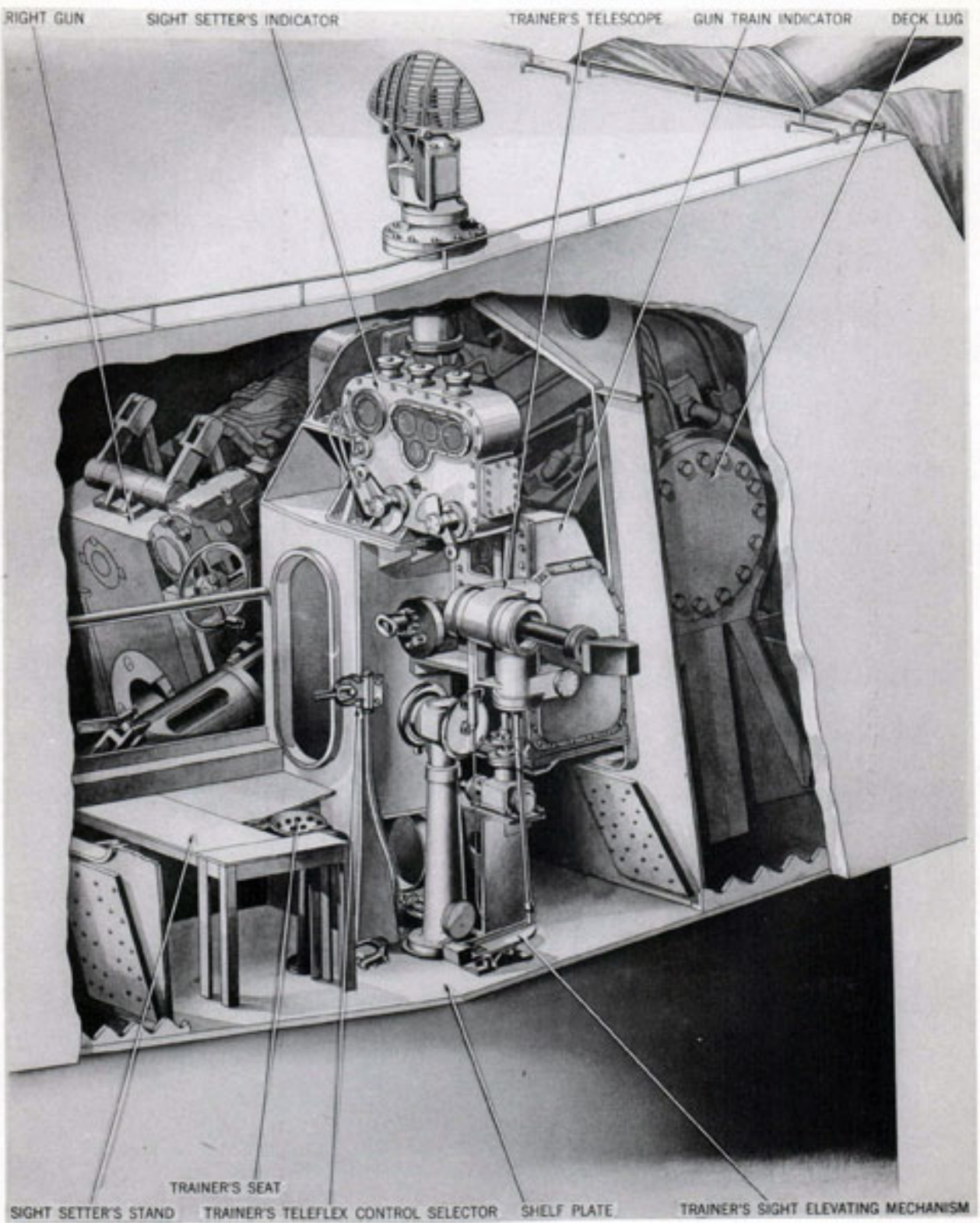



*Figure 74. Trainer,s and Sight Setter's Stations General Arrangement. Right Side View*

the control selector to HAND and manipulates the switches which energize the training gear power and control circuits. After starting the drive, he positions the selector in LOCAL and brings the turret in correspondence with the indicated train signal, after which, when directed by the turret officer, he positions the selector in AUTO.

In turret automatic control the trainer is at stand-by. He makes frequent target sight checks and watches the dial pointers before him to check that gun position agrees with turret train order. He maintains himself at all times in readiness to assume local control of turret train.

In the event of malfunction of the automatic system, or in response to order to shift to turret indicating control, the trainer positions his control selector at LOCAL and begins follow-the pointer operation. In this instance, gun train order indicated on the gun train indicator is matched by the rotation of the handwheels, so that the trainer is directly training the turret.

In the alternative method of turret local control, with the radar operators using the train transmitter (turret order) to send an electrical turret train order signal directly to the train receiver-regulator, the trainer is again at standby, with his control selector at automatic. The same electrical signal is sent to the gun train indicator. This enables the trainer to shift into indicating control, following-the-pointer, if directed by the turret officer.

In the event of radar failure necessitating a shift to turret local sight control, the trainer rotates his handwheels to maintain his telescope on the target, thus training the turret. In this method of control, he operates his firing key to control gun fire when directed by the turret officer, closing his key when his sight cross lines are on the target.

**Equipment used**. The trainer's station and

of sight and correct gun orders. He performs this duty in all methods of turret control. His station and equipment are shown in figures 73 and 74. He operates the hand cranks of his indicator in response to electrically received dial-actuated orders, or, in local control, according to data received by telephone. These values are for offset depression of the lines of sight from parallelism with the guns, called sight angle; azimuth offset of the lines of sight, called sight deflection; and turret train offset for difference in target angle at the director and the guns, called parallax range. In performing these follow-the-pointer duties, he is entering corrections to the gun orders and moving the pointer and trainer lines of sight. When in local control, this movement compels those operators to rotate their handwheels, and thus move the guns until their telescope cross-lines are on the target.

In all methods of remote control, the parallax range, sight deflection, and sight angle values are electrically transmitted from the plotting room to dials on the sight setter's indicator. Associated dials match up when the sight setter turns the hand cranks and transmits the proper values. He mechanically transmits sight deflection to all the sights. He mechanically transmits sight angle to the elevation indicator-regulators and gun elevation indicator, and, through a sight elevation differential, to the pointer's and checker's sights. He mechanically transmits parallax range to the train receiver-regulator and the gun train indicator.

In local control, when plot orders are not available, values for sight deflection and sight angle are telephoned to the sight setter from the auxiliary computer operator. Under this method of control, the sight setter does not match dials on his indicator, since he has no electrical input to activate the order dials, but cranks in the inputs as received.

In local control, the sight setter's indicator also functions to control deflection of the radar antenna.

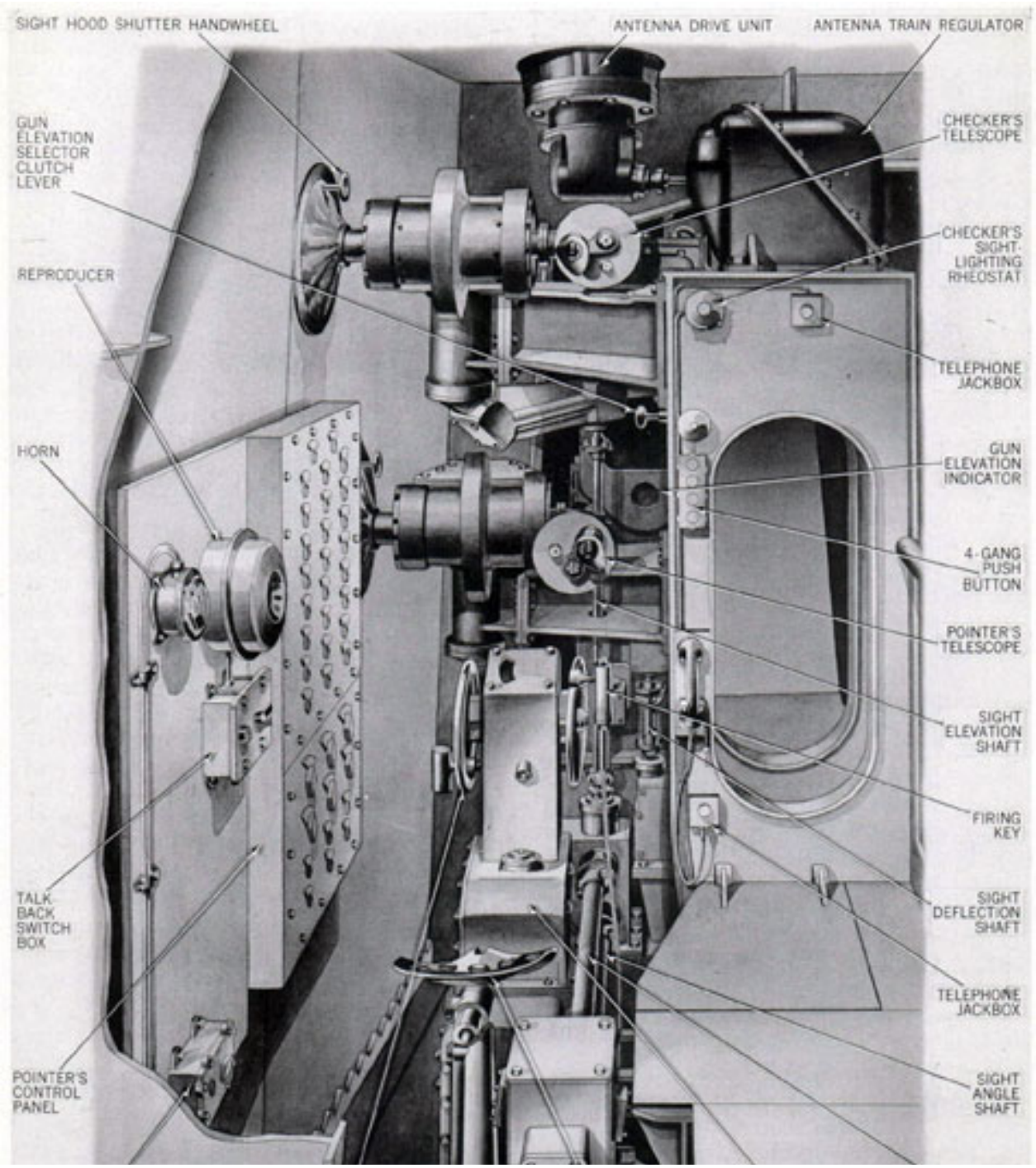
equipment are shown in figures 73 and 74. Principal items are the trainer's control and indicator panel, the gun train indicator, the trainer's handwheels, the trainer's ready switch, the firing key, and the sight.

**Sight setter**

The sight setter is responsible for manually entering mechanical values that offset the lines

A signal is transmitted electrically to the antenna train drive in order that the antenna may be offset the same amount as the line-of-sight. The sight setter rotates an antenna control switch on the indicator in order to perform this operation.





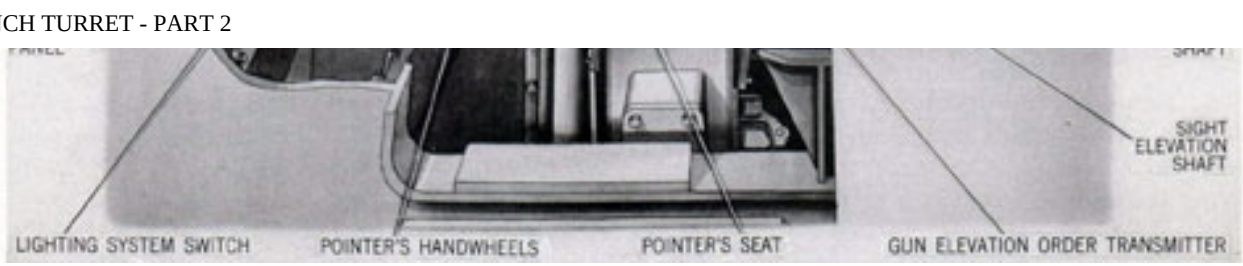



*Figure 75. Pointer's and Checker's Stations General Arrangement. Rear View*



**Equipment used**. With exception of the telephones, all of the equipment used by the sight setter is shown in figures 73 and 74.

**Pointer**

**Duties**. The pointer is directly responsible to the turret officer for the supervision of operation and control of the elevating gear. He manipulates the power supply and master switching controls, shown in figure 75, which govern selection of control of gun elevation.

In starting operations, the pointer positions the regulator selector switches in HAND and closes the start switches which energize all elevating gear motors.

The three emergency gun layers must man the emergency stations during starting operations in order to position the hydraulic pump (A-end) tilting plates in neutral, which will be indicated by lights on the pointer's panel. When the power drives have been started, the emergency gun layers and the pointer should position the three guns and the pointer's transmitter at approximately zero elevation, at which time the pointer should turn the selector switches to LOCAL. With the guns in local control, the pointer should bring the guns into correspondence with the elevation order shown on the pointer's indicator, after which he may position the selector switches in AUTO.

In turret automatic control, the pointer is at stand-by. He makes frequent target sight checks and

In turret hand control, used only in extreme emergency, the emergency gun layers in the gun pits control gun elevation. In this method of control, and when operating under local target sighting control, the pointer, or the trainer, controls gun firing. He has at his disposal a firing key that may be used to fire the guns when the emergency firing circuit has been closed, and he is notified that the turret officer has selected his firing circuit as the one to be used.

**Equipment used**. Figures 75 and 76 show the arrangement and identify all equipment used by the pointer. The principal element is the control panel at his left. In this cabinet are ready light indicators for the guns and elevating drives and manually operated switches controlling starting and stopping of each drive, selection of the method of control, and cut-out of the ready light circuits for the individual guns. Immediately in front of the pointer's seat are his hand-wheel controls in a pedestal on top of an electric gun order transmitter; the right hand grip is a conventional firing key. Above the handwheels is his sight telescope, and before this instrument are two indicator dial panels, both visible in the space under the checker's sight bracket. These are the dials of the gun elevation indicator and the gun elevation response selector. The latter instrument is the unit through which one of the gun elevating movements is chosen to provide gun elevation response data for the sights and the gun elevation order correcting devices. It indicates the elevation synchronism of the three guns. The selection is made manually by shifting a clutch lever mounted as shown in figure 75.

watches the dial pointers before him to check that gun position agrees with gun order. He maintains himself in readiness at all times to assume local control.

In the event of malfunction of the automatic system, requiring a shift to turret indicating control, the pointer positions his transmitter to correspond to the elevation order shown on the gun elevation indicator and positions the regulator selector switches at LOCAL and begins follow-the-pointer operation. In this instance, gun elevation order indicated on the gun elevation indicator is matched by the rotation of the handwheels, so that the pointer is directly elevating the guns to the proper angle.

In turret local control, the pointer positions the guns in elevation by sighting through his telescope and maintaining the telescope cross-wires on the target by rotating the handwheels.

At the pointer's right foot is a foot-operated switch through which he signals to the gun captains, the turret officer, the turret captain, and the trainer, when operating in local control, that he is on the target. (Pointer's ready switch).

**Checker**

**Duties**. The checker is a gunnery training member of the crew, generally the turret officer, turret captain or an assignment from the gunnery officer's staff. His station is manned only during drill operations or practice firing. It is his duty to coach the turret control personnel

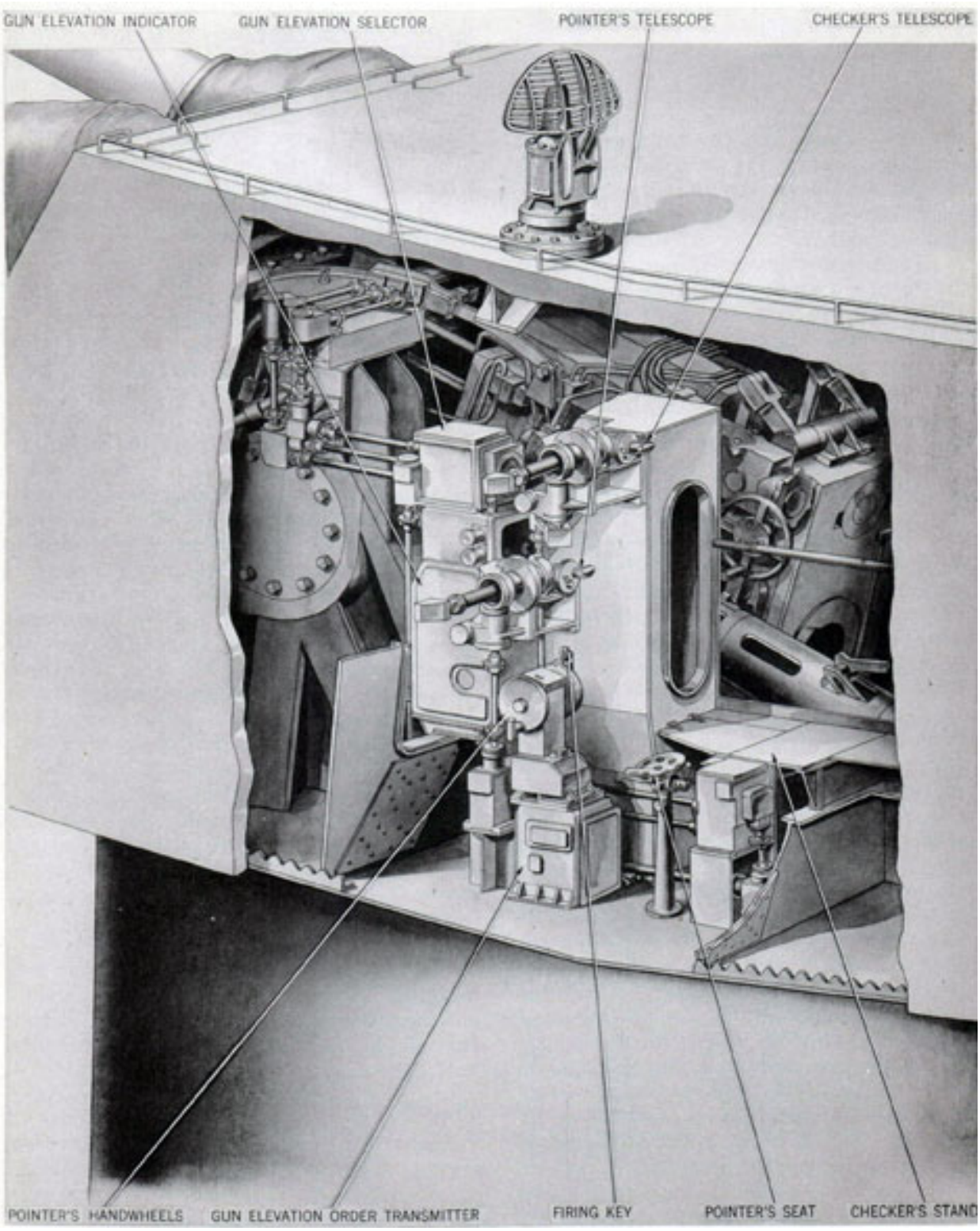



*Figure 76. Pointer's and Checker's Stations General Arrangement. Left Side View*

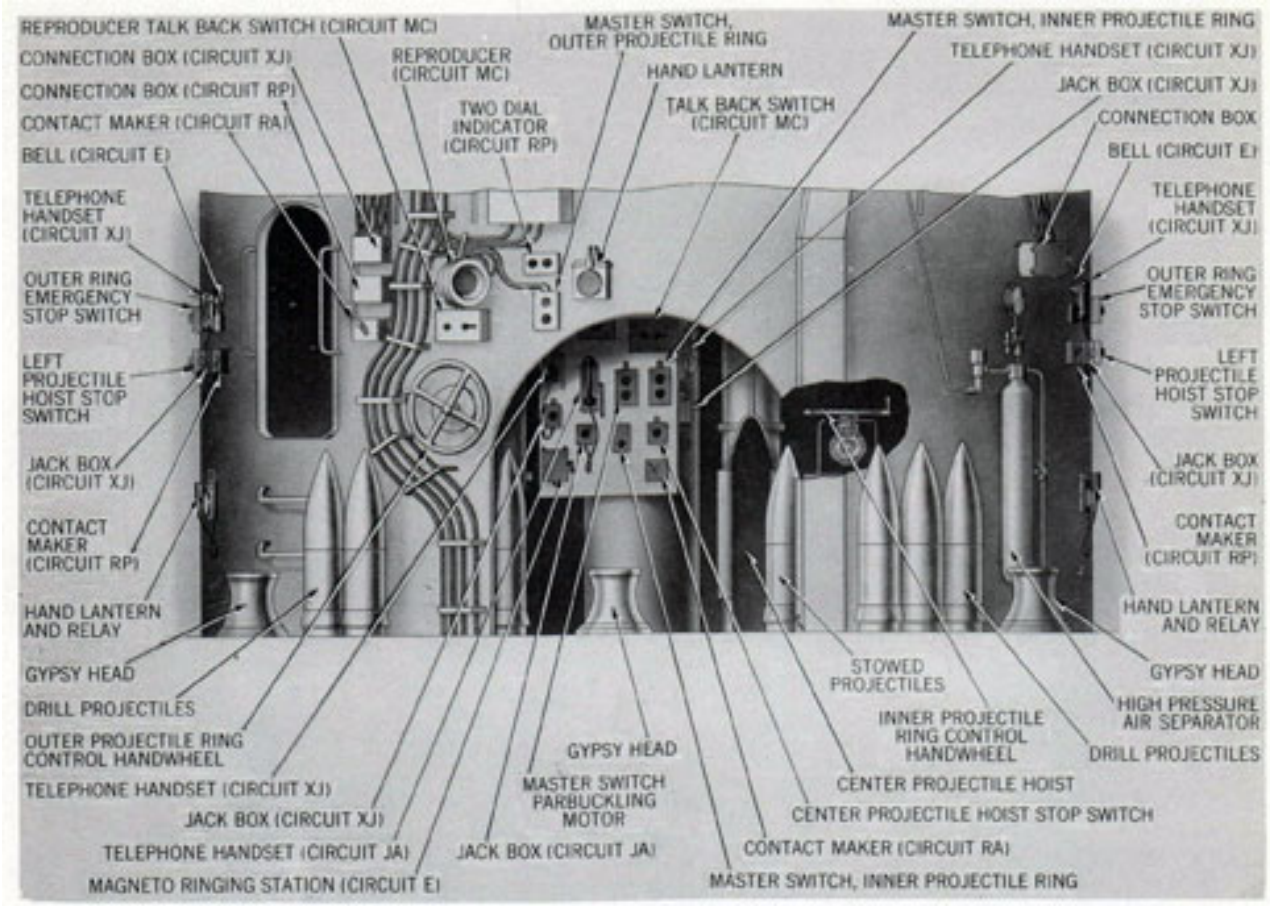



*Figure 77. Projectile Ring and Control Stations*

when operating in target sighting local control. Primarily, he is concerned with developing the skill of the pointer and trainer in operating their handwheels to hold the sight cross-wires on the target. But he is also a fire control safety-man who verifies the drill target to prevent firing accident. He cautions the pointer and orders suspension of firing when the turret approaches a position that may endanger the target towing ship or other craft as a result of dispersion, ricochet, straddle, delayed fuze action or other eventuality.

**Equipment used**. The checker's equipment consists of the sight telescope arranged as shown in figures 75 and 76 and the telephone handset or headset.

**Projectile ring operators**

**Duties**. Each of the four projectile ring for ammunition delivery to the parbuckler men. Each man separately controls the operation of a projectile ring by manually rotating an inner or outer ring control handwheel arranged as shown in figure 77. These control stations and the responsibilities of the operators differ, depending on the type of ammunition service employed.

Inner ring operators are responsible for maintaining projectile supply for one hoist only. They have visual observation of parbuckling, and thus can see when it is safe to move the projectile ring and when more supply is needed. Each operator's work consists of unlatching his handwheel and rotating it to initiate a ring cycle. He releases the wheel, and the cycle is completed automatically. This action places six projectiles within reach of the parbuckler. It must be repeated when the sixth projectile has been removed from the ring and is being transferred to the hoist.

operators of the turret crew is a controlman



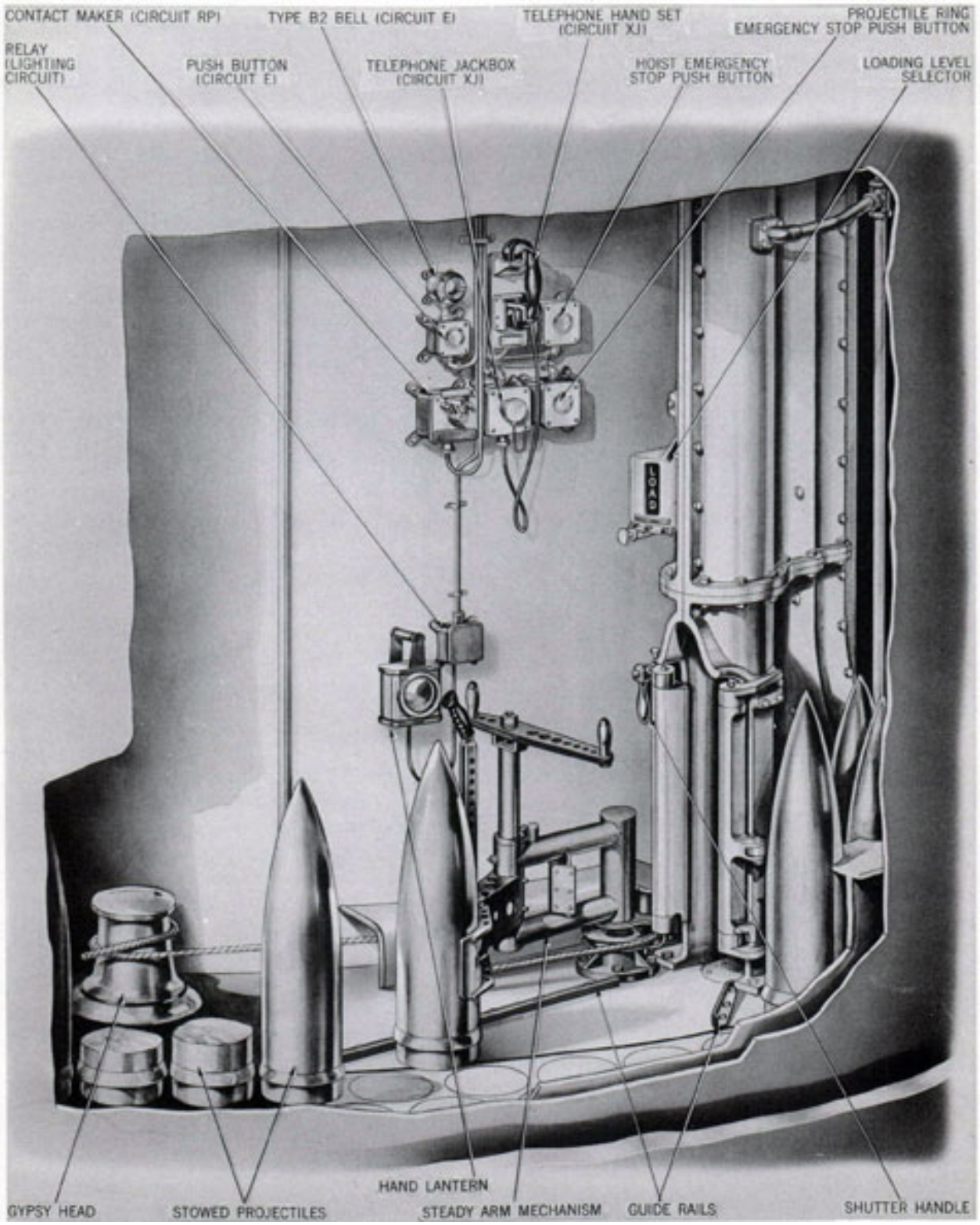



*Figure 78. Projectile Man and Parbuckling Man Stations*

Outer ring operators may have to perform their duties in either of two methods of ammunition service. In one method, the right and left projectile hoists are served from one ring. In the other method, the outer ring of one flat serves the other hoist. The method serving two hoists from one ring requires the operator to be alert to prevent casualty: In this method, the operator cannot observe parbuckling at both hoists; he must watch two indicator dials of projectile ring control circuit RP, unlatching his handwheel and initiating a cycle in the same manner as the inner ring operator when both indicator lights are out.

In addition to their control handwheel duties, all operators are responsible for starting and stopping their respective power drives, and for casting loose and securing the ring centering pins. Between cycles of ring movement, they assist the parbuckling and hoist operators, breaking projectile lashings and steadying projectile transfer.

**Equipment used**. Accessible to each operator when at his station, are his control handwheel, power drive master push button, and a turret alarm contact maker, circuit RA. In addition, the outer ring operation has a circuit RP indicator. All stations are close to the telephone and public address system units of the flat. All equipment is arranged as shown in figure 77.

**Projectile men**

**Duties**. There are three projectile men on each projectile flat, one each located at the right, center, and left steady arm mechanisms of the parbuckling gear. Each projectile man, together with his parbuckler, is a hoist loading operator for parbuckling projectiles from the projectile ring into the hoist. His operations involve grabbing a projectile from the ring with the steady arm device and transferring it into the

**Parbucklers**

**Duties**. There are three parbucklers on each projectile flat, one each located at the right, center, and left gypsy heads. Together with the projectile man with whom he teams, each par-buckler is responsible for continuous delivery of projectiles from the projectile ring into the hoist at which he is stationed. His parbuckling work consists of applying snubbing rope tension immediately after the projectile man has grabbed a projectile. This applies power to the steady arm to pull the arm and projectile to the hoist under guidance of the projectile man. He holds snubbing rope tension until the projectile has been ejected from the steady arm.

Right and left parbucklers have additional duties. Every sixth round they must release the spring detent of the circuit RP contact makers. This action extinguishes the light in the indicator at the projectile ring operator's station. It is the signal to rotate the ring one cycle to supply six more projectiles.

**Equipment used**. A snubbing rope and gypsy head are used by the parbucklers at their respective stations. Typical arrangements are shown in figure 78.

**Electrician (lower projectile flat)**

**Duties**. The electrician in the lower projectile flat performs a number of miscellaneous duties. He is primarily concerned with the turret electric supply panels and other electrical equipment located about the flat. During operation, he acts as a roving trouble-shooter, making circuit continuity checks, replacing fuses and indicator lamps, and otherwise repairing and replacing electrical elements in any instance of malfunction or failure.

**Equipment used**. In performance of the above duties the electrician employs the tools and accessories of the electrical test and service maintenance outfits. His

hoist. This action operates hoist conveyor, door, and trigger controls that cause the power drive of the hoist to lift the projectile one stage or flight cycle.

**Equipment used**. Each projectile man has the steady arm mechanism and hoist loading aperture controls shown in figure 78. His station includes an emergency stop control switch that enables him to stop the hoist power drive.

roving battle station includes the servicing of all electrical installations in the upper and lower projectile flats and the powder handling room.

**Petty officer in charge (powder handling room)**

**Duties**. The powder handling room petty officer is supervisor of safe powder transfer



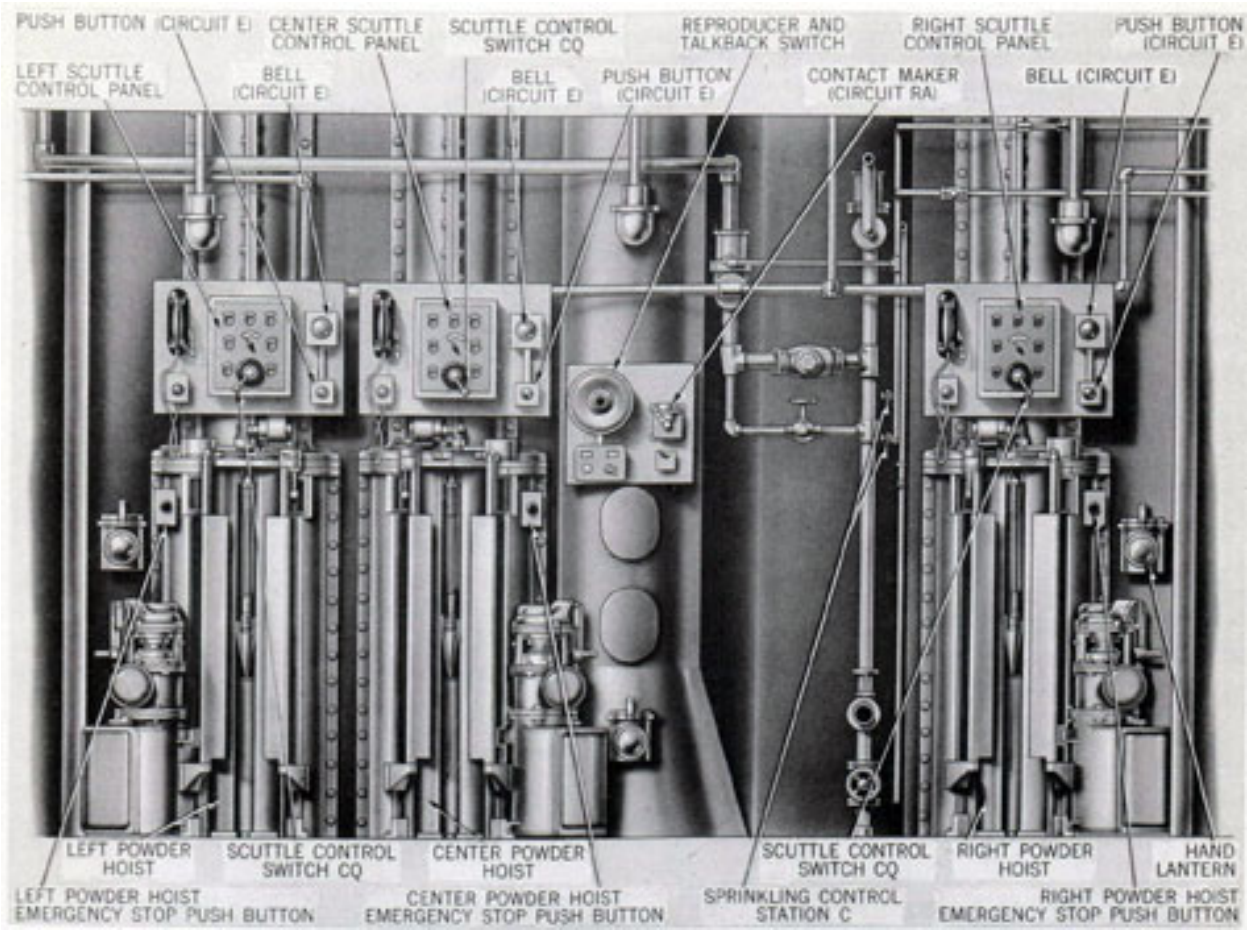



*Figure 79. Powder Handling Room Control Stations*

operations. Under the turret officer, he organizes the powder crew, training the men to be skillful in manipulating the powder trucks when serving the powder hoist scuttle. He directs their movements to prevent traffic confusion, orienting the three hoist crews so that they move between the rotating platform and the magazine scuttles without interference. If the service to any hoist lags, he assists that crew.

The importance of these duties is best appreciated by study of the powder service period of the gun operation cycle illustrated in figure 63, and of the crossing routes of the powdermen; see figure 68. If the powder transfer operation from magazine scuttle to hoist conveyor requires more than five seconds, gun operation is seriously delayed.

In addition to the above primary duties, the petty officer has important safety functions. He and his crew must be alert to prevent transfer of loose powder; an unsafely crimped plug of a powder case will spill powder in the gun loading action; a damaged case or primer will cause misfire or other stoppage.

If a powder case spills in the powder room transfer operation, he must be ready to get rid of the debris so that hoist service will not be delayed.

If any fire hazard is indicated or occurs, he must operate one or both of his sprinkling controls.

When starting up operations, it is his duty to ascertain by careful inspection and operating tests that all magazine and hoist scuttles are safe and in perfect operating condition.

Equipment used. The equipment used by the petty officer consists of the communications units mounted on the central column panel as



shown in figure 79, the controls of sprinkling station C, and a short length of fire hose connected for battle operations at the globe valve hose connection of the fire main water supply line, shown in figure 79. In addition, as supervisor, he is directly responsible for the condition of all scuttles, the six powder trucks, the floor, and all hoist communications, and the secured condition of the ordnance stores rooms behind the hoists.

**Powdermen**

The three groups of powdermen identified in figure 64 have identical operations in supplying their respective hoists.

**Duties**. The first and second powdermen are engaged exclusively in powder transfer. Their operations require skill in removing powder cases are being removed from the scuttle, and also avoid blocking passage of other powdermen.

**Equipment used**. The first and second powderman's equipment comprises specially designed and easily maneuvered powder trucks, hoist scuttle, scuttle controls, scuttle manual drive, the hoist emergency stop switch, and telephone communication to his captain.

The third powderman's equipment comprises the magazine scuttle.

**PREPARING FOR OPERATION**

One hundred and sixty-three manually performed operations* are required to cast loose a secured turret and to start equipment preparatory to firing. This is a minimum preparation schedule that must

from the magazine scuttles and in loading the hoist scuttle. The latter action must be performed smartly to carry the case through the doors and actuate the trigger positively; hasty loading, rolling of ship, and slippery deck can give nonpositive action, possibly cause a "spill," or otherwise delay or stop hoist service. The powderman currently loading the scuttle chamber of each hoist should, after making sure that the powder case is fully inserted, manually operate the scuttle control switch CQ to the position marked "Chamber A to hoist" or "Chamber B to hoist," and observe operation of the scuttle to insure hoist service. In event of scuttle or hoist jam, he must stop the hoist. He must assist in unblocking the stoppage and in getting his hoist drive back into normal powder delivery. In event of failure of the power drive of his hoist scuttle, he must man the hand crank drive for that unit after loading the case into the shuttle. He must also comply with the gun demands and instructions of the gun captain. The third powderman is stationed on the fixed structure at a convenient position for manually rotating the magazine scuttle by means of the operating handle. His normal duties consist of rotating the magazine scuttle when the visual scuttle signaling device indicates that loading on the magazine side is completed. He must, insofar as practicable, rotate the scuttle so as to avoid interference with the first or second powderman while powder eases

be performed after stations are manned. Approximately 240 additional manual actions are required to fill the six ammunition hoists. These activities not only require time, but many of them depend on other time-consuming characteristics of the equipment that delay firing until system temperatures and pressures can build up. It is therefore important that the work to be done must be coordinated by dividing duties amongst the crew and establishing a duty-sequence for each man. This organization of the work should consider the design arrangements for access, turret exterior operations, work priority, and locations of controls, all as briefly reviewed in the paragraphs following.

**Manning stations**

The turret design plan for personnel access is through three doors: the center door in the gun house rear plate and the two doors in the turret foundation at the powder handling flat. The right and left doors in the gun house rear plate are not personnel access doors; they were designed for serving ammunition to the turret and for relining the guns. Both should be closed and secured at all other times.

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* Thirty-six casting-loose operations, releasing centering pins, tube covers, periscope covers, sight hoods, and securing hatches and doors; 127 starting operations, opening cut-off valves, opening breeches, setting switches, checking air and hydraulic systems, closing power circuits, setting ventilator and sprinkler system controls, and establishing control communications.

The crew may be routed through the three doors by any of several alternatives, but the recommended routes are based on a secured center gun pit hatch. This requires all stations below the pan to be manned through the turret foundation doors, while the gun house crew only use the door at the rear of the turret officer's booth. It is a route plan that enables all three guns to be brought into action simultaneously. Any alternative that mans the upper and lower projectile flats through the gun house and the center gun pit delays operation of the center gun. With the condition watch on duty and hoists full, this alternative is therefore inappropriate and unsafe.

**Starting operations**

Seven classes of manually performed operations are involved in starting turret operations. These are:

Auxiliary service operations: Lighting, ventilating, heating, air supply, and sprinkling control operations

Releasing secured equipment
Securing hatches, doors, hoods, and covers
Establishing communications
Ordnance inspection and test operations
Ordnance equipment preparations
Ordnance starting operations

**Auxiliary service operations**. All operations applying to the first class of starting activities are within the turret. They are "first" duties for the crew. Location arrangements and logical crew assignments for accomplishing them are as follows:

LIGHTING. Mounted to the right of the center access door, on the left side of the right radar gear, is a 12-circuit distribution box. Switches on the box provide selective control for closing all the door switch master cutout switch, at his station, as necessary.

An 8-circuit distribution box is mounted on the partial bulkhead at the turret captain's station. Switches on the box provide selective control of lighting and receptacle circuits within the gun pits and at various other points about the pan plate. The turret captain normally operates these switches to match the lighting conditions in the gun room and turret officer's booth.

An 8-circuit distribution box is mounted on the inside of the inner circular bulkhead, to the rear, within the upper projectile flat. Switches on the box provide selective control of magazine-type lighting fixtures and receptacle circuits within the upper projectile flat. Normally, these switches are operated by the inner ring operator.

An 8-circuit distribution box is mounted on the inside of the inner circular bulkhead, to the rear, within the lower projectile flat. Switches on the box provide selective control of magazine-type lighting fixtures and receptacle circuits, within both the lower projectile flat and the powder-handling room. Normally, these switches are operated by the inner ring operator.

INSTRUMENT ILLUMINATION. A snap switch, located on the right inner end of the turret officer's booth, provides control of illumination of instrument dials and sight crosslines for certain equipment in the gun house. The snap switch has four positions; two OFF positions, TOP BATTERY, and ILLUM. TRANS. Ordinarily, the switch will be positioned at ILLUM. TRANS., which serves to step-down the 110-volt, 60-cycle, ship's service supply to the 6-volt current required by the instrument illumination circuit. When the switch is positioned at TOP BATTERY, an emergency supply for the circuit is available from a 6-volt SBM, 100-ampere-hour storage battery. Rheostats in the circuits to the

lighting and portable electrical equipment circuits within the gun room and the turret officer's booth. An additional circuit provides master illumination cutout, within these areas, by door-operated switches at each of the three doors. The turret captain or the roving electrician normally operates switches on this box to obtain the desired lighting conditions, selecting normal lighting (diffusing fixtures), or battle illumination (red globe fixtures), as necessary. The turret officer opens or closes

checker's telescope, pointer's telescope, and trainer's telescope provide dimming control for each of these circuits. The rheostats are located within convenient reach of the users of the respective telescopes, at their stations.

VENTILATION. Two controllers, one for each- of the two ventilating systems, are



mounted at the left side of the turret officer's booth. The controller for the system No. 1 ventilating set is equipped with push buttons which provide start, stop, and reset and emergency control. The controller for the system No. 2 ventilating set is equipped with push buttons which provide high and low speed start, high and low speed emergency run, and stop control. Normally, the roving electrician in the turret officer's booth depresses the START push buttons of these controllers to place the ventilating sets in operation. He also operates the mechanisms for manually setting the exhaust and inlet parts in the overhang at their open detent positions. Air exhaust is automatically regulated to maintain the desired pressure within the turret.

AIR SUPPLY, GAS EJECTOR SYSTEM. Ordinarily, the gas ejector air supply will always be open and under pressure. Either the turret officer or the turret captain may observe their respective pressure gages at their stations to check system pressure. However, there are gate valves in the system beyond the take-off for the gage piping, and these must be checked. Valves are plainly marked, such as GAS EJECT. TO RIGHT AND CENTER GUNS CUTOUT, and GAS EJECT. CUTOUT, and are located within the gun pits, and in the gun room. They usually are checked by the gun captain's assistants when so

right side; the other valve, labeled AIR TO SPRINKLING TANKS is located in the turret officer's booth, close to the air control cock. With these valves open, the turret officer then sets the air control cock in his booth to VENT position. After water appears at the overflow, the cock is kept at vent position until both sprinkling tanks are free of air. At that time, the air control cock is set to. AIR SUPPLY position. A pressure gage adjacent to the air control cock supplies information as to system pressure.

HEATING. Space heaters, located at six control stations in the turret officer's booth and three control stations in the pan plate, provide heat for turret personnel. Two four-circuit distribution boxes are located one above the other on the gun-room side of the partial bulkhead at the rear of the left gun, and one six-circuit distribution box is located on the gun-room side of the partial bulkhead at the rear of the right gun. An ON-OFF snap switch at each box controls the power supply of all heaters fed by the boxes. These are switched on by the gun captain's assistants, when directed. The heaters are located at the radar operator's station; left, center, and right gun captain's station; pointer's station, and trainer's station; and a heater is located at each of the three elevating gear emergency control stations in the forward half of the gun pits. Each heater is provided with an adjacently mounted ON-OFF snap switch,

directed by the turret officer. Should system pressure not be indicated at the gages, it is necessary to check and open the valves at the low-pressure separator in the upper projectile flat, at the gas ejecting relay tanks on the lower projectile flat, and in the piping throughout both projectile levels and the powder-handling room. This is done by designated men on the respective levels, as directed by the turret officer or turret captain.

AIR TO SPRINKLING TANKS. In ordinary turret drill operations, sprinkling tanks are filled with water at all times, but are not under air pressure. In preparing for battle conditions, air pressure is placed on the water in the tanks. The procedure is as follows. The turret officer directs that the two valves in the air line be opened. One valve, labeled AIR TO SPRINKLING TANKS is located on the high-pressure side of the reducing valve on the pan bevel,

which is operated by personnel at the heating stations to provide heat as desired.

**Casting loose**

Casting loose operations consist of opening covers, such as the sight hood shutters, periscope hood covers, case ejector tube covers, and muzzle covers; and of releasing the various securing devices on the gun, slide, turret, and projectile rings. These are individually covered in the following.

**Opening sight hood shutters**. The pointer, trainer, and checker are each provided with a telescope. Telescope sight ports in the side armor are each fitted with a sight hood, shutter frame, shutter rack, shutter, and handwheel pinion shaft operating mechanism. The arc-shaped shutter rotates in the frame under



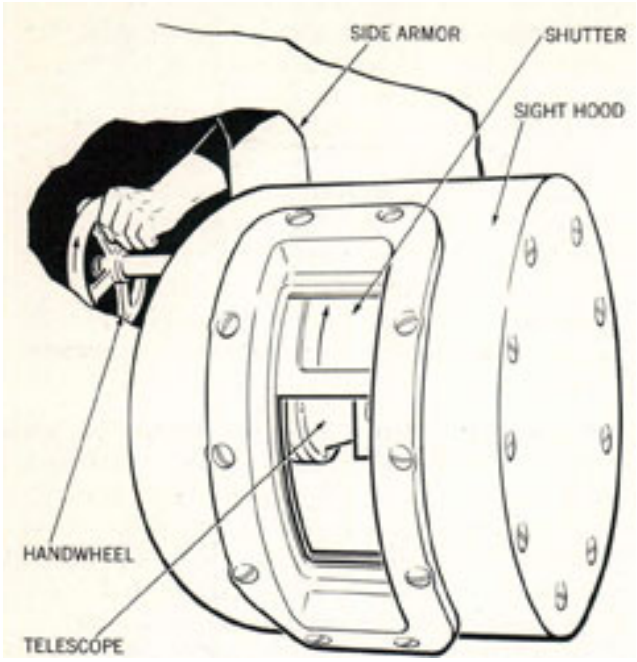


*Figure 80. Opening a Sight Hood Shutter*

handwheel movement, approximately 2 3/4 turns of the handwheel being required to open the shutter. The pointer, trainer, and checker each turns the shutter handwheel at his respective

that the tompion clamping bolt be loosened with a proper wrench and the tompion then lifted out.

**Releasing turret centering pins**. Two turret centering pins are provided, one in each rear corner recess of the shelf plate, at the rear of the gun room. An operating wrench for each pin is mounted on the bulkhead adjacent to the pin. The gun captain's assistants normally release the pins, as illustrated in figure 82. The wrench is used to turn the screw bolt head of the centering pin, a clockwise turning movement screwing the bolt into and raising the centering pin from the tapered centering hole in the barbette in which it fits. The clockwise turning direction to clear the pin is shown on the name plate secured to the top of the flanged mounting in which the pin rides. At the side of this flanged mounting is a rod indicator assembly, which is attached to and rides with the pin. An arrow is marked on the side of this rod. When the centering pin has been raised clear of the barbette, the rod indicator will have

station to open the sight hood shutter, as shown in figure 80. Handwheels are located just inside the side armor, at the sight ports.

**Periscope hood covers**. Personnel designated by the turret officer open the periscope hood covers, reached from the exterior top of the gun house. The covers are secured by a wing nut which must be removed; the cover is then swung to the open position and secured open by another wing nut.

**Case ejector tube covers**. The spring-loaded case ejector tube covers are each secured by three hinged studs fitted with wing nuts. Personnel designated by the turret officer loosen the wing nuts and hinge and secure the studs to one side, as shown in figure 81, so that the tube covers may be sprung open by the ejecting action of the empty cases. Spring action closes the covers, but does not secure them, immediately after an empty case is ejected.

**Tompions, muzzle covers**. Personnel designated by the turret officer remove the tompions or muzzle covers. Removing a tompion requires risen

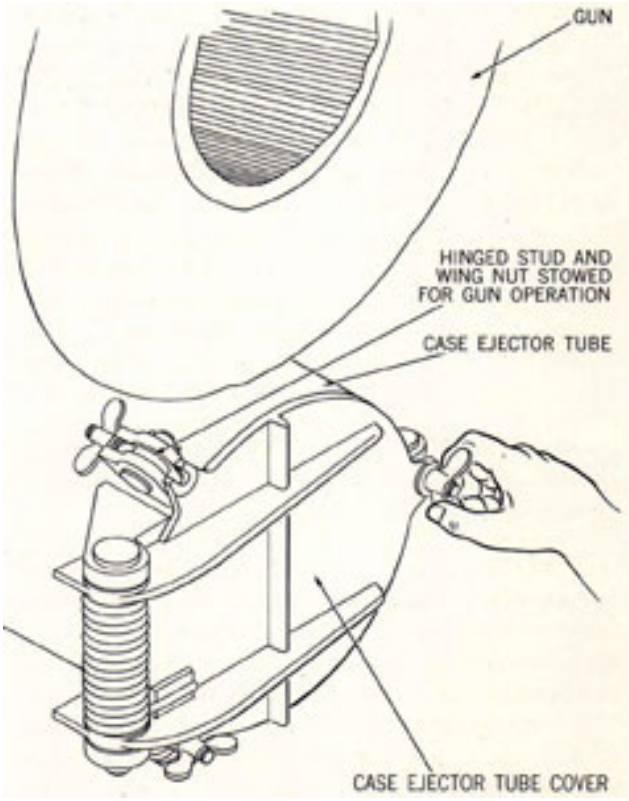
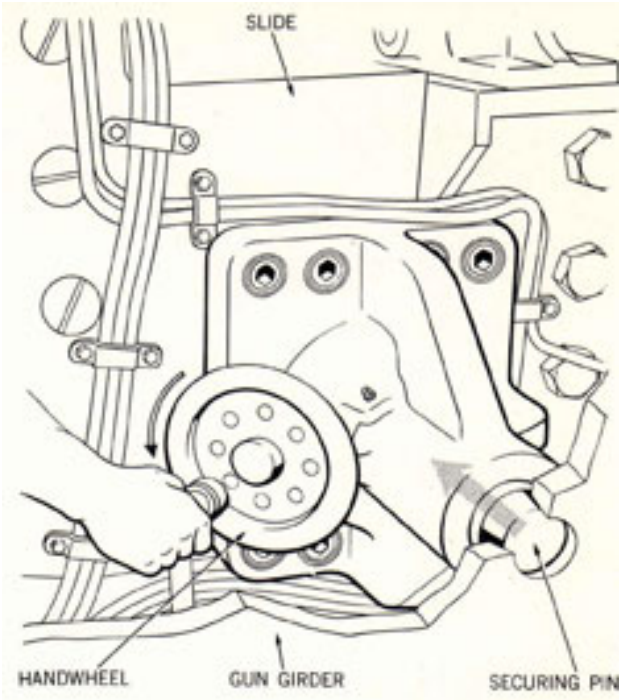



*Figure 81. Securing Case Ejector Tube Cover for Action*





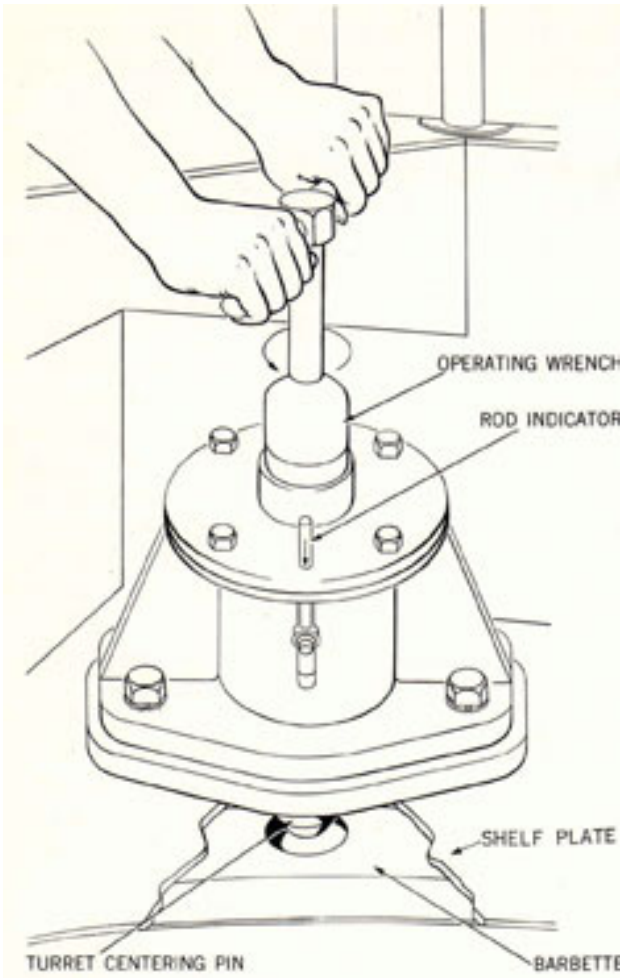



*Figure 82. Releasing Turret Centering Pin*

up through the flanged mounting, so that the point of the arrow is flush with the top of the flange. Travel distance of the pin is approximately two inches.

**Releasing slide steady rests and securing pins**. When directed by the turret officer, the gun captains or their assistants release the slide steady rest and securing pins, as shown in figure 83. These are similar hand-operated screw-type mechanisms mounted on opposite sides of each slide. The securing device is on the inboard side of the slide and should be released before the steady rest, which is on the outboard side of the slide. By turning the respective handwheels, the securing-device pin is withdrawn from its bore in the gun girder and the steady rest from its position against the gun girder.

*Figure 83. Releasing Slide Securing Device*

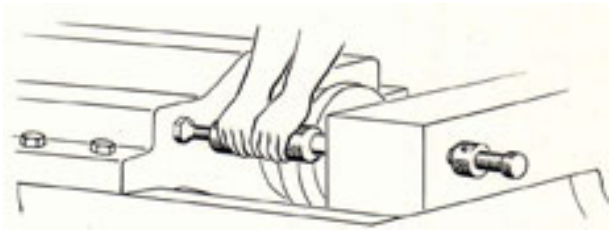


*Figure 84. Releasing Gun Locking Device*

**Releasing gun locking device**. Each gun is provided with a gun locking device which secures the gun and housing assembly to the recoil cylinder. When directed, each gun captain, or one of the gun captain's assistants, disengages the locking device on his gun by loosening the locknut and turning the connecting screw until it is unscrewed from its safety link, and then tightening the locknut until the mechanism is secured in the stowed position. The method is shown in figure 84.

**Releasing projectile-ring pins**. Each projectile ring has two retractable screw-type centering pins, which fit in mating sockets bolted in position in the assemblage of fixed roller cages. A special socket wrench is stowed in a clip at each pin station. The ring operator, or a designated projectile man or parbuckler, retracts the

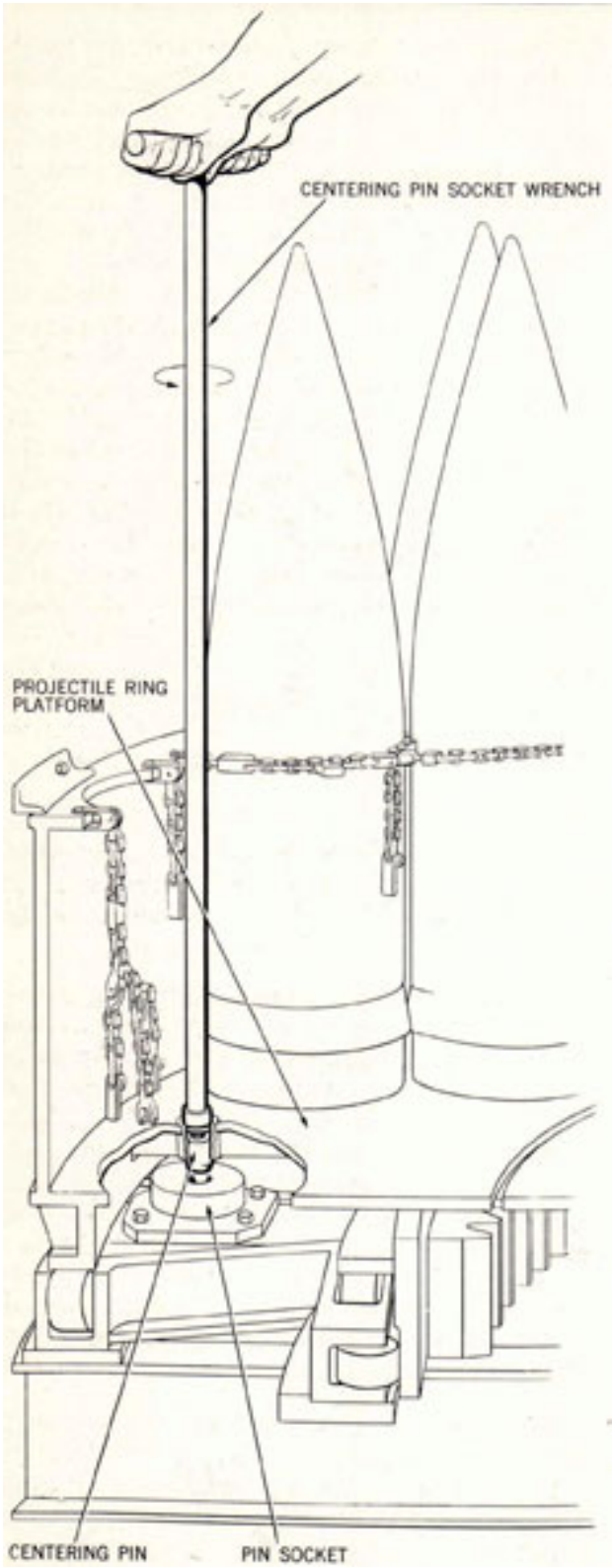



*Figure 85. Releasing Projectile Ring Centering Pin*

ring pins using the special wrench, as shown in figure 85, until the white CLEAR indicator is visible in the top of the pin.

**Establishing communications**

Simultaneously with the preceding starting activities and during performance of certain of the ordnance equipment control setting operations described below, it is imperative that communications be established throughout the turret. This is particularly necessary when closing the supply circuits and manipulating the controls of the electric control systems of the guns, the ammunition hoists, and the gun laying drives. None of the automatic mechanisms should be placed in operation until control members of the crew have received reports that the casting-loose operations and inspections have been completed and that the gun pits, the slides, the projectile rings, and other hazardous areas are clear of personnel, tools, accessories, and supplies; "ready" reports should be coordinated by clearing them through the turret captain.

Communications employed in this essential phase of the starting operations, and subsequently, are the public address and telephone systems. A minimum of 18 members of the crew must install telephone headset receivers and talk-back microphones; others may be similarly equipped according to the turret officer's plan of organization. The required wearers are: the turret officer, turret captain, and computer operator, the three control talkers (see figure 64) , the three gun captains, the pointer, trainer, sight setter, and checker, the three emergency gun layers (temporarily manning their stations when starting), and at least one man (usually the petty officer in charge) on each of the projectile and powder handling flats.

## ORDNANCE EQUIPMENT PREPARATIONS AND STARTING OPERATIONS

Starting operations, described in the paragraphs following, include safety checks, operating precautions, and operating tests that are performed on all ordnance assemblies; also the turning on of turret primary power and starting drives.



### Safety checks, operating precautions, and tests

Personnel must be fully cognizant of the necessary operating precautions and safety checks. All ordnance assemblies require periodic maintenance and inspection. When preparing for operation and before starting any of the electric motors, it is necessary to verify that proper lubrication has been performed; that hydraulic fluid and oil levels, and high and low air pressures, are adequate and available; that the equipment has been cast loose; and that all personnel are clear. These and many other detailed precautions, tests, and checks are noted in other chapters. They should be performed prior to operation. Checks are performed by the personnel directly controlling the various assemblies, or, if inconvenient, by personnel designated by the turret officer.

### Energizing main power circuit

A manual bus transfer panel at the rear of the upper projectile flat, on the inner wall of the inner circular bulkhead, provides two external switches for controlling normal and alternate power for major electrical installations in the turret. Power from the bus transfer panel is transferred to five adjacent circuit breaker power panels; these are the three gun equipment power panels, a training gear equipment panel, and a miscellaneous equipment power panel. Each power panel is power to the following assemblies: projectile rings, parbuckling gear, ventilating systems (2), heating system, IC-FC panel, and radar control amplifier assembly. Each panel cut-off switch is normally turned to the ON position. A mechanical indicator plate located above the operating handle in a small circular window indicates when power is on or off.

Spaced around the inner wall of the inner circular bulkhead on the lower projectile flat are 15 motor controllers which serve to control starting and stopping of power drive motors for the hoists, slide-rammer assemblies, projectile rings, and parbuckling gear. At the rear of the pan level are mounted three elevating gear controllers and one training gear controller. Each controller is equipped with a main line disconnect circuit breaker or switch which is manually operated by an external lever. Ordinarily, these levers are always left in the ON position. The ON or OFF position is indicated by an ON-OFF-TRIP name plate on the controller cabinet. Electricians on these levels inspect the controllers to ascertain that all circuits are closed.

### Starting drives

Procedures detailed in the following paragraphs provide the necessary instructions for starting the drive units for all power-driven ordnance assemblies within the turret.

**Starting elevating gears**. A master pushbutton

provided with an external handle which permits manual cut-off of power. The electrician (projectile flat) turns the chosen bus transfer panel switch to the ON position. If normal power is used, an indicator light above the switch indicates NORMAL POWER AVAILABLE. If alternate power is used, an indicator light above the switch indicates ALTERNATE POWER AVAILABLE. Both of these switches also function to light one of two dial lights on the remote power available indicator in the turret officer's booth, lighting NORMAL or ALTERNATE, depending on which source of power is being used.

Gun equipment power panels supply power to the projectile hoist, powder hoist, slide-rammer, and elevating gear assemblies of their respective guns. The training gear equipment panel supplies power to the training gear drive. The miscellaneous equipment power panel supplies

switch is located on the pointer's control panel, shown in figure 86, for each gun elevating gear. It consists of two push buttons, one labelled START-EMERG and the other STOP. The starting circuit contains a hand start interlock switch and a neutral start interlock switch which operate to prevent starting the elevating gear motor unless the tilting box of the hydraulic pump A-end is at neutral and the regulator selector switch at HAND. Also connected to the master switch is an amber indicating light on the pointer's control panel, designated ELEVATING GEAR NEUTRAL, which is illuminated only when both the hand start interlock switches are closed.

The pointer positions each register selector switch at HAND and each ready light cut-out switch at IN. At this time the ELEVATING GEAR NEUTRAL light on his control panel should flash on. If not, then one of the A-end



dials which indicate the relative positions of the three guns. Each dial is provided with an alignment index, so that gun elevations may be synchronized. To select the gun from which gun elevation input will be taken, the pointer has to have the guns elevated at exactly the same angle, so that the same elevation may be obtained after the shift as before it. A synchro mesh prohibits shifting when guns are not aligned. The selection is made by manipulating a bell crank on the right side of the case which connects the clutch shifting lever to the selector clutch in the gun elevation selector.

After the elevating gear motors are started, the pointer may switch control of the guns from HAND to LOCAL. To do so, he checks that the red ELEVATING GEAR STOP light on his panel is unlighted. If this indicating light is illuminated, one of the gun captains or the turret officer has positioned his elevating gear emergency stop switch to STOP, and it will be necessary to have that switch

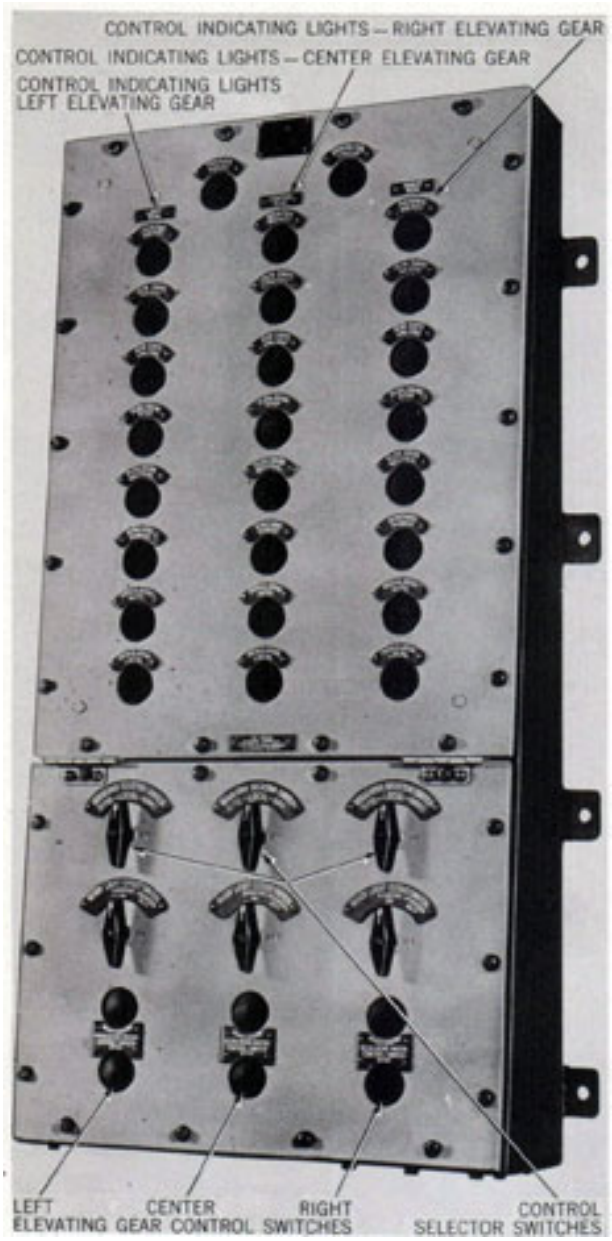



*Figure 86. Pointer's Control Panel*

tilting boxes is tilted and will have to be positioned at neutral by operating the emergency handweels within the gun pits. For this reason, the emergency stations must be temporarily manned when starting.

Immediately after starting operations, the pointer selects the mechanical input of gun elevation to the indicator and sights, using the gun elevation selector. The selector is mounted on top of the elevation indicator, and has three setting changed. The pointer verifies that the amber SYNCHRO POWER indicating light on his panel is lit, signifying that the synchros in the regulator and in the gun elevation order transmitter are energized. He then rotates his handwheels until handwheel elevation order position, as indicated by the handwheel dial, checks with gun elevation as shown by the gun elevation indicator. When these check, the pointer switches the three regulator switches on his panel to LOCAL.

To switch from LOCAL to AUTO, the pointer rotates his handwheels until gun elevation matches gun elevation order, as shown on the gun elevation indicator. When these match, the pointer switches the three regulator switches to AUTO.

Training gear. A master push-button switch is located on the trainer's control panel shown in figure 87. It consists of two push buttons, one labeled START-EMERG and the other STOP. The starting circuit contains a hand start interlock switch and a neutral start interlock switch, which operate to prevent starting the training gear motor unless the tilting box of the hydraulic pump A-end is at neutral and the regulator selector at HAND. Also connected to the master switch is an amber indicating light on the trainer's control panel designated TRAIN GEAR NEUTRAL, which is illuminated only

when both the hand start interlock switch and the neutral start interlock switches are closed.

In order to close the hand start interlock switch the trainer positions the control selector, shown in figure 74, at HAND. At this time the TRAIN GEAR NEUTRAL light on the control panel should flash on. If not, then the A-end tilting box is tilted, and will have to be positioned at neutral by turning the handwheels. Ordinarily, this condition will exist only following power failure which stopped the mechanism during operation. When the neutral light is on, push the START button to start the drive.

After the training gear motor is started, the trainer may shift control of the training gear from HAND to LOCAL by shifting the control selector lever. To do so, he first checks that the turret stop light on his panel is unlighted. Should this indicating light be lit, tile turret officer has positioned his emergency training gear stop switch to STOP, and it will be necessary to have the switch setting changed. The trainer verifies that the amber SYNCHRO POWER indicating light on his panel is lit, signifying that the synchros in the regulator synchro circuits are energized. Control may then be changed merely by moving the control selector lever to LOCAL. To switch from LOCAL to AUTO, the trainer rotates his hand-wheels until turret train matches turret train order, as shown on the gun train indicator. When these match, the trainer may then shift the selector lever to AUTO.

Starting slide power equipment. A master push-button switch for each slide-housing-rammer motor is located on each gun captain's control panel. It is identified on figure 72. It consists of two push buttons, one labelled START-EMERG and the other STOP. The switch is arranged with an amber indicating light which is illuminated during motor operation. To start the motor, the gun captain first ascertains that the slide control

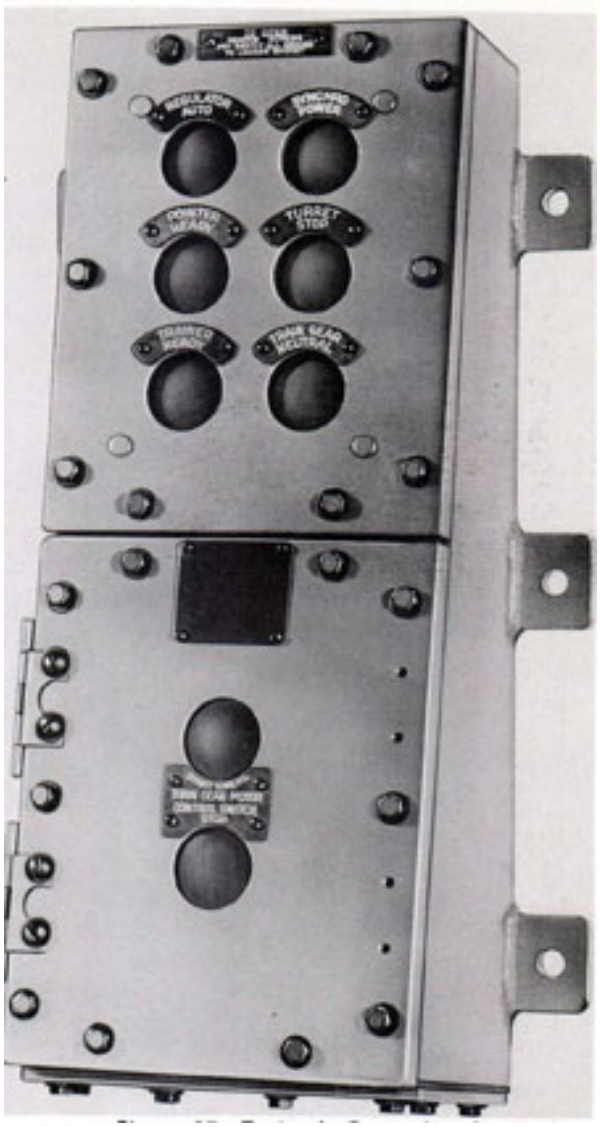


*Figure 87. Trainer's Control and Indicator Panel*

on figure 72. It is the same type and arrangement as the slide power equipment starting switch, including an amber indicating light which is illuminated during motor operation. To start the motor, the gun captain momentarily depresses the START-EMERG push button.

This action starts the power drive only. Hoist action cannot commence until the control system is started as described on page 102.

**Starting powder hoists**. A master push-button switch for each powder hoist is located on the gun captain's control panel as identified on figure 72. It is an arrangement identical to

circuit supply switch, designated on figure 72, is in the OFF position, after which he momentarily depresses the START-EMERG push button. Control action is started separately as described on page 102.

Starting projectile hoists. A master push button switch for each projectile hoist is located on the gun captain's control panel, as identified



the projectile hoist switch, including an amber indicating light which is illuminated during motor operation. To start the motor, the gun captain momentarily depresses the START-EMERG push button.

**Starting projectile rings**. A master push button switch for the inner projectile ring motor is mounted on the control panel at the rear of the central column of the respective flat, as shown in figure 77. A master push-button switch for the outer projectile ring motor is mounted on the outside of the circular bulkhead, above and to the left of the archway of the respective flat. All four of these switches are identical, each consisting of two push buttons, one labeled START-EMERG and the other STOP. To start any projectile ring, the ring operator first centers the control handwheel in the locked or neutral position. This is necessary because the starting switch is arranged with a neutral interlock switch which prevents starting when the pump yoke is offset from the neutral position. The operator then momentarily depresses the START-EMERG switch.

**Starting parbuckling gears**. Each of the upper and lower projectile flat parbuckling gear motors has a master push-button switch located on the control panel at the rear of the central column is identified on figure 77. The switches are identical

certain gun captain and hoist function selector controls; elevating and train systems by setting certain turret officer controls.

**Gun and hoist controls**. Each gun control system is placed in operation when the gun captain closes the electric current supply switch designated on figure 72 as "control selector" for slide control circuit supply." Similar supply switches on either side of this switch enable him to energize the projectile and powder hoist control circuits, but those circuits are not placed in operation until the gun captain's assistants go forward on the gun girders and shift function control selector levers, one for each hoist, which are located near the deck lugs and are normally stowed in STOP position. Each lever must be placed in HOIST position to set the conveyor and cradle controls so that the hoist will automatically deliver ammunition units to the slide.

When the hoist and gun control circuits are thus energized, ammunition is delivered to the gun through the manual, mechanical, and hydraulic operating system actions described in "Firing operations, first round," on pages 104-8.

**Turret officer controls**. All fire control signals and communications transmitted to the gun laying indicators and regulators, the pointer, trainer, and sight setter, and the fuze setting devices are routed through controls set by the turret officer. They are

to those described above for the projectile rings. To start the motor a projectile man or parbuckler momentarily depresses the START-EMERG push button.

**Setting controls; energizing the control circuits**

Two classes or groups of controls must be set and their electric supply circuits must be closed when starting turret operations. These are the ordnance equipment controls and the turret officer's controls. Both groups of operations are described in the paragraphs following and references.

**Ordnance equipment control setting**. The automatic gun control systems, the hoist control systems, and the elevating and training gear regulator control (AUTO) devices are not placed in operation by the power drive starting operations described on pages 99 to 102. Gun and hoist systems are started by manipulating electric switching controls compactly arranged in the large transfer switch panel located as shown in figure 70. The 25 switch units of this panel have slightly different circuit arrangements and switch position identities for turrets I, II, and III. These differences, as explained in Chapter 14, apply only to local arrangements which enable turret II to provide Hi-turret control for turret I. AUTO control arrangements of the three panels are essentially the same as the turret II panel details illustrated in figure 88. This picture and the switch positions tabulated in the list below show the settings for providing remote automatic control (PRIMARY or SECONDARY AUTO) for turret II, as typical.

| Switch No. | Switch Position |
|---|---|
| 1 | FWD |
| 2 | Any FWD position |

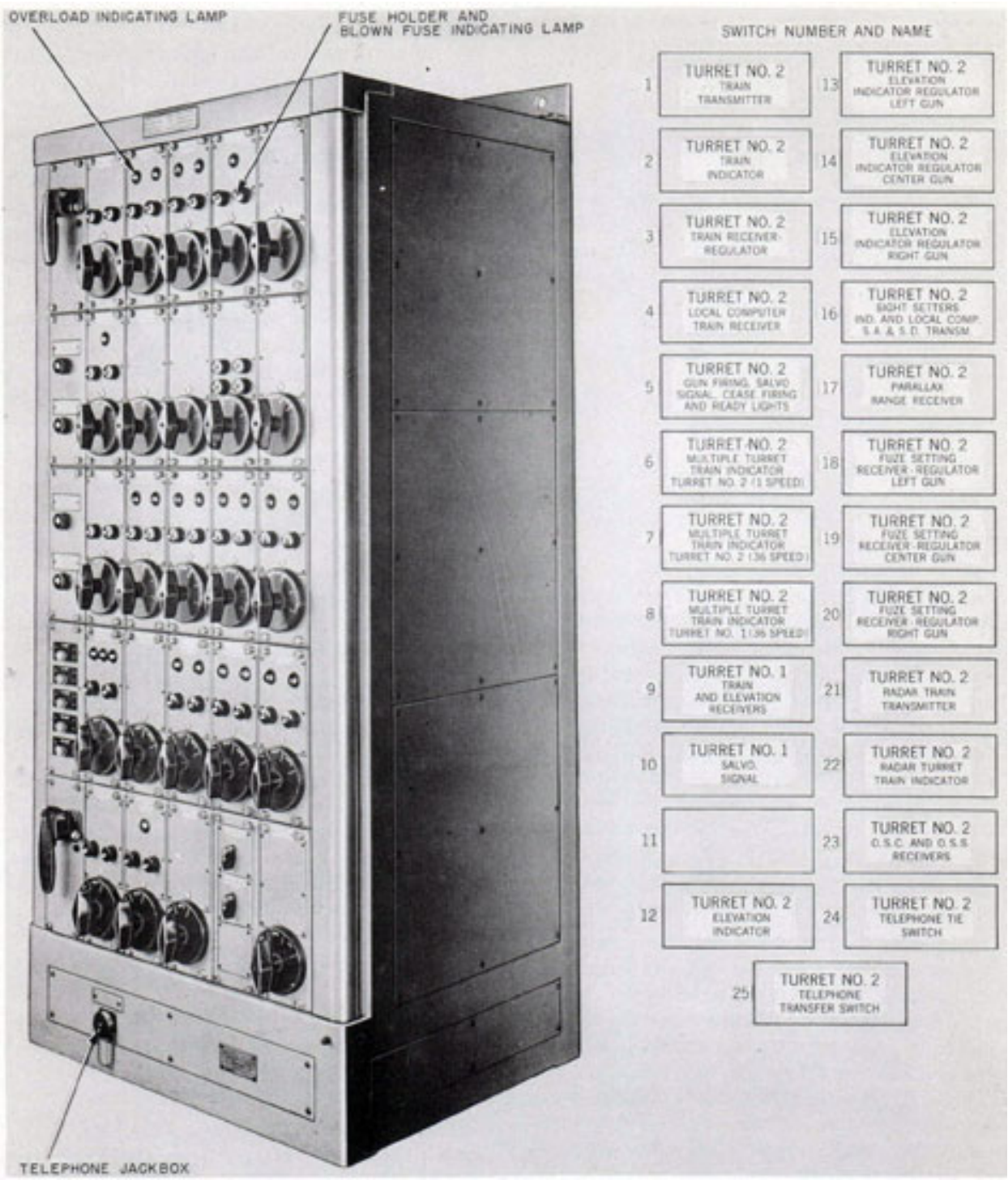



*Figure 88. Turret Officer's Transfer Switchboard*

| Switch No. | Switch Position | Switch No. | Switch Position |
|---|---|---|---|
| 3 | Any FWD position | 5 | FWD |
| 4 | OFF | 6 | ON |

| Switch No. | Switch Position |
|---|---|
| 7 | FWD |
| 8 | FWD |
| 9 | TRAIN |
| 10 | OFF |
| 11* | |
| 12 | Any FWD position |
| 13 | Any FWD position |
| 14 | Any FWD position |
| 15 | Any FWD position |
| 16 | FWD |
| 17 | FWD |
| 18 | OFF |
| 19 | OFF |
| 20 | OFF |
| 21 | OFF |
| 22 | OFF |
| 23 | FWD |
| 24A | FWD |
| 24B | OFF |
| 25 | FWD |

All switches that may be positioned at either FWD or AFT must be positioned similarly; i.e., all at FWD or all at AFT. There are two groups of indicating light panels on the switchboard, each of which may be energized from the plotting rooms. One set, when lighted, notifies the turret officer that the forward plotting room is in control; the other set that the after plotting room is in control. All switches are positioned according to the directing lights.

Two warning buzzers are provided which will sound when any FWD or AFT switch is incorrectly positioned.

switches. The lights show the condition of readiness of the guns and gun laying drives. Of the three switches, the first switch cuts in or out the trainer's firing key; the second switch cuts in or out the pointer's firing key; and the third switch is an emergency firing switch for all guns. Under the conditions outlined above; i.e., in normal automatic fire, with guns under primary or secondary control, the turret officer positions the firing key switches at OUT, and the emergency firing switch at OUT.

A snap switch on the partial bulkhead at the right of the turret officer's station is used to shift from director control to local control of the salvo signal system. Under director control, the turret officer positions this switch at DIRECTOR.

## FIRING OPERATIONS

### First round

In preparing for the first round, a decision is necessary as to whether projectiles will be loaded from the upper, lower, or both projectile levels. The turret officer directs personnel in the lower projectile level to position the three hoist loading level selector switches, which are mounted near the top of the level adjacent to their respective hoists. If, for example, it is directed that loading be from the upper projectile flat, the switches are each set at UPPER. A mechanical indicator, shown in figure 89, located at each hoist on the lower level, then reads DO NOT LOAD continuously. The arrangement may be reversed, or both levels may be used; the lower level indicators being mechanically interlocked with projectiles in the hoists, so that personnel on the lower level are always aware when a projectile should be loaded.

Each of the projectile hoist and powder hoist functional control selector switches must be properly set as described on pages 102-104.

If H.C. nose-fuzed projectiles are being used, the fuze setter retractor lever latch on the upper end of each of the hoist cradles is moved to the DOWN position by the gun captain's assistants. The latch is placed in the UP position when handling other projectiles.

In addition to the above-described switches, the turret officer also operates the turret officer's selective switch, mounted on the upper partial bulkhead at his station. This consists of a pair of rotary switch elements, one labeled DIRECTOR-OFF-LOCAL, the other AC SUPPLY-OFF-BATTERY. By rotating these switches, the turret officer selects local or remote firing, and the source of power to energize the firing circuit.

The turret officer's indicator panel on the partial bulkhead at his station comprises 24 indicator light dials, and three rotary snap

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*No. 11 is a spare switch.



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switches on his control panel as follows:

Switch B-Projectile hoist control supply-NORM.
Switch A-Slide control supply-NORM.
Switch C-Powder hoist control supply-NORM.
Switch BJ-Projectile cradle control-AUTO
Switch AB-Transfer tray control-AUTO
Switch AP-Breech close control-AUTO
Switch CJ-Powder cradle control-AUTO

Depending upon whether or not H.C. projectiles with nose fuzes are being used, the gun captain positions the FUZE SET REG CONTROL switch at OFF, SAFE, or RUN. Instructions on the' positioning of this switch come from the turret officer.

The gun captain directs his assistant to

At this stage, each gun captain takes over control of his respective gun. He positions

trip the breech bolt manually to open the breech; to check that the manual breech operating mechanism is declutched, and to check that the slide accumulator shut-off valve is open.

**Serving hoists**. When the preceding preparations are completed, the projectile men and parbucklers on the designated loading level are directed to begin serving the projectile hoists, and the powder men to begin serving the powder hoists.

A projectile man and parbuckler work together to parbuckle projectiles into the hoist aperture. The projectile man operates the steady arm mechanism, as shown in figure 90, to grab a projectile. The parbuckler operates the snubbing rope, looping the free end of the rope twice around the gypsy head and pulling it tight enough to provide snubbing action that brings the projectile end of the steady arm to the hoist loading aperture. The projectile man operates the handwheel on the steady arm mechanism to guide the projectile. As the projectile reaches the hoist opening, forward travel of the steady arm is halted; the rammer is released and ejects the projectile into the hoist. At the moment of complete ejection, hand-pull of the snubbing rope is released, and the steady arm is pivoted away from the hoist, ready to grab another projectile. Inner and outer ring operators operate their respective handwheels every six rounds, to position the projectile rings so that the projectile men may reach the stowed projectiles with the steady arm mechanisms.

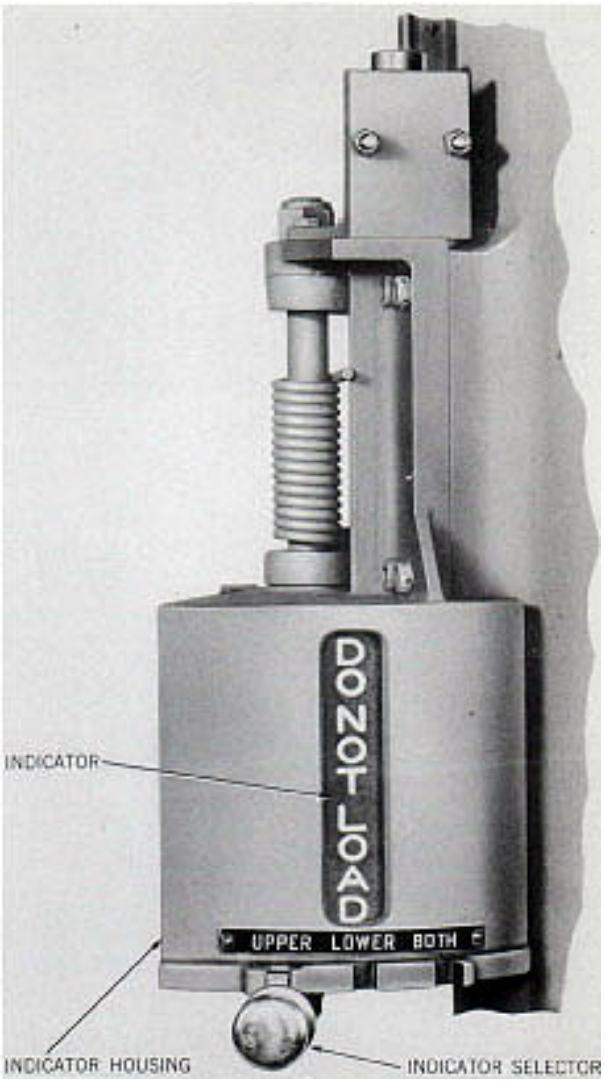

*Figure 89. Hoist Loading Level Selector*

Three powdermen work together to load each powder hoist. Two men operate powder case trucks while the third operates the magazine scuttles. The two truck operators alternately load a powder case from the powder-passing scuttles in the circular foundation into their trucks, roll the loaded trucks onto the rotating powder handling platform, and tilt the cases from the truck into the powder hoist scuttle. The scuttle drive control switch is then moved to rotate the shuttle so that the loaded powder case is placed within the hoist conveyor. Scuttles are designed so that the rotating shuttle has two opposed loading chambers; when one side is enclosed within the hoist, the opposite

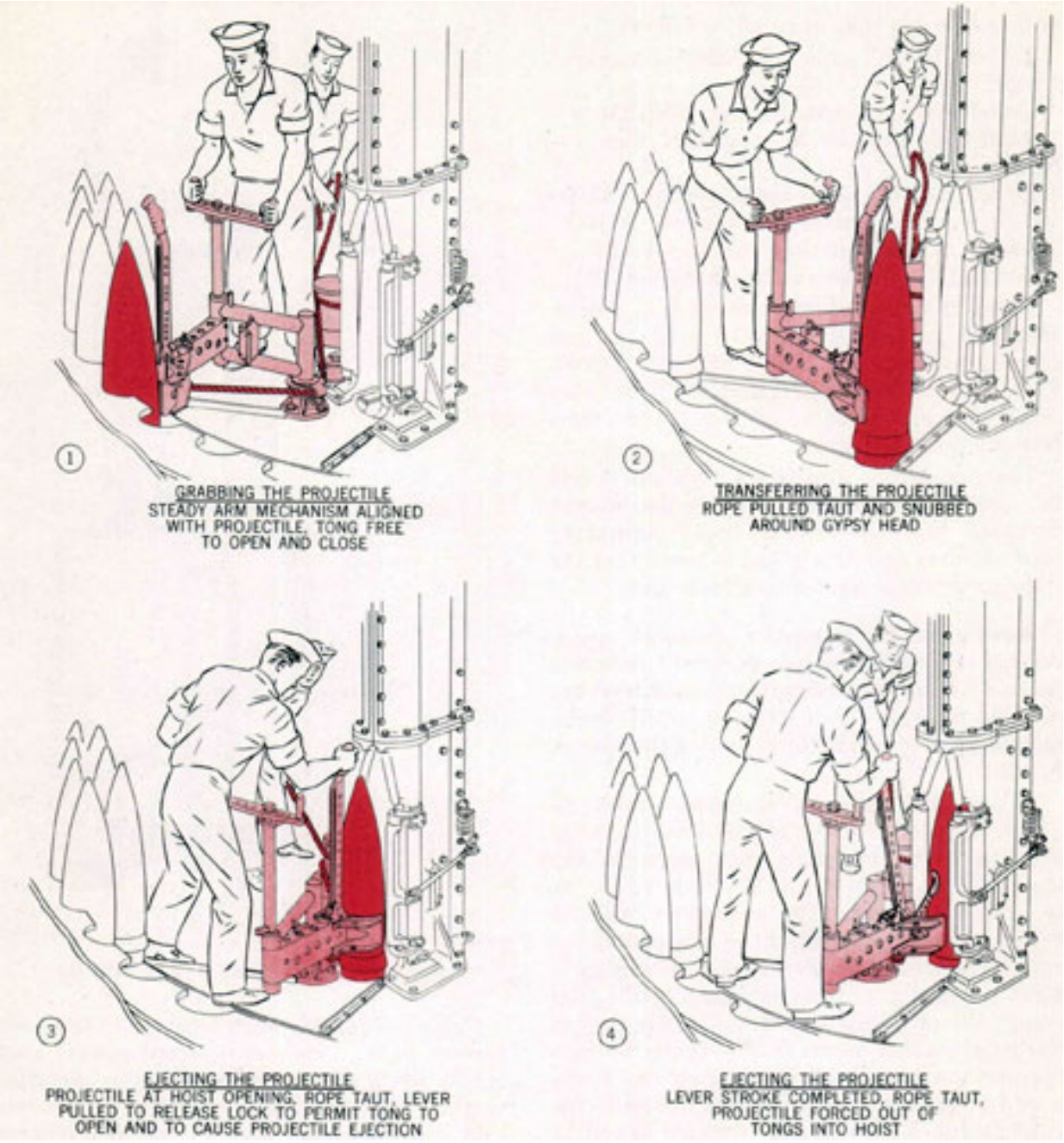


*Figure 90. Projectile Parbuckling Operations*

side is exposed for loading. As soon as the enclosed powder case is carried upward, the shuttle is again rotated, when the drive control switch is moved, to deliver the next case to the hoist and expose the opposite side for loading. The truck operators arrange their traffic so that, as one is loading his powder case truck from the magazine scuttle, the other is tilting a powder case into the hoist scuttle. Each should complete his operation at the same time and trucks should pass each other en route from one scuttle to the other.

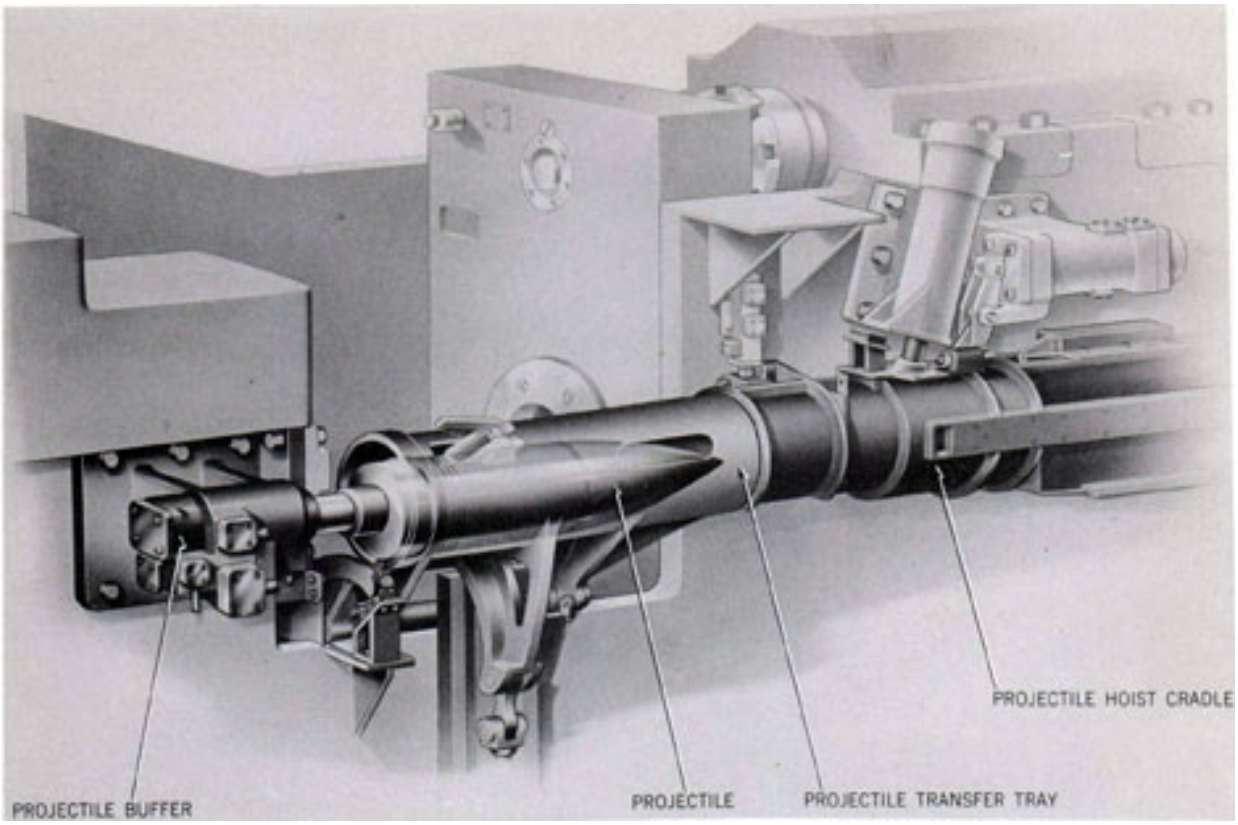


*Figure 91. Projectile Transfer Tray Firing Position*

**Filling hoists**. As a projectile is parbuckled into the projectile hoist, and a powder case enclosed within the powder hoist, these ammunition units depress pawls in the loading apertures of their respective hoists. The pawls operate to close electrical interlock switches in their respective hoist control circuits. Since all other interlock switches are closed in the hoisting circuit, the action of the pawl in closing the switch completes the hoisting circuit. Hoist drives thereupon operate to move the ammunition units one flight upward, at which time the circuits are broken and hoisting ceases until the next units are loaded. As successive ammunition units are loaded, the drives continue to operate until the first ammunition units loaded enter their respective hoist cradles. The cradles then rise automatically and latch to the slide.

**Fuze setting**. Fuze setting of H.C. nose-fuzed projectiles is accomplished while the projectile is within the projectile hoist cradle. Operation of the mechanism in the cradle is controlled by a switch on the gun captain's control panel. The switch may be positioned at OFF, SAFE, or RUN. Should it be placed at RUN, a fuze setting signal from the plotting room is relayed through the turret officer's transfer switchboard and the control panel to the mechanism. Should the switch be placed at SAFE, a dummy signal is relayed to the mechanism which operates to fix the fuze at the standard safe position. For non-fuzed projectiles, the switch is set at OFF.

**Ammunition transfer**. With the breech open, transfer trays extended to the firing position, hoist cradles latched to the slide, empty-case tray empty, and the fuze setting circuit either OFF or CLOSED, conditions are readied so that both the projectile and the powder case are spring-ejected into their respective transfer trays, as shown in figures 91 and 92.

**Loading**. The gun captain then positions the transfer tray control switch, figure 72 (designated also by symbol AB), from AUTO to RAM; the transfer trays move over to the ramming position shown in figure 93.

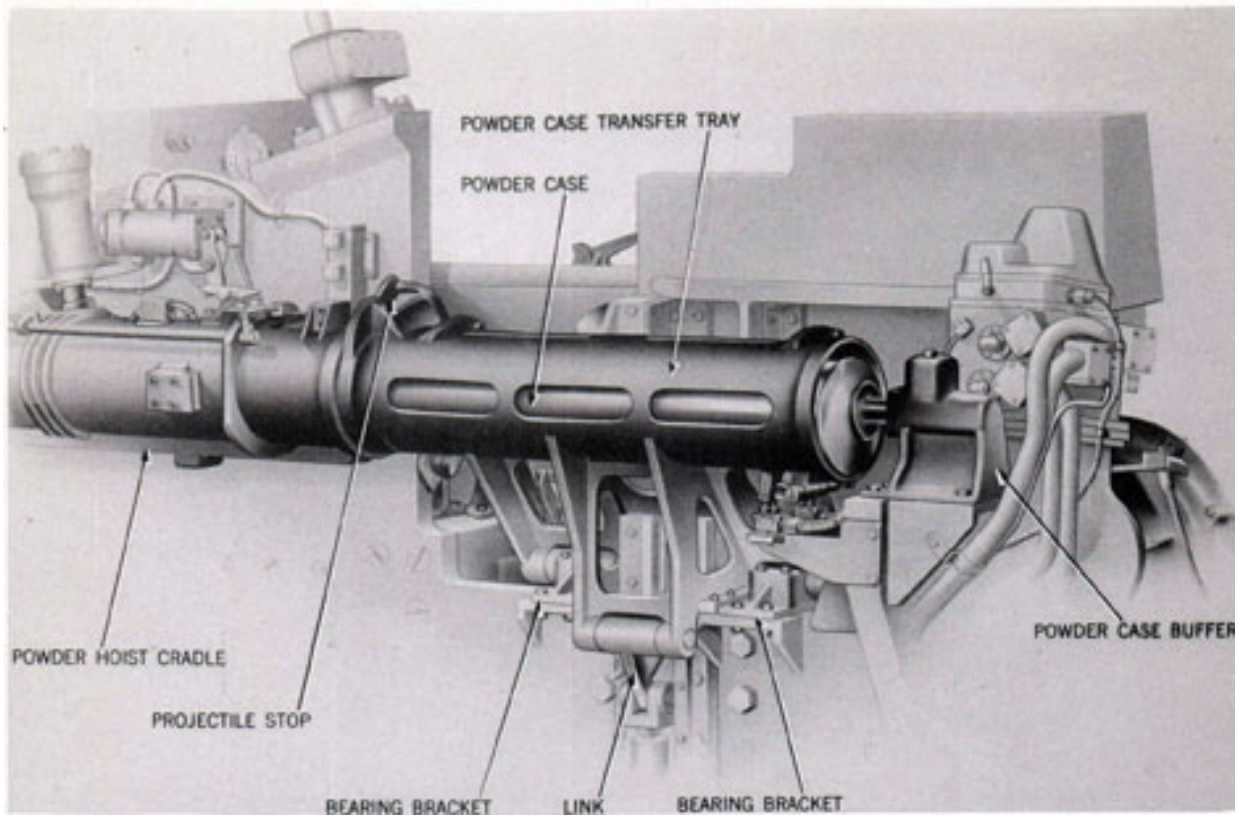


*Figure 92. Powder Transfer Tray Firing Position*

Simultaneously, both cradles unlatch and lower to the hoists. Switch AB is then positioned at AUTO.

**Ramming**. In order to start the ramming action, the gun captain moves the rammer control, figure 72 (designated also by symbol AM), from RETRACT to RAM, and the ammunition units are rammed into the gun. He releases the lever, and the action is automatically completed. As the rammer retracts, the breech closes. Upon the completion of retraction, the transfer trays move back to the firing position. During the ram stroke, the cradles are latched to the hoists and are automatically loaded with the next round.

**Firing**. When the breech closes, the firing circuit is completed and the gun is fired electrically by remote control.

to the slide by the time the breech is open. Immediately following breech opening, the empty case is extracted from the breech. Extraction of the case and its delivery to the empty-case tray close a switch that completes the circuit which governs the movement of the transfer trays from firing to ramming position. For the initial round, since an empty case is not present, transfer-tray movement to ramming is controlled by the gun captain, who manually positions switch AB to RAM.

**Case ejection**. The empty case is deposited in the empty-case chute when the transfer trays reach the ramming position. Presence of the case in the chute closes a switch which starts the empty-case drive unit, and the empty case is thrust forward into the closed section of the chute.

**Normal automatic fire**

Thereafter switch AM, rammer control, is held in the RAM position continuously. Since the transfer trays are in the ramming position

During recoil and counter-recoil, the breech bolt is tripped automatically and the breech is opened. During firing and breech opening actions, the cradles move from the hoists to the slide. Both cradles are latched



(see figure 93) , the ramming control circuit is closed and the ramming action takes place. The cycle then continues automatically, as long as switch AM is held in the RAM position, with successive and simultaneous operations closing the various circuits. Normal automatic operation begins immediately after the first round is fired. The breech is opened automatically during counterrecoil. The empty case extraction closes the switch and the circuit that moves the transfer trays to ramming position. Thus, the two operations that, on initial loading, required manual control, are automatically taken care of following first-round firing .

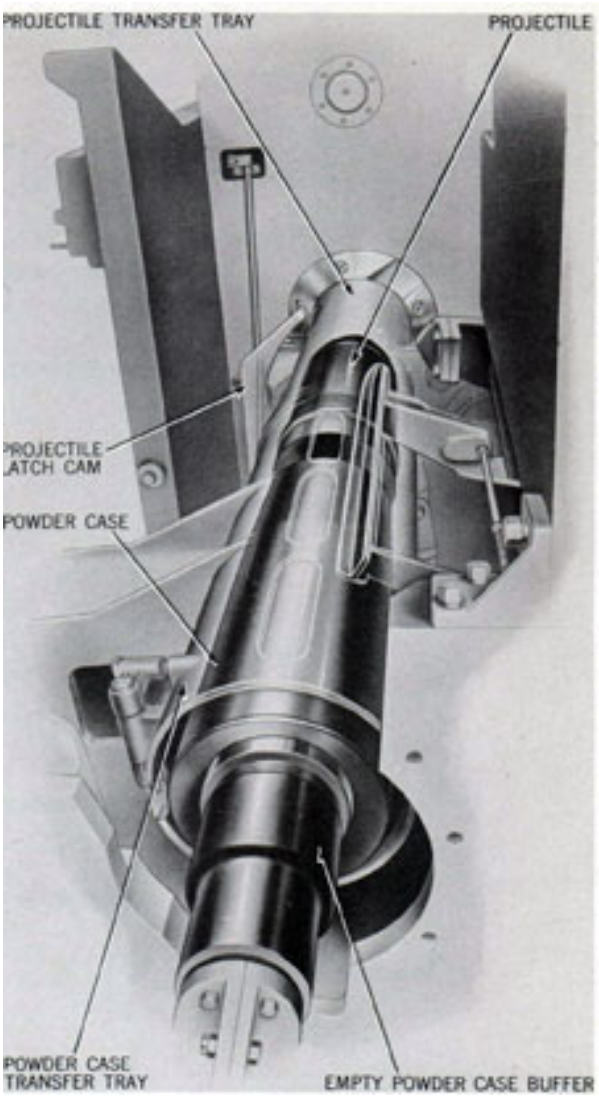


*Figure 93. Projectile and Powder Transfer Trays Ram Position*

**Indicating lights, gun captain's control panel**. The status of each phase of the cycle of operations discussed above may be observed and checked by indicating lights on the gun captain's control panel. These lights, appropriately designated, light up as their circuits are energized, and remain lighted for the duration of the individual operation.

**Gun laying, firing**

Turret control methods of gun laying and firing include primary or secondary AUTOMATIC control, primary or secondary INDICATING control,

as the sights. Parallax range is relayed through the turret officer's transfer switchboard to the sight setter's indicator, where the sight setter, in matching the order by hand, transmits it mechanically to the train receiver-regulator and the gun train indicator. These inputs are factors of gun order correction. Sight deflection, although not used in automatic control, is transmitted to the sights for checking purposes.

LOCAL control and HAND control. Each of these methods is described in the following text.

**Automatic control**. In primary or secondary automatic control, gun laying and firing are accomplished entirely by remote control. Electrical signals to lay the guns in elevation and train the turret are relayed from either forward primary, forward secondary, after primary, or after secondary director and plot through the turret officer's switchboard to the gun elevating gear indicator-regulators and the turret train receiver-regulator.

Inputs to the elevating gear and to the training gear in the various methods of control are shown in figures 94 and 95, pages 110-111.

Sight deflection and sight angle orders are relayed through the turret officer's transfer switchboard to the sight setter's indicator, where the sight setter, in matching the sight angle order by hand, transmits this order mechanically to the gun elevation indicator and the three gun elevation indicator-regulators, as well

These factors are automatically combined in the regulators and other instruments to correct the range position of the guns and the azimuth position of the turret.

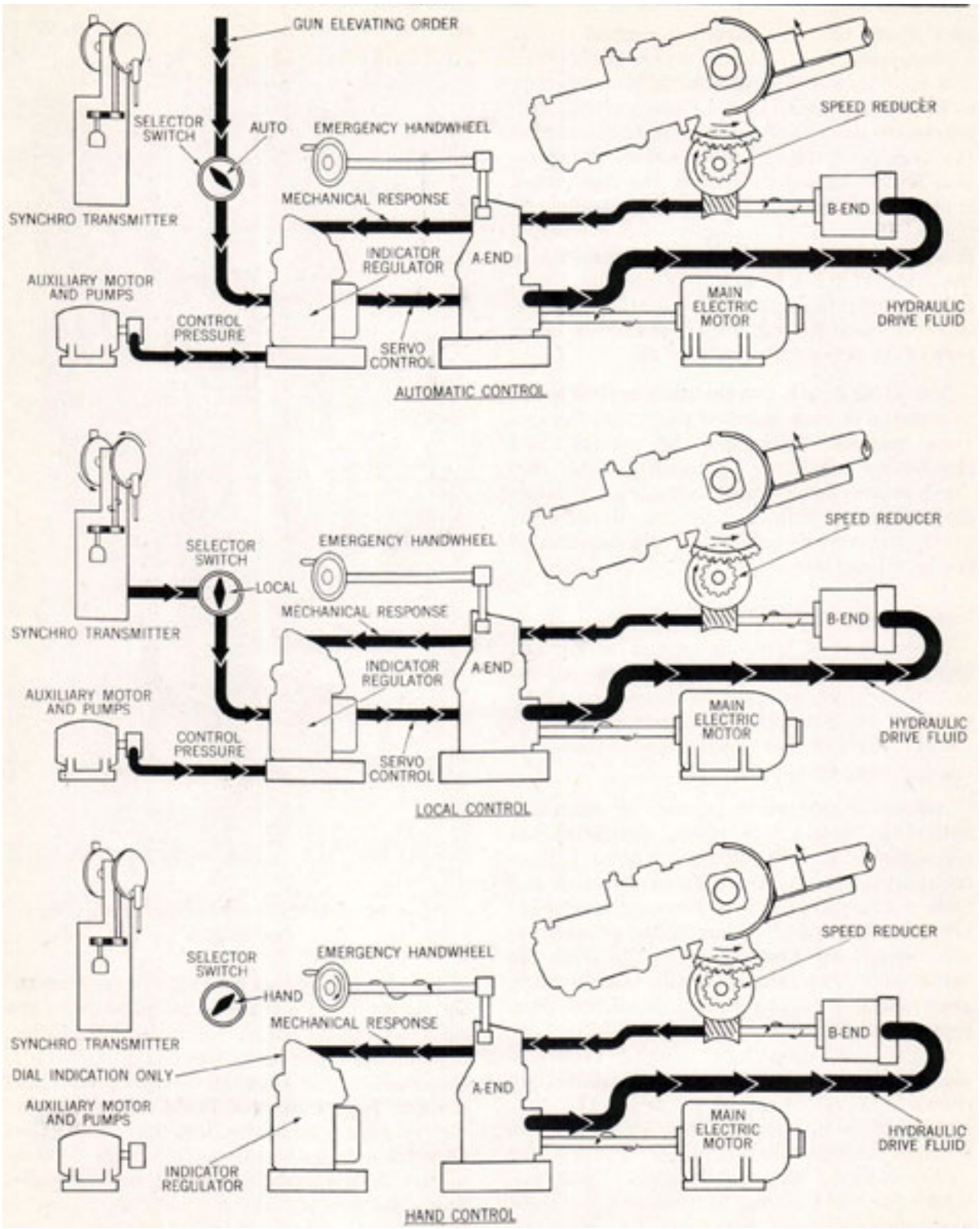


*Figure 94. Elevating Gears and Controls Functional Diagrams*

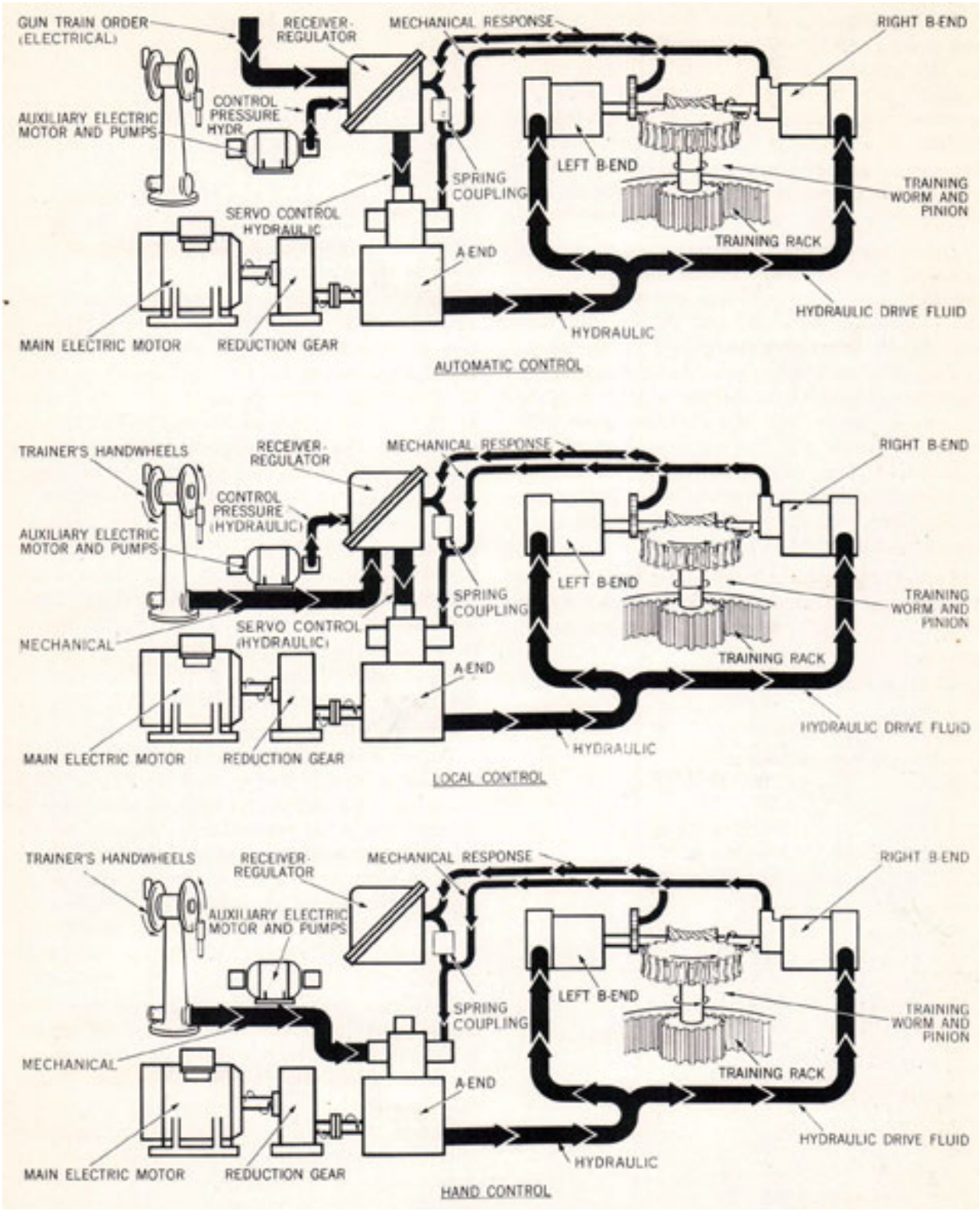


*Figure 95. Training Gears and Controls Functional Diagrams*

During normal automatic fire, turret personnel must at all times be in readiness to switch to any other method of control. The pointer, trainer, and turret officer must be ready to position the various switches at their stations to their new positions. The radar operators and the computer operator must be ready to furnish the values necessary for local control of gun laying.

**Indicating control**. A second type of control is primary or secondary indicating control. Under this method, gun orders are relayed from the remote control center plot through the turret officer's transfer switchboard to the pointer's and trainer's indicators. Those men operate their handwheels to follow-the-pointer to place the proper inputs into the elevating gear indicator-regulators and the train receiver-regulator. In switching over from automatic control to indicating control, operations are performed by the turret officer, pointer, trainer, and sight setter as follows:

**Turret officer**. The turret officer positions the switches on his transfer switchboard as follows:

| Switch No. | Switch Position |
|---|---|
| 1 | FWD or AFT |
| 2 | Any FWD or AFT position |
| 3 | OFF |
| 4 | OFF |
| 5 | FWD or AFT |
| 6 | ON |
| 7 | FWD or AFT |
| 8 | FWD or AFT |
| 9 | TRAIN |
| 10 | OFF |
| 11* | |
| 12 | Any FWD or AFT position |
| 13 | LOCAL** |
| 21 | OFF |
| 22 | OFF |
| 23 | FWD or AFT |
| 24A | FWD or AFT |
| 24B | OFF |
| 25 | FWD or AFT |

All other switches controlled by the turret officer are in exactly the same position as they were in automatic control.

**Pointer**. The pointer checks that handwheel elevation order position agrees with gun elevation as shown by the gun elevation indicator. When these agree, he switches the three regulator switches on his panel to LOCAL. Thereafter, by rotating his handwheel to follow-the-pointer of the gun elevation indicator, he is actually controlling gun elevation of all guns, via the local gun elevation order transmitter.

**Trainer**. The trainer shifts the regulator control selector to LOCAL. Thereafter, by rotating his handwheels to follow-the-pointer of the turret train indicator, he is controlling turret turning by transmitting a mechanical signal to the train receiver-regulator.

**Sight setter**. The duties of the sight setter, in indicating control, are identical to those in automatic control.

**Turret local control**. Local control involves the use of turret radar equipment, auxiliary computer, and sights. As such, local control in its entirety is not applicable to turret I, which has no radar equipment. Turret I can be operated in local control if range can be received from a remote control source, or it may be controlled by turret II. The following description covers the local control system in turrets II and III

| | |
|---|---|
| 14 | LOCAL** |
| 15 | LOCAL** |
| 16 | FWD or AFT |
| 17 | FWD or AFT |
| 18 | OFF |
| 19 | OFF |
| 20 | OFF |

*No. 11 is a spare switch
**This switch selection duplicates the pointer's selector switch. It is a control routing installed at date of this publication, but which will probably be eliminated.

only.

**Switching operations**. In switching from Primary control to LOCAL control, operations are performed by the turret officer, pointer, trainer, radar operators, and computer operator. These activities are:

**Turret officer**. The turret officer positions switches on his transfer switchboard as follows:

| Switch No. | Switch Position |
|---|---|
| 1 | LOCAL |
| 2 | RADAR |



| Switch No. | Switch Position |
|---|---|
| 3 | RADAR |
| 4 | ON |
| 5 | LOCAL |
| 6 | ON |
| 7 | OFF |
| 8 | OFF |
| 9 | TRAIN and ELEVATION |
| 10 | ON 11* |
| 12 | LOCAL |
| 13 | LOCAL** |
| 14 | LOCAL** |
| 15 | LOCAL** |
| 16 | LOCAL |
| 17 | OFF |
| 18 | OFF |
| 19 | OFF |
| 20 | OFF |
| 21 | ON |
| 22 | ON |
| 23 | FWD or AFT |

is directed by the radar equipment, utilizing the train transmitter (turret order) , which sends an electrical gun train order to the train receiver-regulator. If the turret has been in indicating control, and the trainer has been following-the-pointer with his selector switch in LOCAL, he switches back to AUTO, thereby de-clutching his handwheels for automatic turret train under radar control.

**Radar operators**. The radar operators perform necessary switching operations to place the radar equipment in operation, and thereafter observe their instruments and manipulate their controls as described in paragraphs following. The radar controls are a part of the Radar Equipment Mk 27 Mod 0, operation of which is fully described in OP 1155.

**Computer operator**. If the computer operator has not already placed the computer in operation, he does so at this time. Detailed instructions for starting and operating his instrument are given in OD 4257.

**Turret operation, local control**

In local control of the turret, turret train angle is

| | |
|---|---|
| 24A | FWD or AFT |
| 24B | ON |
| 25 | LOCAL |

The turret officer positions one element of his selective switch at LOCAL. The second switch remains at either AC SUPPLY or BATTERY, depending on the source of power being used to energize the firing circuit.

The turret officer positions the three switches on his indicator panel to determine whether the trainer or pointer will fire the guns. Usually, the pointer is selected. Finally, he shifts the salvo signal snap switch, on the bulkhead at the right of his station, to LOCAL to complete the shift from director control.

**Pointer**. The pointer observes the dial on his handwheel to verify that the position agrees with gun elevation as shown by the gun elevation indicator. When these check, he switches the three regulator switches on his panel to LOCAL.

**Trainer**. If the turret has been in normal automatic control, the trainer leaves his regulator selector in AUTO. This is necessary because, in turret local radar control, turret train determined and obtained by the radar operators, using the radar gear and the turret train order transmitter. Gun elevation is determined by the pointer. He positions the guns by operating the handwheels to hold his line-of-sight on the target. The methods used to determine turret train angle and gun elevation order are described in the following paragraphs:

There are two complete radar systems, one for operation leftward and the other rightward. Two systems are necessary, since neither radar antenna can make a complete revolution without encountering radar signal interference from the guns and the ship's superstructure.

Prior to locating the target, both antennae are searching; that is, turning 360° at any desired rate of from one to 12 revolutions per minute. Alternatively, the target bearing may be designated by telephone, or it may have been tracked while the turret was in automatic control, before shifting to local control. In any event, when the target is located, the radar operator whose antenna has picked up the target, positions his rate control knob so that the antenna will slow down and track the target.

*No. 11 is a spare switch.
**See second footnote page 112.

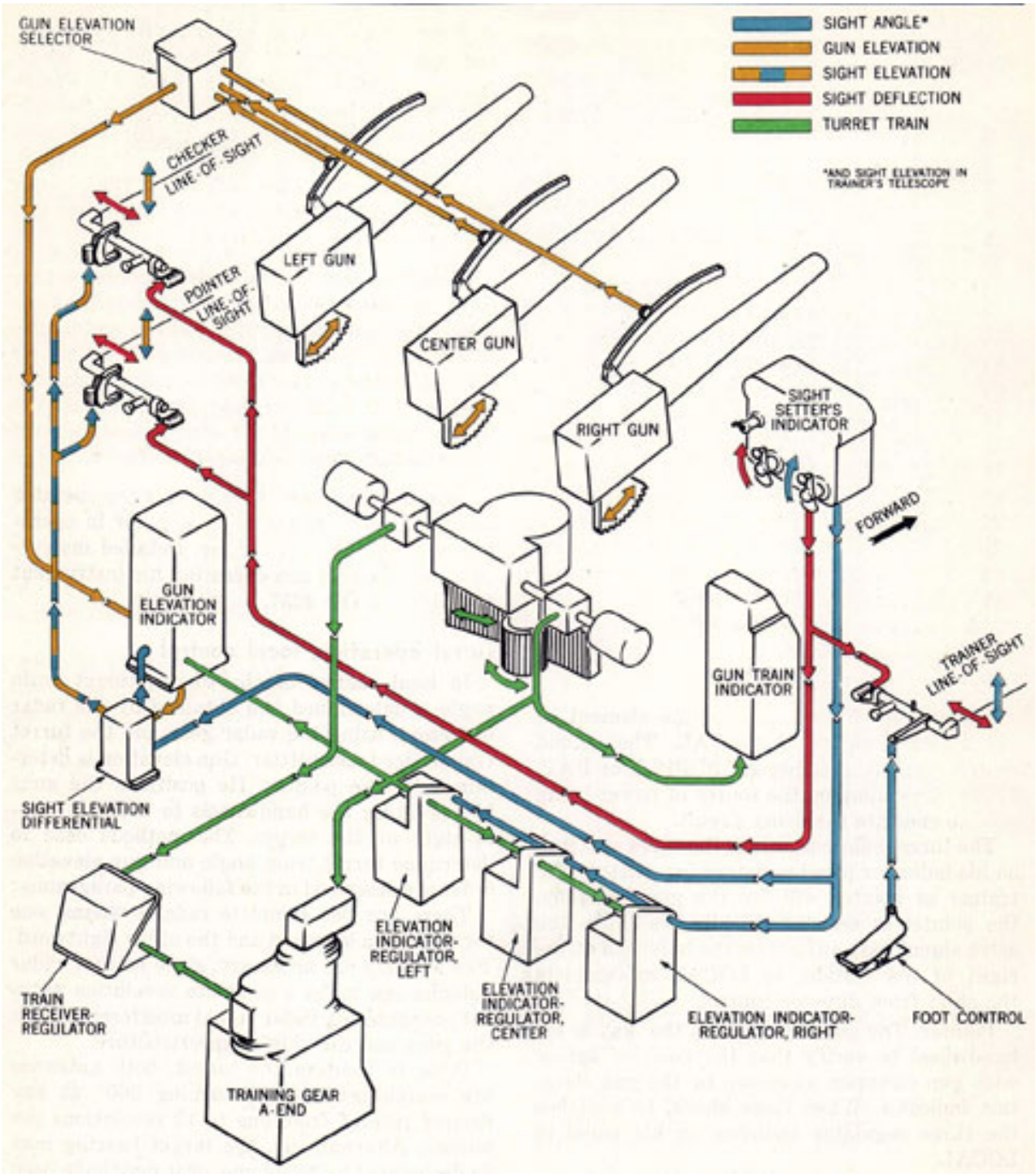


*Figure 96. Sight and Gun Attachments*
*Local Control Operations*

He then telephones range and bearing, via the talkers, to the auxiliary computer operator, who sets these values into the computer.

Between the two radar sets is the train transmitter (turret order). By means of a manual control, the radar operator in command can operate the transmitter to send an electrical signal to the training gear receiver-regulator, and thus function to train the turret to the same bearing as the antenna positioned on the target.

During the initial training operation, the computer estimates the values for sight angle and sight deflection and telephones them via his talker to the sight setter. The sight setter sets the values as received in his indicator, by means of the respective hand cranks.

At this time the radar operator positions his antenna control switch to AUTO, so that the antenna and sights are equally set in deflection under control of the sight setter's indicator. This operation is completed when an antenna drive control switch on the sight setter's indicator is shifted to the ON position.

As the antenna is offset in deflection from the turret train angle, the radar operator operates the train transmitter (turret order) to keep the antenna and turret on the target at the same bearing. Any change in range and bearing is given to the computer. The process then becomes continuous, that of keeping the antenna trained on the target-training the turret to match the deflected position of the antenna-and furnishing corrected

for positioning the slides and turret when securing after operations. Certain tests and adjustments also require its use. Otherwise it is an emergency control arrangement that is slow and not adapted for accurate, rapid fire.

In hand control the emergency gun layers observe the indicating dials of the gun elevation indicator-regulators. They operate emergency handwheels to elevate and depress the guns, matching the gun response dial against the sight angle dial. Thus sight angle as transmitted by the sight setter, in response to verbal data received from the computer, is the gun laying order.

Such gun laying is not adapted to continuous fire. Firing is performed by the pointer at "level" position. He closes his firing key as his sight crosswires roll on the target or the horizon.

In addition to this firing control function, the pointer is the "coordinator" for hand gun laying. His gun elevation selector dials enable him to observe lack of synchronization between the three guns and to instruct the gun layers verbally.

The trainer controls turret train by direct HAND control signal input to the A-end pump of the power drive. He manipulates his hand-wheels while observing the target with his sight, holding his crosswires on the target. Thus, the sight setter, by applying sight deflection, in response to verbal data received from the computer, gives the correcting order to change the azimuth position of the fall-of-shot.

**Sighting**

Sight setting. Sight setting is accomplished by the sight setter, using the sight setter's indicator. The indicator functions to set the sights by mechanically transmitting sight angle and sight deflection orders. These are the local control orders that shift the lines-of-sight to cause the pointer and trainer to change the range and azimuth position of the guns.

The indicator is also the receiving and transmitting instrument for applying locally certain corrections of remote control orders. These are range corrections entered by sight angle

data to the computer operator.

The pointer lays the guns in elevation, using the telescope at his station. He maintains the telescope line-of-sight on the target by means of his handwheels, and, by so doing, he holds the guns at the proper degree of elevation. Corrective adjustments to the pointer's telescope, offsetting the telescope from parallelism with the gun bore, are continuously transmitted from the sight setter's indicator. The manner in which these values are combined are indicated in the schematic arrangement of figure 96.

**Turret operation, hand (emergency) control**

The hand control method for laying the guns and turning the turret is a type of turret control required for starting the power drives and

input at the elevation indicator-regulators and horizontal parallax corrections entered by a parallax range input at the train receiver-regulator.



In addition to these mechanical transmitting arrangements, the indicator is an electrical transmitter, operating to control the local radar antenna train drives.

All of the sighting control signals, as received and transmitted by the indicator, are indicated on dials visible to the sight setter.

Under automatic or indicating control, gun elevation orders are received from the plotting room; sight angle is matched; and the order is then transmitted mechanically to the sights, elevation indicator-regulators, and gun

**Trainer's sight operation**. In turret automatic control the trainer, like the pointer, is at stand-by. He watches the dial pointers before him to check that turret position agrees with turret train order, and he makes periodic target sight checks through his telescope. He maintains himself in readiness at all times to assume local control of turret train.

In turret indicating control, the trainer does not use his telescope. He matches dials in follow-the-pointer operation. In turret local radar control, the trainer is again at stand-by. Turret train is controlled by one of the radar operators, who operates the train transmitter (turret order). In this method of control, the trainer closely follows the training operation with his telescope, so that he will be in readiness to assume control of turret train, should hand-wheel control be necessary.

In local hand (sight) control, the trainer assumes full control

elevation indicator. Parallax range is mechanically transmitted to the train receiver-regulator and to the gun train indicator. Sight deflection is mechanically transmitted to all the sights.

Under turret local control, the value for parallax range is not required; values for sight angle and sight deflection are received by telephone from the computer and set in the indicator as received by means of the respective hand cranks. The flow of signal transmission in this method of sight operation is illustrated in figure 96.

**Pointer's sight operation**. In turret automatic control, the pointer is at stand-by, insofar as sight operation is concerned. He makes quick target sight checks through his telescope from time to time and watches the dial pointers before him to check that gun position agrees with gun elevation order. He maintains himself in readiness at all times to assume local control of gun laying.

In indicating control, the pointer does not use his telescope. He matches dials in follow-the-pointer operation.

In turret local control, the pointer maintains his telescope on the target by means of the handwheels, thereby elevating the guns to the proper position. The telescope is offset from parallelism with the gun bore by line-of-sight adjustments from the sight setter's indicator. Sight deflection orders move the telescope in azimuth. Sight angle orders, in combination with gun of turret train. He sights the target through his telescope and maintains his telescope on the target by means of his handwheels, thereby training the turret to the proper position. The telescope is offset from parallelism with the gun bore in elevation by foot control of his sight setting mechanism, and is moved in azimuth by sight deflection order from the sight setter's indicator.

**Range estimating**

**Computing data**. The auxiliary computer is used by the computer operator in local control to solve the fire control problem for all movements of the target and ship and for wind across the line-of-sight.

Three electrical inputs are synchro-received in the computer, as shown in figure 97. These are ship speed and ship course, received from the ship's gyro compass and Pitometer log via the plotting room; and turret train, received from the local gun train indicator.

Thirteen inputs are manually introduced. These are: projectile, initial velocity, target angle, target speed, wind angle, wind speed, true target bearing, ship speed, deflection correction, present range, range correction, time, and turret train follow-up. Three of these hand inputs are identical to the electrical inputs-true target bearing, turret train follow-up, and ship speed. The first two are for emergency use when

elevation, move the telescope in elevation.

In turret hand (emergency) control, if the automatic indicating system is inoperative, the pointer sights the target through his telescope and telephones gun elevation instructions to the emergency gun layers in the gun pits.



the corresponding electrical input or the respective follow-up is inoperative. The electrical input for ship speed operates a dial but does not set the mechanism. Setting must be done by hand.

The outputs of the computer are sight deflection and sight angle, indicated on dials or counters at the computer and orally transmitted.

The auxiliary computer is designated Computer Mk 3 Mod 9. No publication has been prepared or is expected to be prepared on this particular computer; however, a similar design Computer Mk 3 Mod 5, which differs only in ballistics, is described in OD 4257. This publication contains complete description and instructions and provides all information necessary to operation.

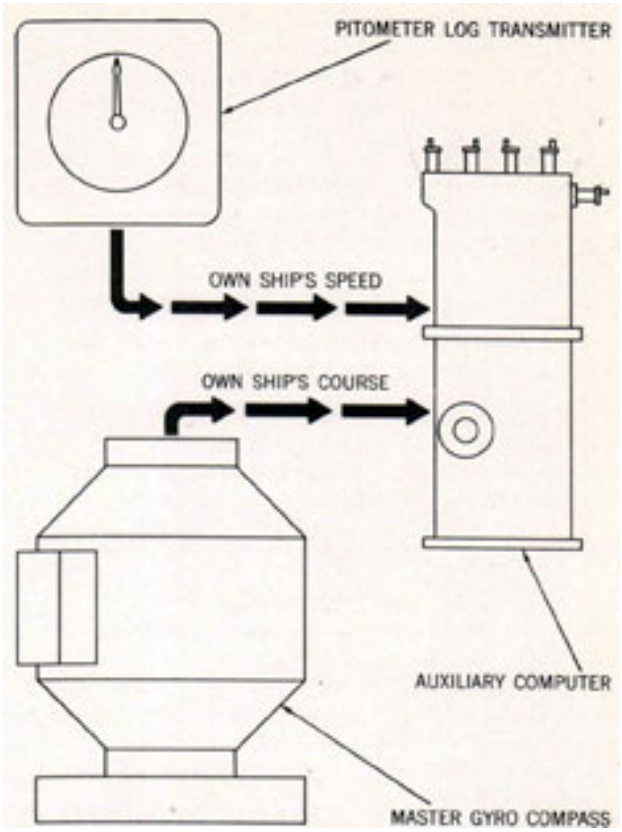


*Figure 97. Auxiliary Computer Operation Automatic Inputs*

## GUN CASUALTY OPERATION

### Misfire operations

At occurrence of misfire a series of manually controlled and manually performed operations are necessary in order to correct the malfunction, prevent "cook-off," and quickly resume normal the misfire and receives permission to open the breech.*

The gun captain turns the transfer tray control switch AB to FIRE and orders his assistants to latch both trays in firing position. He then turns the projectile cradle control switch BJ to LOWER. Next he positions switch AB at RAM to unlatch the cradles (which return to the hoists).

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United States Navy Regulations, article 972:

automatic fire. These operations are performed by the gun captain and the two gun captain's assistants. This team is required because of the conditions that commonly prevail when misfire occurs and because of the number of operations, the urgency, and the labor involved.

The normal procedure is quickly performed, but it requires 15 control and unloading and loading actions. These actions stop gun laying, extract and remove the misfired powder charge, and ram the powder charge that has been delivered to the slide for the next round; all in the sequence of operations described in the next paragraph.

Operating procedure for normal method of misfire correction. When misfire occurs, the malfunction is corrected by the following series of activities:

The gun captain immediately releases the rammer control switch AM (which returns to RETRACT position) and shifts his ready switch, figure 98, to UNLOAD position. This stops gun laying movement at 9° elevation and opens the firing circuit.

The gun captain notifies the turret officer of

"The possibility of a serious accident due to opening the breech of a gun too soon after a misfire demands the constant exercise of the utmost prudence and caution. After an unsuccessful attempt to fire a gun, it shall be assumed that hang-fire is under way, and the procedure outlined below shall be followed:

(1) Keep the gun pointed and trained in a safe direction.
(2) Continue attempts to fire, if desired, provided such efforts do not involve any movement tending to open the breech.
(3) Do not open the breech for 30 minutes after the last attempt to fire. This, at the discretion of the commanding officer, is not obligatory in time of action."

CIRCUIT QC ELEMENTS

21. POWDER HOIST POWER FAILURE SOLENOID INDICATING LIGHT—SCD
22. POWDER HOIST CONTROL SUPPLY INDICATING LIGHT
23. POWDER HOIST CONTROL CIRCUIT SUPPLY SWITCH—C
24. POWDER CRADLE CONTROL SWITCH—CJ
25. POWDER CRADLE LOWERING SOLENOID INDICATING LIGHT—SCC
27. POWDER CRADLE RAISE SOLENOID INDICATING LIGHT—SCB
28. POWDER HOIST OPERATION SOLENOID INDICATING LIGHT—SCA
29. POWDER SCUTTLE OPERATION SOLENOID INDICATING LIGHT

CIRCUIT QE ELEMENTS

1. PROJECTILE HOIST CONTROL SUPPLY INDICATING LIGHT
2. PROJECTILE HOIST POWER FAILURE SOLENOID INDICATOR LIGHT—SBD
3. PROJECTILE HOIST CONTROL CIRCUIT SUPPLY SWITCH—B
4. PROJECTILE CRADLE CONTROL SWITCH—BJ
5. PROJECTILE CRADLE LOWERING SOLENOID INDICATING LIGHT
7. PROJECTILE FUZE SETTING OPERATION COMPLETED INDICATING LIGHT
8. PROJECTILE CRADLE RAISING SOLENOID INDICATING LIGHT
9. PROJECTILE HOIST OPERATION SOLENOID INDICATING LIGHT
10. SLIDE CONTROL SUPPLY INDICATING LIGHT
32. FUZE SETTER REGULATOR CONTROL SWITCH—BW

CIRCUIT QS ELEMENTS

6. PROJECTILE PAWL TRIP SOLENOID INDICATING LIGHT—SAG
10. SLIDE CONTROL SUPPLY INDICATING LIGHT
11. SLIDE CONTROL CIRCUIT SUPPLY SWITCH—A
12. TRANSFER TRAYS CONTROL SWITCH—AB
13. BREECH OPERATION CONTROL SWITCH—AP
14. TRANSFER TRAYS TO RAM SOLENOID INDICATING LIGHT—SAB
15. RAMMING SOLENOID INDICATING LIGHT—SAC
16. RETRACT SOLENOID INDICATING LIGHT—SAD
17. BREECH CLOSING SOLENOID INDICATING LIGHT—SAE
18. TRANSFER TRAYS TO FIRING SOLENOID INDICATING LIGHT—SAA
19. EMPTY CASE DRIVE OPERATION SOLENOID INDICATING LIGHT—SAF
20. RAMMER OPERATION CONTROL SWITCH—AM
26. POWDER PAWL TRIP SOLENOID INDICATING LIGHT—SAH
32. FUZE SETTER REGULATOR CONTROL SWITCH—BW

POWER CIRCUIT ELEMENTS

30. ELEVATING GEAR EMERGENCY STOP INDICATING LIGHT
31. ELEVATING GEAR EMERGENCY STOP SWITCH
33. CLEAR SECTOR INDICATING LIGHT
34. DANGER SECTOR INDICATING LIGHT
35. EMERGENCY FIRING CIRCUIT INDICATING LIGHT
36. GUN CAPTAIN READY INDICATING LIGHT
37. POINTER READY INDICATING LIGHT
38. GUN CAPTAINS READY SWITCH
39. EMERGENCY FIRING SWITCH
40. PROJECTILE HOIST MOTOR CONTROLLER MASTER SWITCH
41. RAMMER MOTOR CONTROLLER MASTER SWITCH
42. POWDER HOIST MOTOR CONTROLLER MASTER SWITCH

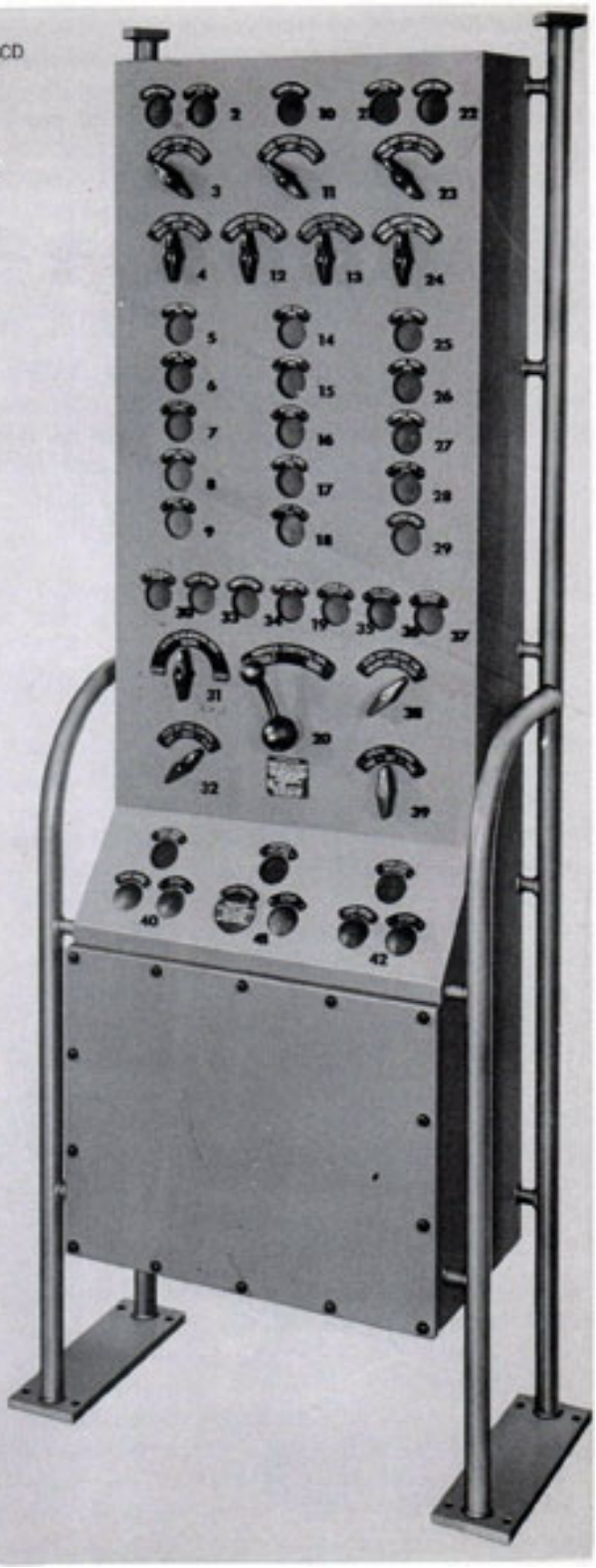

*Figure 98. Gun Captain's Control Panel. General Arrangement and Identities of Controls*

He then returns switch AB to FIRE and orders one of his assistants to operate the manual breech bolt unlocking lever to cause the breech to open and the misfired case to be extracted into the empty-case tray.

The gun captain and his assistants remove the misfired case from the tray, using the hot-case tongs as illustrated in figure 99. They dispose of the case through one of the doors at the rear of the turret officer's booth. The assistants then unlatch the transfer trays.

The gun captain then returns his ready switch to READY; moves switch AB to RAM, thence to AUTO; and returns switch BJ to AUTO. He then moves switch AM to RAM and holds it continuously in that position as normal automatic firing is resumed.

**Operating procedure for emergency method of misfire correction**. If the misfire has occurred as result of firing circuit failure, an emergency procedure must be employed to clear the gun. This method stops gun laying, extracts the misfired powder charge, gets it out of the turret, and hand rams a "short case" charge which has a precussion-type primer. It is performed in the sequence of the following activities:

The gun captain moves his ready switch to UNLOAD position. He requests and receives permission to open the breech. He orders one assistant to operate the manual breech operating lever and to shift the latches that block movement of the transfer trays from firing position to ramming position. With the other assistants, he removes the misfired case from the slide, and casts it from the rear door. He instructs one assistant to climb into the slide and install the percussion firing device, and the other assistant to pass a "short case,"

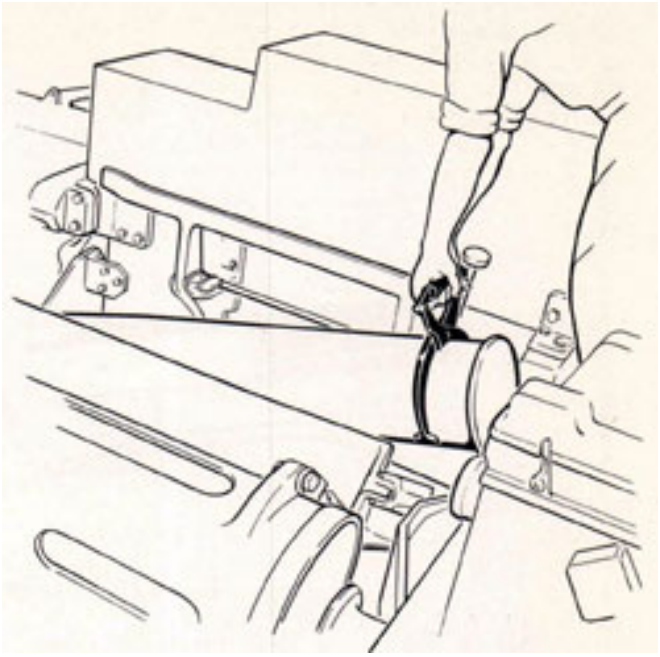

*Figure 99. Use of Hot-Case Tongs*

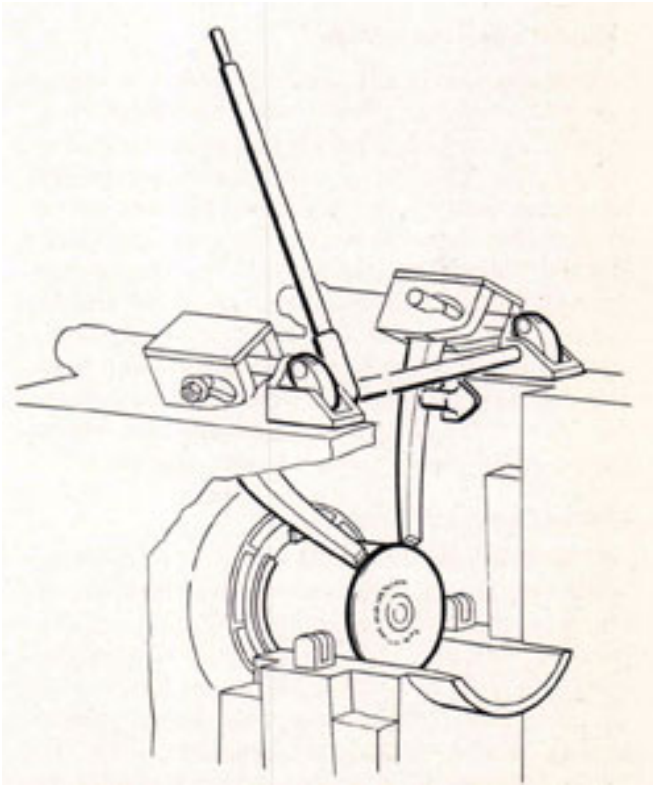

*Figure 100. Case Extraction, Auxiliary Manual Operation*

which the man in the slide rams by hand.

When the man in the slide climbs out, the gun is ready to be cleared. This is accomplished by lanyard pull to release the hammer of the percussion firing device, after the gun has been pointed to a safe area. Safe pointing is obtained quickly by shifting the ready switch to SAFE. Thereafter, when the gun has been fired, by percussion, the ready switch is returned to UNLOAD position; one of the assistants removes the percussion firing device; and the electrician repairs the firing circuit. The transfer trays are then released before moving



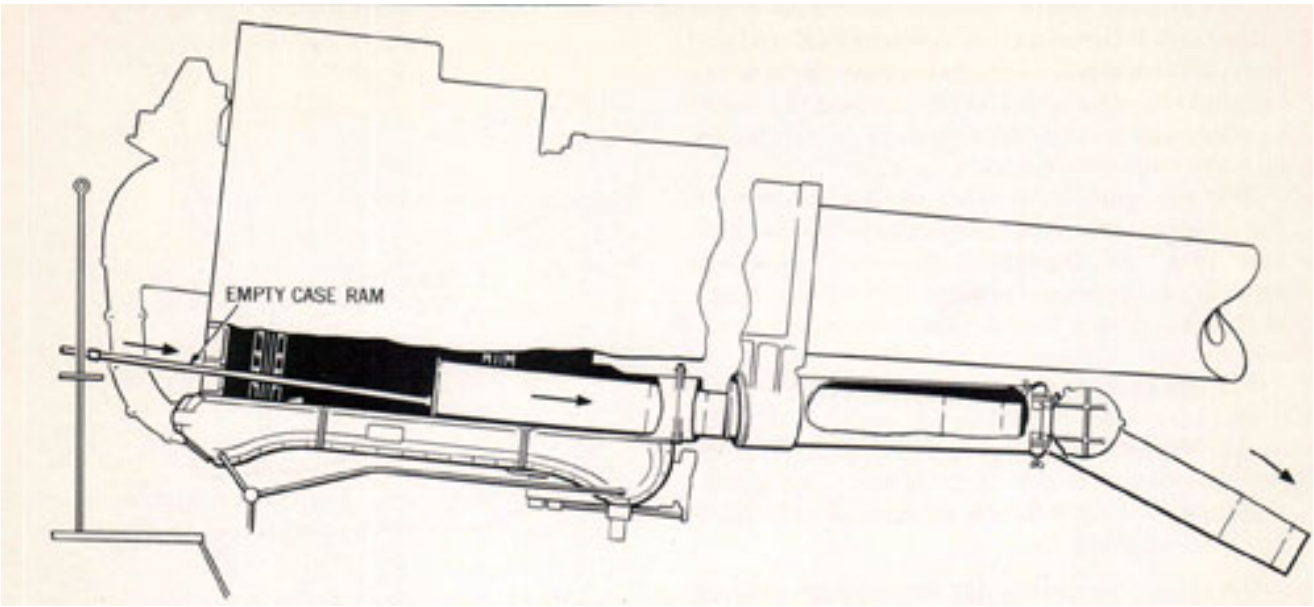


*Figure 101. Use of Empty-Case Ram*

switch AB to RAM and then to AUTO, and switch AM to RAM and the ready switch to READY. These control actions restore the gun and gun laying controls to automatic operation.

**Manual case extraction**

When power is not available and it is necessary to extract an empty case or a loaded case, manual extraction is performed as illustrated in figure 100. This hand lever action moves the extractor spades in the same manner as in power operation, extracting the case and ejecting it through the housing into the empty-case tray of the slide. Spring action of the hydraulic cylinder pistons and the extractor buffers returns the extractors to normal gun loading position. Manual case extraction trips the gas ejector blow valve and causes gas-ejecting action in the same manner as in power operation.

**Manual case ejection**

The manually operated device for ejecting empty cases is a ram consisting of sections of straight pipe, pipe couplings for joining the sections, and pipe caps to cover the ends of the ram. The tool is used as shown in figure 101, to push any empty cases that have become lodged in the empty-case tube out onto the deck. Sections of pipe are added to the ram as required. The operation is performed with the gun depressed as shown.

**Manual projectile extraction**

A backing-out rammer is used to remove drill projectiles from the gun. The outfit consists of a ram, a backing-out adapter, a rope, a muzzle sheave rig of two pulleys, and a rope buffer. It is used as shown in figure 102. The adapter is inserted in the gun bore from the muzzle, so that its teeth engage the ogive of the projectile. The woven rope buffer is placed in the powder chamber to protect the breech when the projectile breaks loose. The breech is then closed; the sheaves, rope, and rammer are installed; and the gun is elevated as shown. The ram is dropped on the adapter and raised by means of the pulleys and ropes. The operation is repeated until the projectile is unseated and falls back against the buffer. When removing flat-nosed projectiles, do not use the adapter.

**Manual hoist operation**

Each projectile hoist and the powder hoist conveyor has a hand lowering drive. This is intended in event of power failure, for lowering ammunition to empty the hoists. It is also adapted for installing hoist chains.

The unit is located in the gun pits at the top of the conveyor. It consists of a worm and wormwheel operated by a hand crank. The worm is mounted on the input end of the worm shaft of the gear reducer, and serves as one of the hubs of the coupling that connects the

B-end drive shaft to the gear reducer. The hand lowering worm is carried in a swing housing pivoted on a spud shaft on the gear reducer bearing cover. The housing is normally locked in position, with the worm out of mesh, by a detent plunger that actuates a switch to indicate that the worm is not engaged. To operate the hand lowering drive, the worm is placed in mesh with the wormwheel and locked in this engaged position by the detent plunger.

## SECURING OPERATIONS

At conclusion of firing operations, a great many duties must be performed in order appropriately to stow and secure the ordnance assemblies, auxiliary equipment, and turret stations. The work includes conventional gun cleaning and preservation activities as defined by the Ordnance Manual, inspections and system replenishing services, closing down power units, shifting controls, and securing operations. These activities are generally the reverse of the casting-loose and starting preparations described in the earlier parts of this chapter. They are duty assignments that include all members of the turret organization.

This work comprises three general classes of activities, identified and briefly described in the text which follows under the following titles:

Stopping equipment
Conditioning for stowing
Securing

### Stopping equipment

All power-driven ordnance equipment and the auxiliary ventilating units are stopped by depressing master push-button stop control switches.

The electric control systems of the gun, hoists, elevating gears, and training gear and antenna train drive units are stopped by shifting control supply switches at the respective control stations, and by opening signal circuits and supply switches of the turret officer's transfer switchboard and selective switch.

Heaters are cut off by opening supply switches adjacent to each unit.

In addition to the above operations to stop equipment, the power-supply manual disconnect switches of all Ordnance controllers are opened, and supply switches are opened at all power equipment panels except the miscellaneous equipment panel.

Other power operating mechanisms, such as the hydraulic accumulators, are stopped by the securing operations.

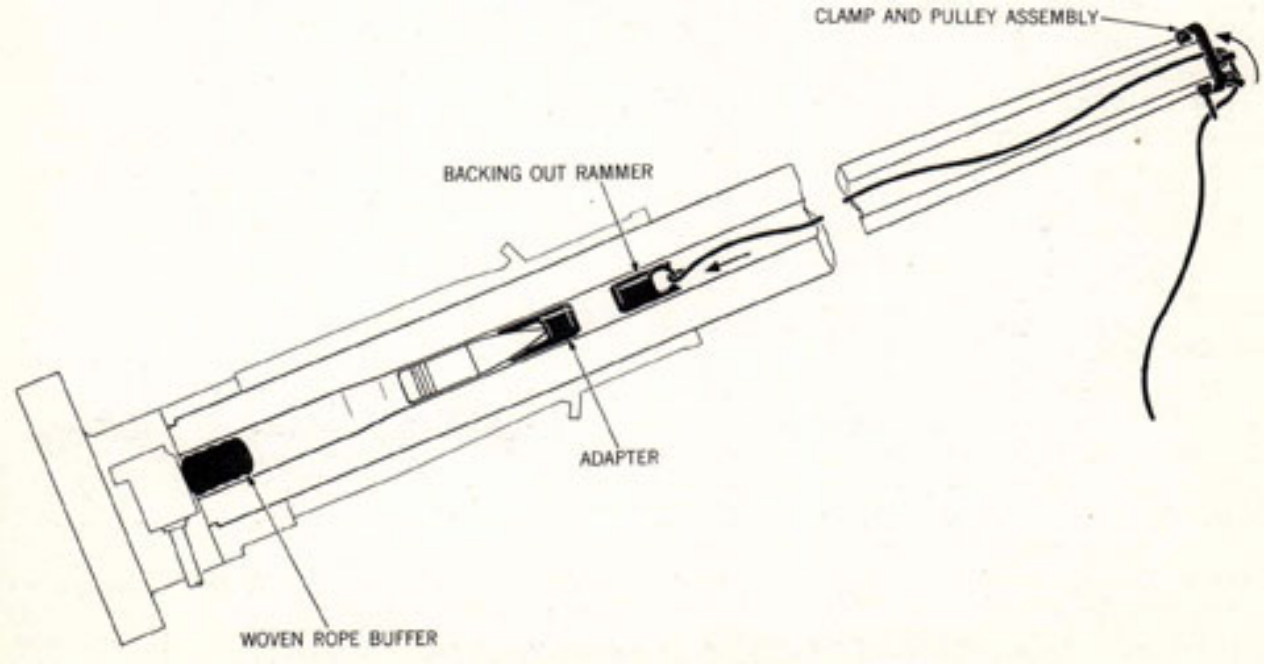


*Figure 102. Use of Backing-Out Rammer*

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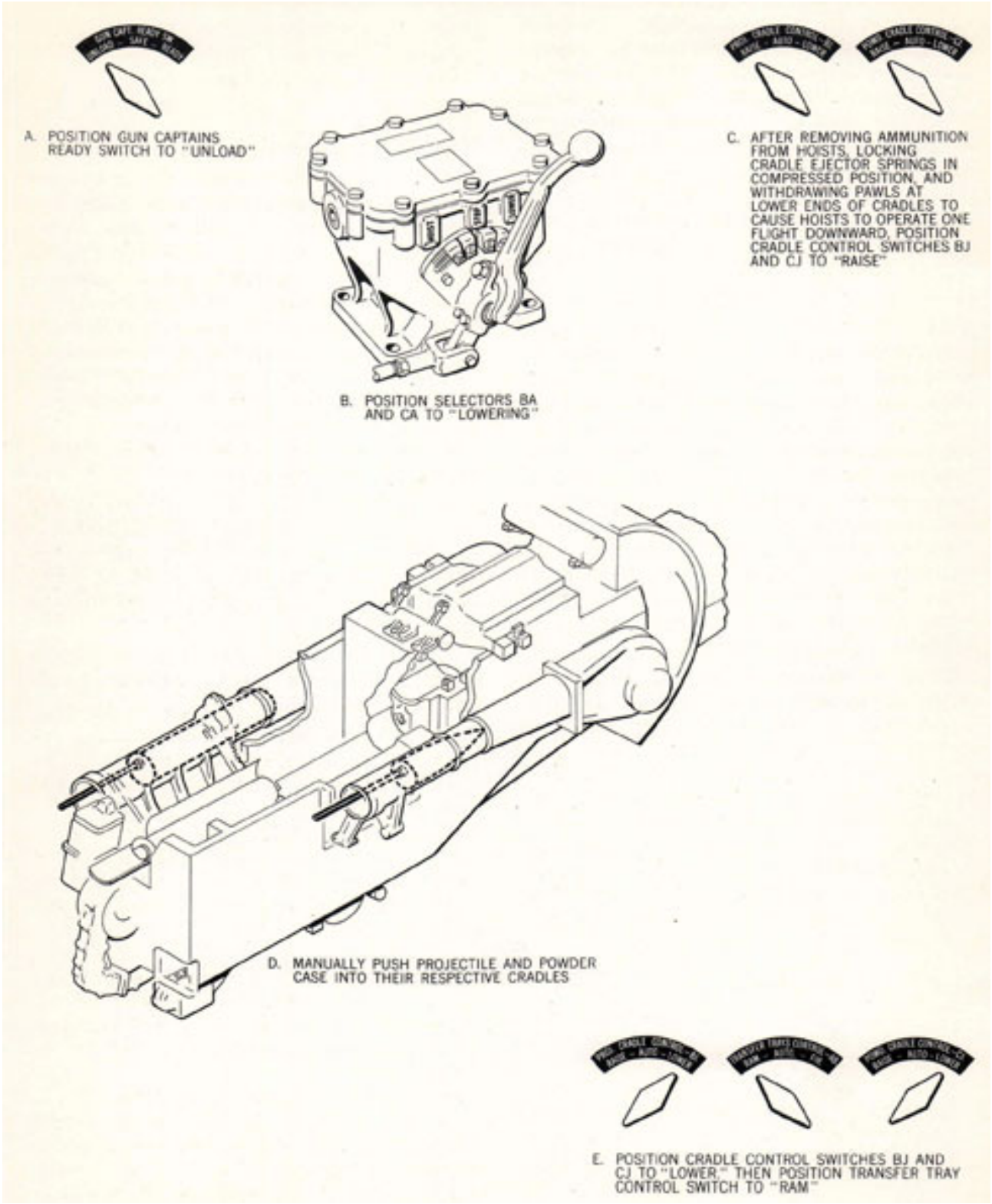


*Figure 103. Gun Control System. Operation. "Cease Fire" Operation to Return Ammunition to Hoist*

Certain of these operations however are deferred when the "Cease fire" order is received, in order to unload the guns and hoists, to condition units for stowing, or to move them to securing positions. Unloading operations are described in the next paragraph.

**Hoist unloading operations**. The power drives of the hoists must be in operation in order to unload the gun and move ammunition from the slide to the projectile and powder handling levels. Control positions and transfer operations for this normal method of unloading are indicated in figure 103. The operations are:

At "Cease fire" the gun captain moves his ready switch to UNLOAD, sets switch AB at FIRE, and releases switch AM to permit it to return to RETRACT position. These actions stop automatic gun operation in preparation for unloading and stowing activities.

Ammunition handlers at the lower ends of the hoist are instructed via telephone to remove units at the bottom. The gun captain's assistants set the hoist function control selectors at LOWER and operate the cradle ram retractor cranks to relieve the ram spring loads.

Ammunition units in the transfer trays are manually thrust into the cradles, and the gun captain places switches BJ and CJ at LOWER. Transfer tray control switch AB is turned to RAM momentarily and is then returned to AUTO. This unlatches and drops the loaded cradles to the hoist conveyors. The gun captain's assistants rotate the two cradle pawl retractor handles, and the hoists automatically operate one reverse cycle, unloading the cradle. Each hoist continues to operate in reverse, as rapidly as it is unloaded at the lower end, until it is empty.

**Conditioning for stowing**

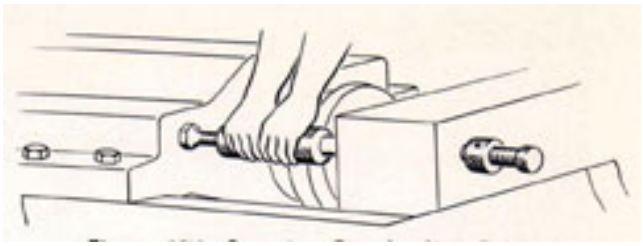

*Figure 104. Securing Gun Locking Device*

lights, light-well illumination, and other battle illumination, replacing all defective lamps.

**Cable check**. Cable loops of the firing circuit, free-hanging cables of the control circuits at the three power tubes, and all other wiring exposed to chafing and twisting action must be examined for kinks, insulation break, or other defect.

**Emptying the case ejector**. In preparation for stowing the gun and before securing the slide, all empty cases in the case ejector must be removed. This is essential in order to prevent corrosion from salt water trapped in empty cases. The operation is performed with the gun depressed, by using the manual ram accessory described on page 120 and shown in use in figure 101.

**Securing**

The principal securing operations are illustrated in the paragraphs following. The descriptions indicate the design plan as to the stowed positions of guns, slides, cradles, and other parts.

**Securing the guns**. Each gun is secured after completion of cleaning, bore gage tests, and preservation treatment as follows:

The tompion or muzzle cover is installed. The breech is closed. The gun locking device is connected as shown in figure 104, with the screw fully seated in the safety link and with the locknut firmly clamping the secured screw.

Preparations for stowing the equipment consist of cleaning and inspecting all assemblies, performing "After Operation" lubrication to fill voids of deck lug and other bearings as prescribed by the lubrication charts, and servicing counterrecoil and accumulator bottles and hydraulic system tanks to replenish depleted air and fluid volumes.

Lamp replacements. The inspection work must include complete check-off of all ready-

The gas ejector supply cut-off valve is closed.

Breech manual operating devices are unclutched.

Switch controls of the gun captain's control panel are secured with the control supply switches at OFF, the cradle controls at LOWER, the transfer tray control at FIRE, the breech control at CLOSE, the ready switch at SAFE, the emergency firing control at OFF, and the fuze setting control at OFF.



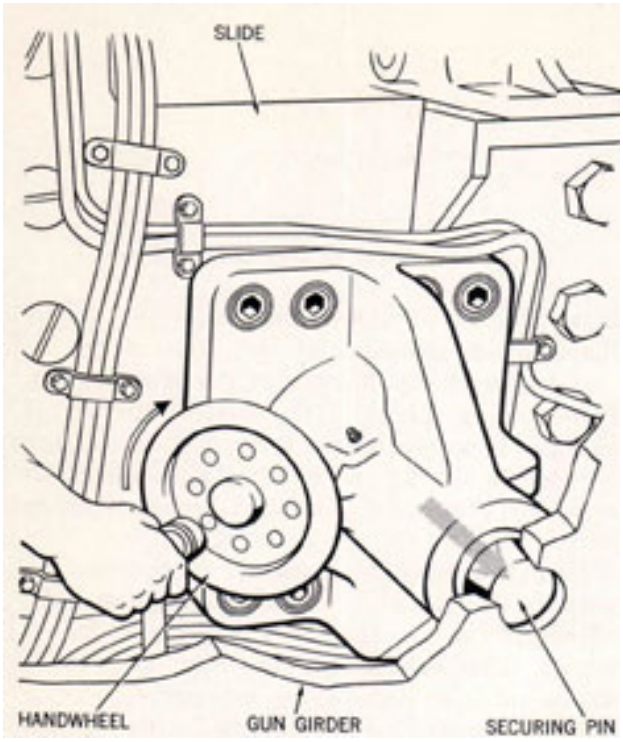


*Figure 105. Securing Slide Securing Device*

**Securing the slides**. Slides are secured as follows: Each elevating drive is separately operated in HAND control until the securing pin aligns with the seat in the gun girder; that is, at the zero degree elevation position. The pin is firmly seated as shown in figure 105, after the steady rest pin on the opposite side is run-out to bear against the opposing girder.

Valve T of each accumulator system is firmly seated; the bypass of the control valve block is opened.

Powder and projectile transfer trays are stored in firing position with the operating cylinder latches set to block tray movement to ramming position. The latter is a prudent stowing position that eliminates accidental operation while personnel may be working in the slide; a movement that is possible when power is off but accumulator pressure is available. It can never occur with valve T closed and the bypass open; the tray latch position, however, is an additional safety precaution that the crew should observe.

When the case ejector has been emptied, as previously prescribed, the tube cover must be secured as illustrated in figure 106.

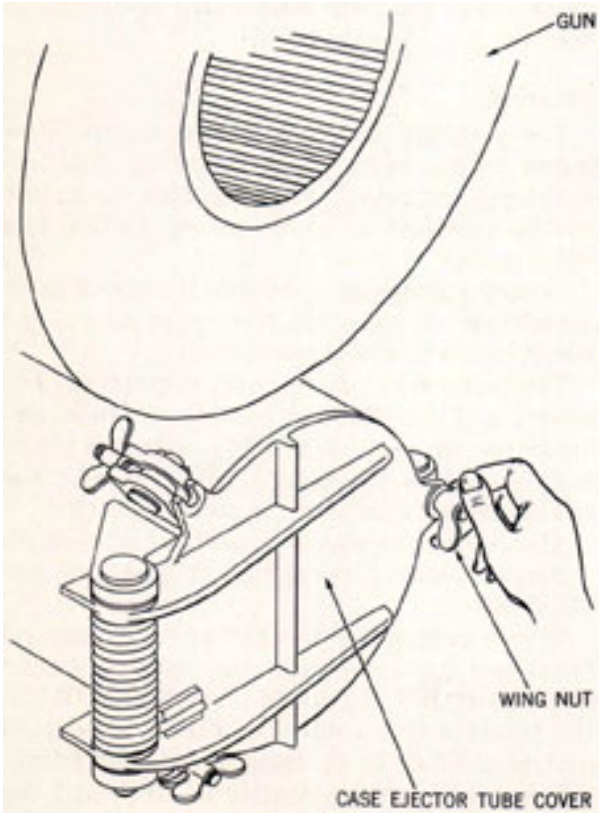


*Figure 106. Securing Case Ejector Tube Cover*

**Securing the hoists**. Each ammunition hoist must be stowed empty. At conclusion of cleaning, lubrication, and preservation work, it should be secured with the cradle latched to the conveyor and with the function control selector at STOP.

**Securing the elevating gear**. The elevating gear is locked against backlash action and seaway stress when the slide securing and steady pins are in secured position. Controls are secured when the control selector switches, figure 86, are placed at HAND, and the three ready light switches at OUT; these positions are secured before stopping the three power drives.

**Securing the training gear**. The training gear is secured by operating the drive in HAND control, slowly, until the two centering pins, figure 107, register with their barbette seats. Both pins must be run-out until each is tight. This operation is essential in order to prevent seaway stress in the roller carriage, "brinnelling" in the roller tracks, and backlash chatter in the pinion and training circle.

Train controls are secured with the Teleflex

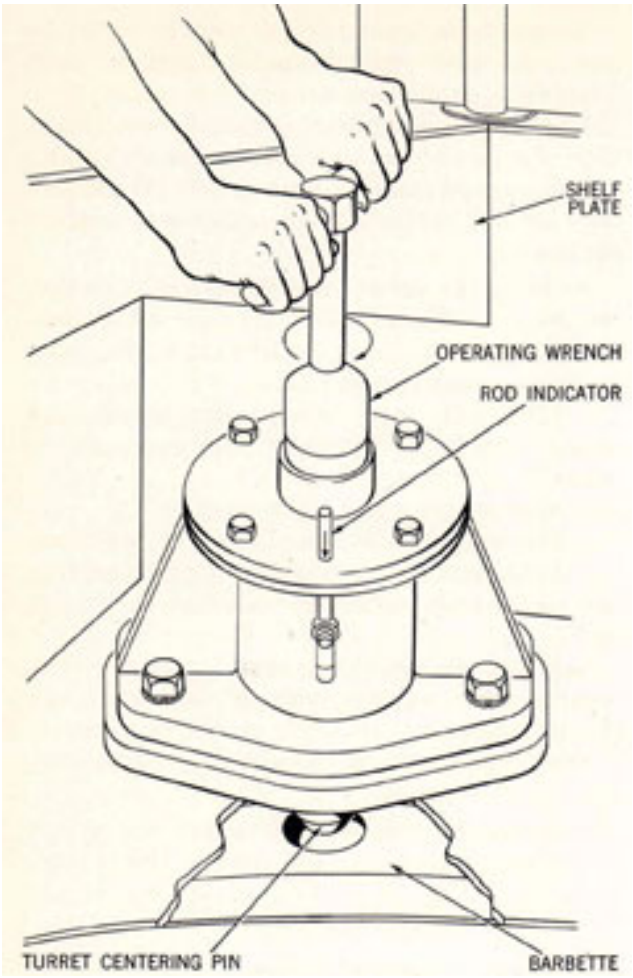


*Figure 107. Securing Turret Centering Pin*

control selector lever at HAND when stopping the power drive.

**Securing the projectile rings**. The four projectile rings are secured by operating each ring from its "Cease fire" position in repetitive power drive cycles until the centering pins and sockets register. Each din is seated as shown in figure 108. It is important that both pins of each ring be seated wedge-tight; holding-down clips should be checked as to tightness and design clearance. If the rings are secured in this manner, there will be no appreciable vibration or pounding when the ship is running at full speed.

All projectile lashings are inspected to verify secured position of each toggle link; lashings of expended ammunition should be tied to the coaming if the turret is not being served

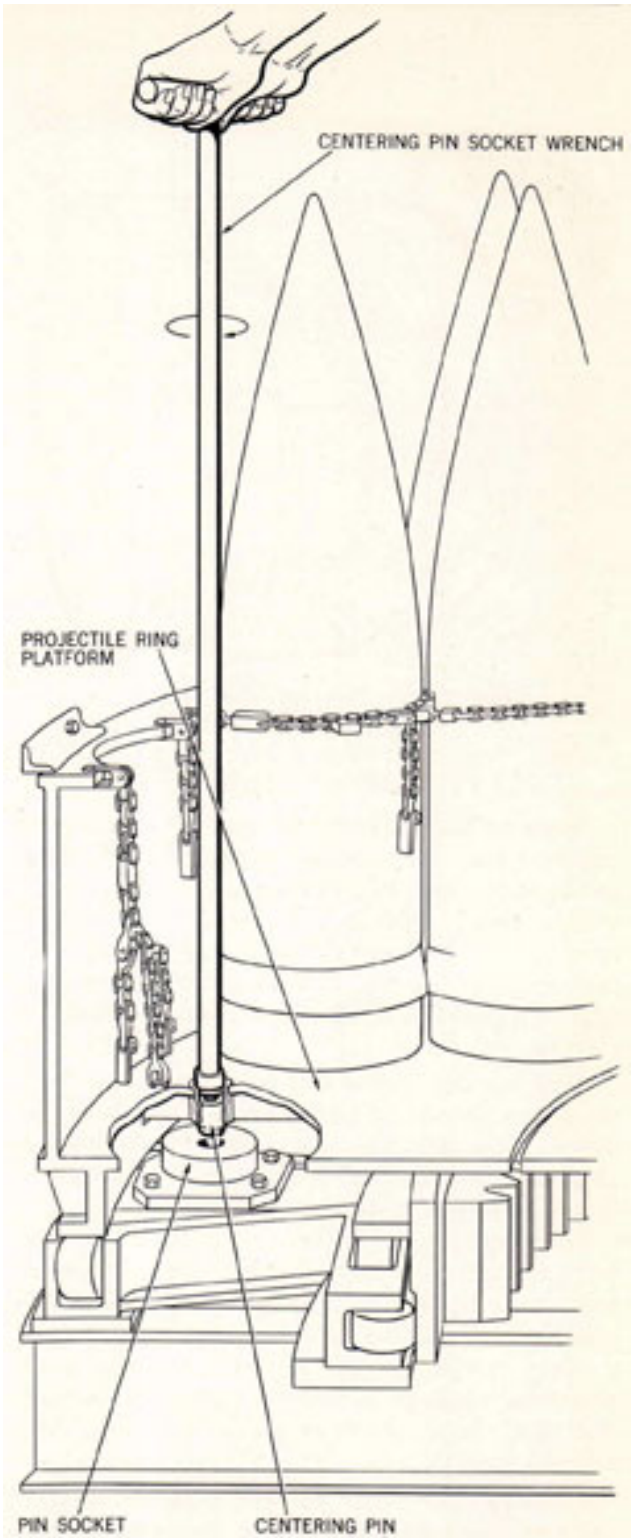


*Figure 108. Securing Projectile Ring Centering Pin*

immediately with fresh supply.



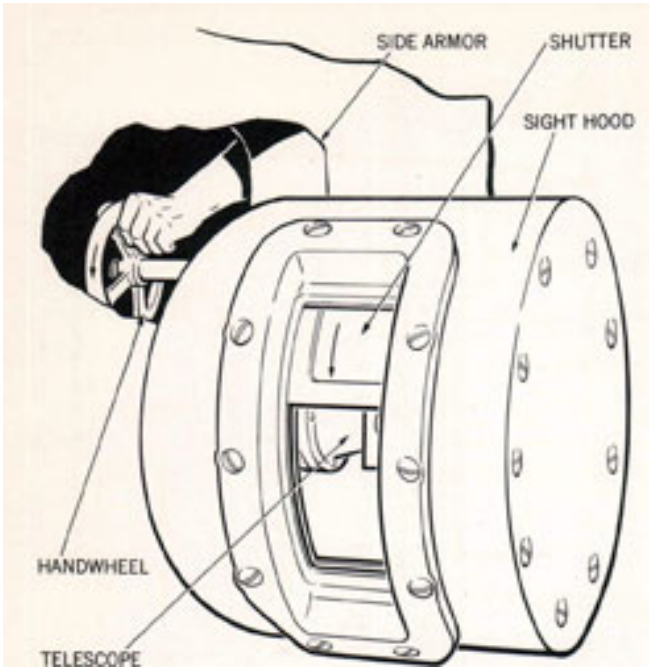


*Figure 109. Securing Sight Hood*

Each projectile ring control handwheel is secured at STOP detent position.

**Securing the parbuckling gear**. The two parbuckling gear assemblies are stopped, and ropes and steady arms are stowed as follows: Each steady arm is folded, and a snap hook on the base casting is snapped into a ring provided at the rope attachment. In this position the steady arm is against its stops and cannot swing or vibrate.

**Securing the sights and periscopes**. The turret optics should be positioned with offsets removed when securing; sight setter handcranks at 2,000 minutes sight angle, 500-mil deflection; periscopes at zero azimuth.

Each periscope is secured by seating the azimuth movement plunger and releasing the cover from its open position, swinging it to its closed position and running the wing nut tight.

The antenna train selector switch should be positioned with signal transmission to both train drive regulators cut out.

The train transmitter should be positioned with the train dial and handcrank indicating turret secured position, zero or 180° train, and the rate dial and crank indicating zero degrees per second.

**Securing the turret officer's controls**. The turret officer's transfer switches, selective switch, stop control, and firing switches are positioned as follows when securing:

SELECTIVE SWITCH: pointer knob and pointer handle at OFF and with the stop secured.

STOP CONTROL: at RUN position.

FIRING SWITCHES: at CUT-OFF positions.

TRANSFER SWITCHBOARD: all gun elevating and turret train signal transmission circuits at OFF.

**Securing the sprinkling system**. Air pressure control valves at the right and left tanks are closed; system air pressure should be relieved.

The firemain cut-off valve in the powder handling room is closed.

**Securing the ventilating system**. Exhaust and intake ports are secured at open or closed positions, according to weather conditions, at the direction of the turret officer.

**STOWING AMMUNITION**

Sight telescopes are secured, after wiping objective windows with lens paper, by closing the sight hood shutters as indicated in figure 109.

**Securing the radar controls**. Radar control units are secured according to the instructions of OP 1155.

The sight setter's antenna control switch is positioned at OFF.

Ship and turret design arrangements permit alternative methods of routing powder and projectiles to stowed positions. One method is similar to the conventional operation of earlier ships. It strikes each unit from the main deck to the magazine level. This is described in the text below as the "hatchway route."

The other method is much faster. It utilizes the turret ammunition hoists and is described as the "hoist route."

**Ammunition stowage *via* hatchway route**. Both powder and projectiles are handled by the same whip hoist strikes when stowing by way of the hatchway route. Ship and turret arrangements when stowing projectiles are illustrated in figure 110; powder is handled with the same rig to the bottom of the strike and thence via trolley into the magazines.

This arrangement consists of a hatchway strike outside the turret from the main deck



to the magazine level, a conveyor arrangement through the turret foundation bulkhead to the powder handling room, and a hatchway strike in the turret from the powder handling room to both projectile flats. Equipment arrangements for the route are two whip hoists and the magazine level conveyor installation. The hoist for the main deck strike is suspended above the hatchway, either by portable davit or from the boom equipment that is provided for handling the ship's paravanes. The hoist for lifting projectiles from the powder handling room floor to the projectile flats is located at the rear of the upper projectile flat. It is permanently mounted on a bracket under the pan floor structure, so that its hook is centered over the hatchway. This hoist is an electric whip hoist with automatic limit switch and brake stop control. The stop control may be set for

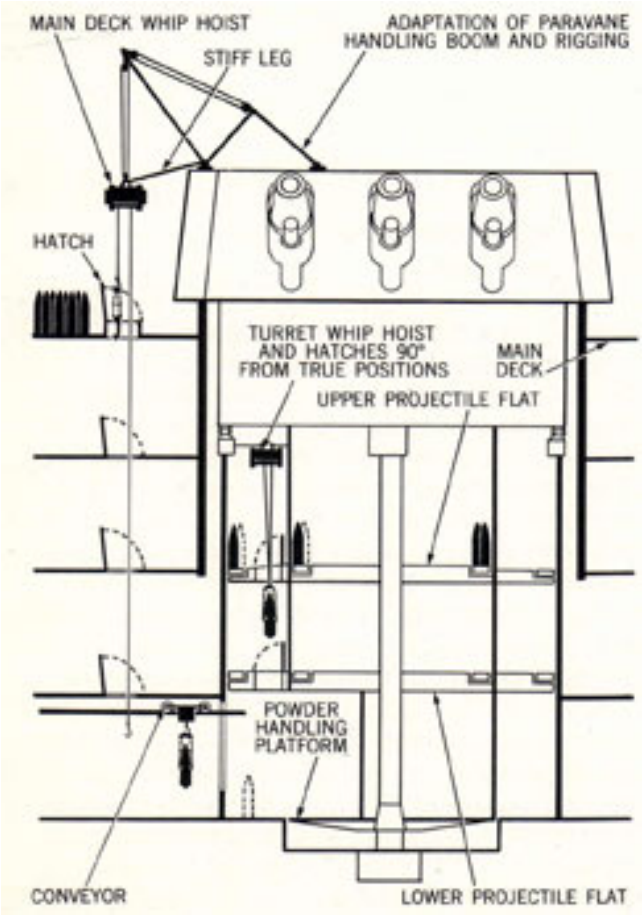


*Figure 110. Striking Down Ammunition Via the Hatchway Route*

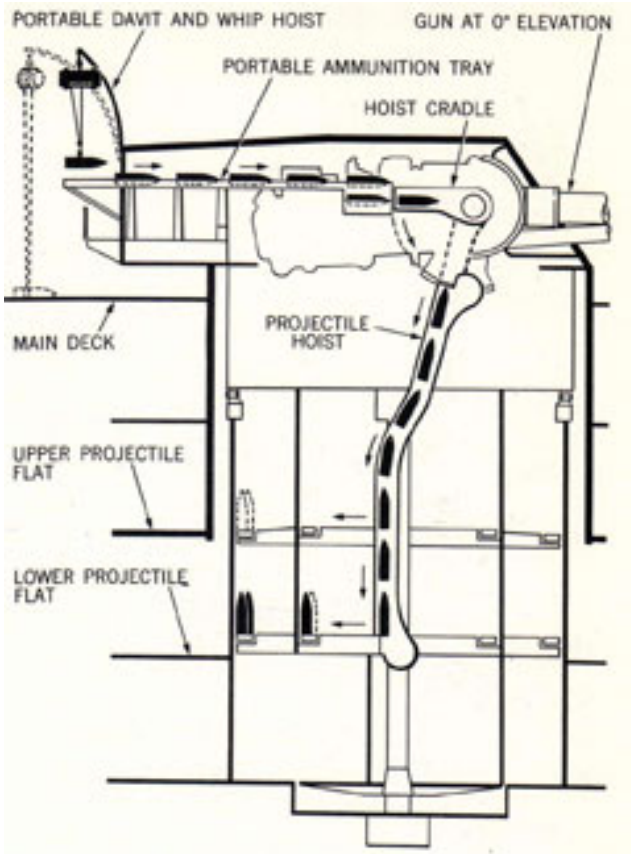


*Figure 111. Striking Down Ammunition Via Portable Ammunition Trays and the Ammunition Hoist Route*

automatic stop at either projectile flat, as well as at the powder handling room hook loading position. Starting control for lowering and lifting the hook is an electric switch push-button station located on the circular bulkhead of the upper projectile flat near the hatch.

The conveyor for moving projectiles from the foot of the main deck strike into the powder handling room is an overhead trolley with rails mounted in the fixed structure and curving around the powder handling room to serve all scuttles and to carry projectiles beneath the turret hatchway and whip hoist.

Projectiles are handled by means of a projectile holding yoke and base stirrup with wire rope sling and becket. When the projectile is delivered to the handling platform at the side of the hatch on the turret projectile flat, this yoke carrier is removed,

and projectiles are man-handled to stowage positions on the respective rings.



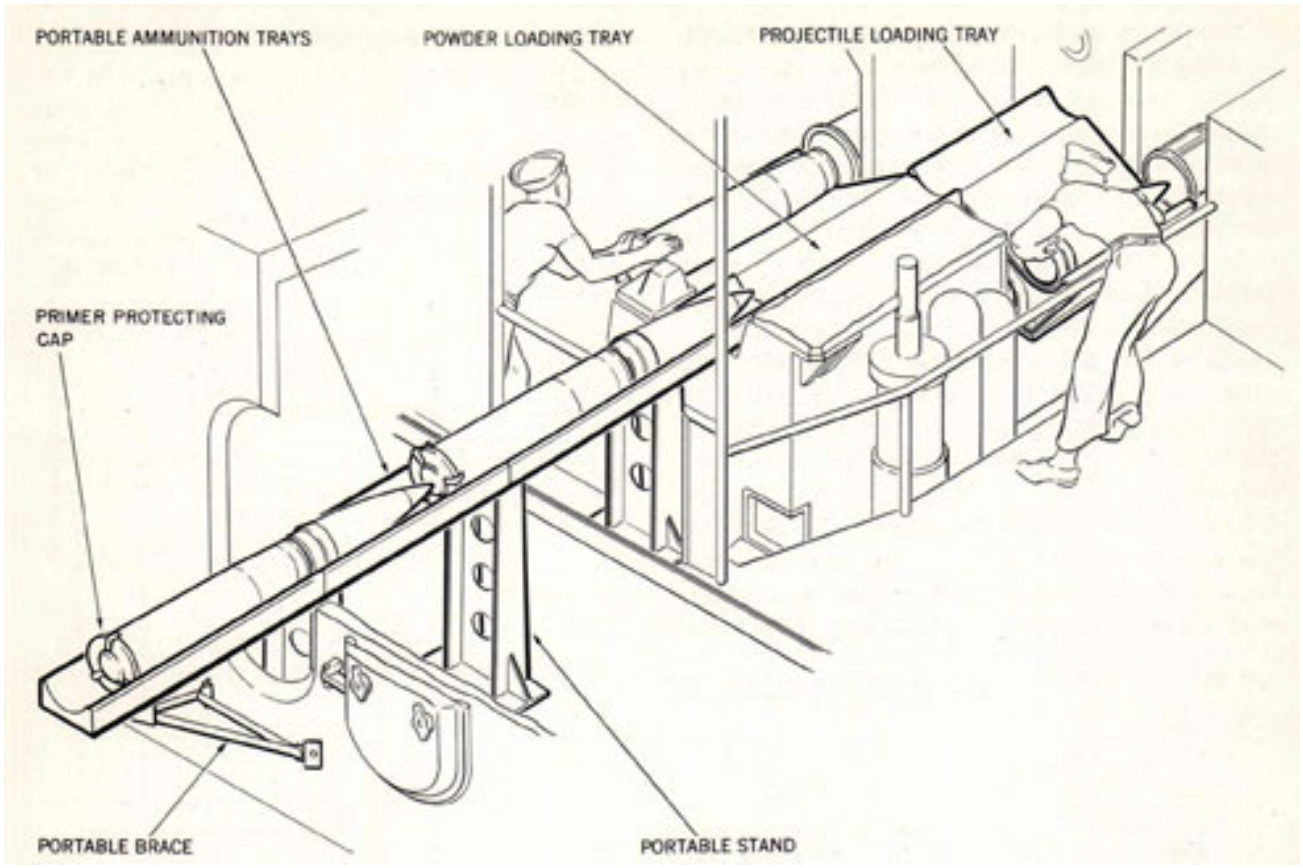


*Figure 112. Use of Portable Ammunition Trays in Stowing Ammunition Via the Hoist Route*

**Stowage handling via the hoist route**

Turret arrangement for transferring projectiles and powder from the main deck to the projectile flats and magazines by the hoist route is shown in figure 111. In this plan three, portable davit and whip assemblies are mounted on the turret roof at the rear plate, and the three access doors in the rear plate are opened and fitted with the following rigs.

Three special tray accessories are installed for sliding ammunition units through the rear plate across the turret officer's booth and onto the slides. Each is installed as shown in figure 112. These trays are large portable structures of steel

It has two wing tray elements that extend to the right and left positions of the transfer trays when they are in the firing position. These wing trays align with the respective hoist cradles when the cradles are latched to the slide. The arrangement permits manual sliding of powder cases and projectiles in a continuous flow onto the gun slides and then rolling them to their respective wing tray positions.

When the portable tray is set up and manned, the power drive of each hoist is started and controls are set as follows: Each function control selector is set at LOWER; the cradle ram is retracted and each cradle pawl retractor handle is manned by one of the attendants for manual manipulation when the loaded cradle is lowered to the conveyor. The cradle action

plate, each of which provides a continuous tray surface from a point at the rear of the turret rear plate to the rear face of a gun housing. This tray is supported on the slide on top of the powder and projectile transfer trays when those trays are in ramming position.

is controlled by the gun captain; he operates the two cradle control switches of his panel, alternately shifting them from RAISE to LOWER to RAISE.

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The route operates to transfer ammunition semiautomatically down the hoist, the cycles repeating as rapidly as attendants in the handling flats unload the respective hoists. Each cycle is under control of the gun captain who observes completion of manual cradle loading in the gun house and by visual indications of his control panel checks as to completion of automatic cradle unloading and manual conveyor unloading.

At the powder and projectile flats, ammunition units are manually removed from the hoists; the parbuckling gear is not used, but the powder hoist scuttle automatically unloads the power conveyor. Cases are then manually removed from the shuttle.

If the projectiles are to be unloaded at the upper loading level, the landing pawls in the base of the upper loading level are left in their normal position. If the unloading is to be done at the lower loading level, the pawls must be manually retracted to provide clearance for the projectiles to pass. Pawls are retracted by means of a retracting handle stowed on the side of the hoist.

Each projectile, when it is man-handled onto the projectile ring, is lashed to the coaming with its chain toggle device.

Each powder case is trucked across the handling room and passed through the foundation bulkhead scuttles to the magazines.

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# Appendix I

## GENERAL DATA

| | |
|---|---|
| **Ship data** | |
| Displacement (standard), tons | 17,000 |
| Length, feet | 716.5 |
| Beam, feet | 76.5 |
| Amplitude of roll, degrees | 15 |
| Period of roll, seconds | 13 |
| Amplitude of pitch, degrees | 5 |
| Period of pitch, seconds | 6.5 |
| **Main battery positions** | |
| Turret I | |
| From bow,* feet | 157.5 |
| Above waterline,** feet and inches | 27-9 |
| Turret II | |
| From bow,* feet | 205.5 |
| Above waterline,** feet and inches | 36-2 |
| Turret III | |
| From bow,* feet | 538.5 |
| Above waterline,** feet and inches | 28-9 |

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* Vertical axis from forward perpendicular at 24-foot waterline
** Trunnion axis above 24-foot waterline

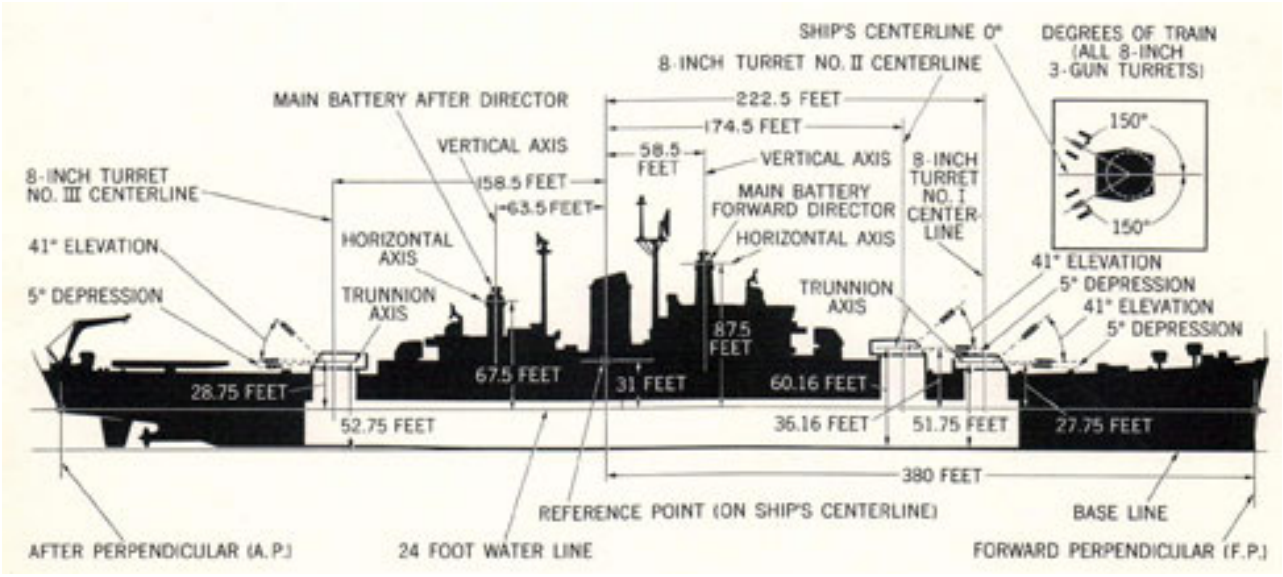


*Figure 113. USS SALEM Class. Main Battery Positions and Fire Control Data*

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**Main battery director positions**

| | |
|---|---|
| For'd director | |
| From bow,* feet | 321.5 |
| Above waterline,** feet and inches | 87-5 1/2 |
| Aft director | |
| From bow,* feet | 443.5 |
| Above waterline,** feet and inches | 67-10 1/2 |
| Reference point | |
| From bow, feet | 380 |
| Above waterline, feet | 31 |

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* Vertical axis from forward perpendicular at 24-foot waterline
** Director line-of-sight

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## Appendix 2

## ORDNANCE DATA

**Internal ballistics**

| | |
|---|---|
| Length of gun, inches | 440.10 |
| Bore, inches | 8.0 |
| Bore length, inches | 379.23 |
| Projectile travel, inches | 388.69 |
| Chamber length, inches | 61.12 |
| Chamber volume, cubic inches | 3367.0 |
| Maximum powder pressure, long tons per square inch | 19 |
| Number of grooves | 64 |
| Length of grooves, inches | 383.49 |
| Depth of grooves, inches | 0.07 |
| Twist | Right-hand, uniform, one turn in 25 calibers |

**External ballistics**

| | |
|---|---|
| Muzzle velocity, A.P. Projectile (service charge), feet per second | 2,500 |
| Muzzle velocity, H.C. Projectile (service charge), feet per second | 2,700 |
| Range, A.P. Projectile (service charge), gun at 41° elevation, yards | 30,000 |
| Range, H.C. Projectile (service charge), gun at 41° elevation, yards | 29,800 |

**Range tables**

| | |
|---|---|
| Armor-piercing 8-inch projectile | OP 807 |
| High-capacity 8-inch projectile | OP 1041 |

**Weights, pounds, each turret**

| | |
|---|---|
| Turret roller path load | 1,167,500 |
| Total ordnance installation | 469,000 |
| Indicator-regulator, each | 1,000 |
| Training gear: | |
| Main electric motor | 2,850 |
| Reduction gear and pump assembly | 1,600 |
| A-end | 5,000 |
| Right B-end with response | 1,850 |
| Left B-end | 1,600 |
| Receiver-regulator | 900 |
| Training worm and pinion assembly | 17,625 |
| Projectile rings, upper or lower: | |
| Inner | 4,600 |
| Outer | 7,750 |
| Electric motor, each | 550 |
| Gear reducer, each | 4,675 |
| A-end, each | 1,000 |
| B-end, each | 600 |
| Projectile hoists, each: | |
| Conveyor assembly, complete | 6,615 |
| Cradle, with fuze setter | 1,000 |
| A-end and electric motor | 1,542 |
| B-end and control unit | 572 |
| Powder hoists, each: | |
| Scuttle | 3,600 |
| Conveyor assembly, complete | 9,320 |
| Cradle | 1,300 |
| A-end and electric motor | 1,435 |
| B-end and control unit | 572 |

**Train limits, all turrets**

| | |
|---|---|
| Right train, degrees | 150 |
| Left train, degrees | 150 |

**Elevating limits, each gun**

| | |
|---|---|
| Elevation, degrees | 41 |
| Depression, degrees | 5 |

**Firing data**

| | |
|---|---|
| Total projectile allowance | 132,100 |
| Turret structure | 541,500 |
| Gun assemblies, right, center, left, each: | |
| Gun | 37,370 |
| Housing | 13,300 |
| Slides, right, center left, each | 58,000 |
| Rammer, each | 2,085 |
| Elevating gear, right, center and left: | |
| Main electric motor, each | 1,600 |
| Speed reducer, each | 3,000 |
| A-end, each | 1,300 |
| B-end, each | 675 |

| | |
|---|---|
| Rate of fire, rounds per minute | 10 |
| Rate ammunition service, seconds | 6 |
| **Ammunition data** | |
| Armor-piercing projectile, 8-inch: | |
| Designation | Mk 21 Mod 0 |



| **Ammunition data (continued)** | |
|---|---|
| Weight, pounds | 335 |
| Length, inches | 36 |
| Radius of ogive, inches | 83 |
| High-capacity projectile, 8-inch: | |
| Designation | Mk 24 Mod 0 |
| Weight, pounds | 260 |
| Length, inches | 34.56 |
| Radius of ogive, inches | 83 |
| Mechanical Time Fuze | Mk 57 Mod 0 |
| Powder case, 8-inch: | |
| Designation | Mk 1 Mod 0 |
| Weight of powder charge, pounds | 78 |
| Complete weight, pounds | 140 |
| Volume powder space, cubic inches | 3,281 |
| Powder case, 8-inch, short case: | |
| Designation | Mk 2 Mod 0 |

| | |
|---|---|
| Distance of recoil, maximum, inches | 29 |
| Gun oscillating weight, pounds | 115,500 |
| Gun recoiling weight, pounds | 52,100 |
| Gun laying speeds: | |
| Maximum training gear rate, degrees per second | 5 |
| Maximum elevating gear rate, degrees per second | 8.2 |
| Gun firing order | C, L, R |
| Firing delay period, second | 0.06 |
| Firing load, trunnion pressure, gun at 41° elevation, pounds, each gun | 308,000 |
| Gun brake load, pounds | 215,000 |
| Recoil system pressures, maximum: | |
| Recoil brake pressure (0° service charge), p.s.i. | 1,300 |
| Recoil cylinder pressure (0° proof charge), p.s.i. | 1,700 |
| Counterrecoil buffing pressure, p.s.i. | 6,000 |
| Counterrecoil system pressure, maximum: | |

| | |
|---|---|
| Weight of powder charge, pounds | 44 |
| Complete weight, pounds | 92 |
| **Projectile stowage** | |
| Outer projectile stowage ring, each flat | 150 |
| Inner projectile stowage ring, each flat | 74 |
| Fixed stowage for inner rings, each flat | 1 |
| Drill projectile fixed stowage for inner ring, lower flat | 3 |
| Drill projectile fixed stowage for inner ring, upper flat | 2 |
| Drill projectile fixed stowage for outer rings, upper and lower flats, each | 5 |
| **Gun data** | |
| Internal ballistics | See page 133. |
| Center of gravity, from breech, inches | 157.65 |
| Center of gravity of oscillating weight: | |
| To rear of trunnion, inches | 1.25 |
| Below centerline of gun, inches | 0.385 |
| Radius of gyration of oscillating weight, feet | 9 |
| Center of gravity of recoiling weight, assembled in slide: | |
| Before trunnion, inches | 64.92 |
| Above centerline of gun, inches | 0.06 |
| Distance of recoil, design length, inches | 28 |
| Counterrecoil pneumatic pressure, p.s.i. | 1,985 |
| Counterrecoil liquid pressure, p.s.i. | 2,340 |
| Recoil and counterrecoil period, slide at 5° elevation, seconds | 0.8 |
| Gun spacing, centerline of center gun to centerline right and left guns, inches | 85 |
| Lines-of-sight data: | |
| Lateral spacing, trainer-to-pointer telescope objective lens, feet | 30 |
| Sight angle movement, degrees | 46 |
| Deflection movement (left), mils | 90 |
| Deflection movement (right), mils | 110 |
| **Hydraulic fluid data** | |
| Quantity, gallons per turret | 964 |
| Slide power equipment, each, gallons | 110 |
| Training gear, gallons | 194* |
| Elevating gear, each, gallons | 40 |
| Projectile hoist, each, gallons | 25 |
| Powder hoist, each, gallons | 25 |
| Projectile rings: | |
| Inner, each, gallons | 40 |
| Outer, each, gallons | 45 |

* Estimated

# Appendix 3

## INDEX OF ASSEMBLIES

### 8-INCH TURRET ASSEMBLY NO. 232
### Turret I- USS Salem

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | |
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR - REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER - REGULATOR | - | 25.0 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER - REGULATOR | 1.1 | 1.1 | 1.1 |

| | | | |
|---|---|---|---|
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20.5 | - | 20.5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132182, 138253.

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**8-INCH TURRET ASSEMBLY NO. 233**
**Turret II- USS Salem**

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.0 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT - | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |

| | | | |
|---|---|---|---|
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.1 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132183, 138253.

## 8-INCH TURRET ASSEMBLY NO. 234
## Turret III- USS Salem

| ORDNANCE ASSEMBLY | MARK AND MOD | | | |
|---|---|---|---|---|
| | RIGHT | CENTER | LEFT | |
| GUN | | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 | |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 | |
| SLIDE | 20.0 | 20.0 | 20.1 | |
| RAMMER | 18.0 | 18.0 | 18.1 | |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 | |
| DECK LUG | 18.0 | 18.1* | 18.0 | |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 | |
| TRAINING GEAR | - | 22.0 | - | |
| PROJECTILE RING | - | 1.0** | - | |
| PARBUCKLING GEAR | - | 1.0*** | - | |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 | |
| POWDER HOIST | 36.0 | 36.0 | 36.1 | |
| SIGHT | - | 32.0 | - | |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 | |
| TRAINING GUN ATTACHMENT | - | 7.0 | - | |
| FUZE SETTER | 20.0 | 20.0 | 20.0 | |
| FIRING CIRCUIT | - | 8.0 | - | |
| LIGHTING CIRCUIT | - | 8.0 | - | |
| FIRE CONTROL EQUIPMENT: | | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 | |
| TRAIN RECEIVER REGULATOR | - | 25.2 | - | |
| GUN ELEVATION INDICATOR | - | - | 45.0 | |
| GUN TRAIN INDICATOR | 25.7 | - | - | |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 | |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - | |
| RADAR EQUIPMENT | 27.0 | - | 27.0 | |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 | |
| COMPUTER | - | 3.9 | - | |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.9 | - | |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 | |

| | | | |
|---|---|---|---|
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | - | -5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132184, 138253.

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**8-INCH TURRET ASSEMBLY NO. 244**
**Turret I- USS Des Moines**

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1 0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |

| | | | |
|---|---|---|---|
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR - REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER - REGULATOR | - | 25.0 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER- REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20.5 | - | 20.5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132196. 138253.

## 8-INCH TURRET ASSEMBLY NO. 245
### Turret II- USS Des Moines

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.1 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |

| | | | |
|---|---|---|---|
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132197. 138253.

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**8-INCH TURRET ASSEMBLY NO. 246**
**Turret III- USS Des Moines**

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |

| | | | |
|---|---|---|---|
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.2 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.9 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | | -5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 132198, 138253.

## 8-INCH TURRET ASSEMBLY NO. 250
### Turret I- USS Newport News

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.0 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |

| | | | |
|---|---|---|---|
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20.5 | - | 20.5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 116888, 138253.

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**8-INCH TURRET ASSEMBLY NO. 251**
**Turret II- USS Newport News**

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |

| | | | |
|---|---|---|---|
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.1 | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.7 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.1 | -6 | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 166889, 138253.

## 8-INCH TURRET ASSEMBLY NO. 252
### Turret III- USS Newport News

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | 25.2 | - | |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.9 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |

| | | | |
|---|---|---|---|
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 166890, 138253.

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**8-INCH TURRET ASSEMBLY NO. 258**
**Turret III- USS Mississippi**

| ORDNANCE ASSEMBLY | MARK AND MOD | | |
|---|---|---|---|
| | RIGHT | CENTER | LEFT |
| GUN | 16.0 | 16.0 | 16.0 |
| HOUSING | 1.0 | 1.0 | 1.1 |
| GAS EJECTOR | 16.0 | 16.0 | 16.1 |
| SLIDE | 20.0 | 20.0 | 20.1 |
| RAMMER | 18.0 | 18.0 | 18.1 |
| CASE EJECTOR | 1.0 | 1.0 | 1.1 |
| DECK LUG | 18.0 | 18.1* | 18.0 |
| ELEVATING GEAR | 23.0 | 23.1 | 23.2 |
| TRAINING GEAR | - | 22.0 | - |
| PROJECTILE RING | - | 1.0** | - |
| PARBUCKLING GEAR | - | 1.0*** | - |
| PROJECTILE HOIST | 31.0 | 31.1 | 31.2 |
| POWDER HOIST | 36.0 | 36.0 | 36.1 |
| SIGHT | - | 32.0 | - |
| ELEVATION GUN ATTACHMENT | 7.0 | 7.1 | 7.2 |
| TRAINING GUN ATTACHMENT | - | 7.0 | - |

| | | | |
|---|---|---|---|
| FUZE SETTER | 20.0 | 20.0 | 20.0 |
| FIRING CIRCUIT | - | 8.0 | - |
| LIGHTING CIRCUIT | - | 8.0 | - |
| FIRE CONTROL EQUIPMENT: | | | |
| GUN ELEVATION INDICATOR-REGULATOR | 47.0 | 47.0 | 47.0 |
| TRAIN RECEIVER-REGULATOR | - | 25.0# | - |
| GUN ELEVATION INDICATOR | - | - | 45.0 |
| GUN TRAIN INDICATOR | 25.7 | - | - |
| GUN ELEVATION ORDER TRANSMITTER | - | - | 4.0 |
| TURRET TRAIN ORDER TRANSMITTER | - | 14.1 | - |
| RADAR EQUIPMENT | 27.0 | - | 27.0 |
| ANTENNA TRAIN DRIVE | 5.0 | - | 5.0 |
| COMPUTER | - | 3.9 | - |
| MULTIPLE TURRET TRAIN INDICATOR | - | 12.9 | - |
| FUZE SETTING RECEIVER-REGULATOR | 1.1 | 1.1 | 1.1 |
| SIGHT SETTER'S INDICATOR | 8.0 | - | - |
| TELESCOPE, CHECKER'S | - | - | 53.1 |
| TELESCOPE, POINTER'S | - | - | 98.0 |
| TELESCOPE, TRAINER'S | 99.0 | - | - |
| PERISCOPE | 20-5 | - | 20-5 |
| PERISCOPE MOUNT | 5.16 | - | 5.16 |

* TWO ASSEMBLIES.
** ONE ASSEMBLY COMPRISES FOUR SEPARATE DRIVES, ONE EACH FOR INNER AND OUTER RINGS OF EACH FLAT.
*** ONE ASSEMBLY COMPRISES TWO SEPARATE PARBUCKLING GEARS, ONE EACH ON EACH FLAT.
#CHANGE GEARS AND MOD NOT ESTABLISHED AT DATE OF PUBLICATION.

NOTE: THIS INDEX DERIVED FROM SKETCH NOS. 168636, 138253.



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## Appendix 4

## SAFETY PRECAUTIONS

**Foreword**

The statements and data of this appended section of Ordnance Pamphlet 1180 are warnings and safety measures for operation of the turret.

The compilation is a recapitulation of the operating precautions of all chapters of the six volumes of the pamphlet, together with extracts from U.S. Navy Regulations.

This precautionary material is of first importance to the turret organization; every member of the crew should be thoroughly conversant with every warning and the significance or reason for each.

**U.S. NAVY REGULATIONS, EXTRACTS**

**From Article 972**

1. As familiarity with any work, no matter how dangerous, is apt to lead to carelessness, all persons who may supervise or perform work in connection with the inspection, care, preparation, or handling of ammunition-

(1) Shall exercise the utmost care that all regulations and instructions are rigidly observed.

(2) Shall carefully supervise those under them and frequently warn them of the necessity of using the utmost precaution in the performance of their work. No relaxation of vigilance shall ever be permitted.

2. In each part of the ship where ammunition is stored or handled or where gunnery appliances are operated, such safety orders as apply shall be posted in conspicuous places easy of access, and the personnel concerned shall be frequently and thoroughly instructed and drilled in them.

Nothing in these safety orders shall be construed as authorizing firing under such conditions.

4. The commanding officer shall at any time issue such additional safety orders as he may deem necessary, and a report thereof shall be made to his immediate superior and to the Bureau of Ordnance.

5. When in doubt as to the exact meaning of any safety order, an interpretation should be requested from the Bureau of Ordnance.

6. The Bureau of Ordnance shall be informed of any circumstances which conflict with these safety orders or which for any other reason require changes in or additions to them.

7. Helpful suggestions and constructive criticism of these orders are invited. They should be made to the Bureau of Ordnance through official channels.

8. Changes, modifications in, or additions to ordnance material, or other material used in connection therewith, shall not be made without explicit authority from the bureaus concerned.

9. Safety devices provided shall always be used to prevent possibility of accident, and shall be kept in good order and operative at all times.

10. No ammunition shall be used in any gun for which it is not designated.

11. Handling of ammunition shall be reduced to the minimum to prevent immediate accident and ..... damage to tanks and cartridge cases, loosened projectiles, .....

12. Service ammunition is supplied to ships for use in battle. It shall not be used for drill, for testing appliances, or for other similar purposes except upon the express authority of the Navy Department. It shall be regarded as a part of the vessel's outfit, shall be

3. Conditions not covered by these safety orders may arise which, in the opinion of the commanding officer, may render firing unsafe.

kept distinct from the ammunition used for gunnery exercises, and shall never be expended in gunnery exercises unless authorized in the orders for gunnery exercises or special instructions from the Bureau of Ordnance.

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13. Special ammunition is issued for gunnery exercises, except when a part of the ship's allowance of service ammunition is designated for that purpose.

14. Only such of the ammunition issued for gunnery exercises as does not contain a primer, fuze, or detonator may (at the discretion of the commanding officer) be used for testing the fit in hoists, guns, and appliances

15. No other than drill ammunition shall be used for drill.

16. The unexpended portion of such ammunition as may have been issued for a specific gunnery exercise or experimental firing shall be turned in as soon as practicable, after such firing, to an ammunition depot, unless additional firings are immediately authorized by the Navy Department.

17. Since the safety in handling and the disposition of ammunition depend upon the correctness of reports and records, care shall be taken not to obliterate identification marks on ammunition or to put it into incorrectly marked containers. When ammunition in other than normal condition is returned to an ammunition depot in compliance with these safety precautions, it shall be marked to indicate its condition and the reason for its return. If smokeless powder is involved, the weight of the smokeless powder returned shall also be indicated.

20. A loaded and fuzed projectile, seated in the bore of a gun that is hot from previous firing, presents a hazard since detonation of the projectile is probable as a result of being heated.* Whenever practicable, such projectiles should be disposed of promptly by firing the round. Whether a gun is hot or cold, the risks attendant upon removing a loaded and fuzed projectile seated in the bore, by backing out, are considered unwarranted except in the case of guns for which existing instructions specifically prescribe this procedure.

22. Nose fuzes being sensitive, care shall be taken to prevent them from being struck as by the gun in recoil, by ejected cases, by dropping, etc.**

23. Time fuzes which have been set shall be reset on "safety" before sending them below.

26. Smokeless powder shall not be exposed to the direct rays of the sun. Powder ..... in tanks, cartridge cases, ..... or in any other containers shall be protected against abnormally high temperatures over 100°F.)

28. If any smokeless powder be exposed to temperature higher than 100°F., a special report shall be made to the Bureau of Ordnance immediately, explaining the circumstances in detail and stating the temperature and length of time the powder was so exposed.

29. Smokeless powder which has been wet from any cause whatever must be regarded as dangerous for dry storage. Such powder shall be completely

18. Projectiles shall not be altered, nor shall fuzes or any other parts be removed or disassembled on board ship without explicit instructions from the Bureau of Ordnance. Projectiles shall not be allowed to rust or to become oversize through paint. Slings and grommets and other similar protective devices shall be removed before loading projectiles into guns. Since the slings are likely to jam the hoists, they shall be removed before sending up the projectile.

19. A fuzed projectile, or a cartridge case, whether in a container or not, if dropped from a height exceeding five feet, shall be set aside and turned in to a naval ammunition depot at the first opportunity. (See par. 17.) Such ammunition shall be handled with the greatest care.

immersed in fresh water and kept immersed and landed at an ammunition depot at the first opportunity. (See par. 17.)

30. Smokeless powder in leaky containers shall be transferred to airtight containers, and these must be marked "Transferred from leaky containers." If airtight containers are not available or if the container in use cannot be repaired properly, the powder shall be forwarded to an ammunition depot at the first opportunity, the container being marked "Leaky container." (See par. 17.)

32. Naked lights, matches, or other flame-producing apparatus shall never be taken into magazines or other spaces used primarily as

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* See also "cook-off" safety precautions on page 147.
** See "Fuze setter retraction" instruction and precautions, page 151.



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magazines while these compartments contain explosives.*

33. Before performing any work which may cause either an abnormally high temperature or an intense local heat in a magazine or other compartment used primarily as a magazine, all explosives shall be removed to safe storage until normal conditions have been restored.

34. Magazines shall be kept scrupulously clean and dry at all times. Particular attention shall be paid that no oily rags, waste, or other materials susceptible to spontaneous combustion are stored in them.

36. Nothing shall be stored in magazines except explosives, containers, and authorized magazine equipment.

53. As soon as a gun is loaded the breech shall be closed without delay.

55. A firing lock into which a live primer has been inserted shall never be opened, either independently or by operation of the breech mechanism, unless the firing circuit is broken externally at the lock or breech mechanism (for example, at local pointer's key or gun captain's ready switch), except when it is known that the loaded gun has fired. This applies to the firing of primers at drill, to the operation of loaded guns, and the examination of primers referred to in paragraph 67.

57. Effective measures shall be taken to guard against prematurely opening the breech of a loaded gun, whether or not the gun is filled with a salvo latch.

63. The utmost care shall be taken to insure that the

37. During firing no other ammunition than that immediately required shall be permitted to remain outside of the magazines.

38. During action and during target practice magazine blowers shall be shut down and Covers of both supply and exhaust branches to magazines shall be closed.

42. When cartridges are outside the magazines, wherever practicable, each flameproof compartment or space which forms a stage of the ammunition train, including the magazines and gun compartments (in or out of turrets), shall be closed from all other compartments or spaces, except when the actual passage of ammunition requires it to be open. Where practicable, no flameproof stage of the ammunition train shall be open to both the preceding and the following stages at the same time.**

44. If flame seals be damaged during firing, except in action, so that they cannot fulfill their purpose, the gun or guns concerned shall cease firing until the flame seals are again effective. 51. Except when using a power rammer, no force greater than that which can be applied by the hand alone shall be used in loading a live cartridge into a gun. Any cartridge which does not freely and fully enter the chamber of the gun shall be carefully extracted and put aside, and in peace time no further attempt shall be made to fire such a cartridge.

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* This means all compartments and levels of the turrets.
** Particularly apply this rule to the hatches in the pan and projectile flats and the turret circular foundation doors.

firing pin and other parts of the firing mechanism of a case gun are in good condition and properly assembled in order to prevent premature discharge.

66. If a gun is loaded at the order "Cease firing."

(1) The gun shall remain loaded and shall be pointed and trained in a safe direction;

(2) The breech mechanism shall be kept fully closed;

(3) The firing key shall be opened and the firing circuit broken elsewhere;

The crew shall never leave a loaded gun until these precautions have been carried out.***

67. The possibility of a serious accident due to opening the breech of a gun too soon after a misfire demands the constant exercise of the utmost prudence and caution. After an unsuccessful attempt to fire a gun, it shall be assumed that a hangfire is under way; and the procedure outlined below shall be followed:

(1) Keep the gun pointed and trained in a safe direction.

(2) Continue attempts to fire, if desired, provided such efforts do not involve any movement tending to open the breech.

(3) Do not open the breech for 30 minutes ..... after the last attempt to fire. This, at the discretion of the commanding officer, is not obligatory in time of action.

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*** See "Cease fire" unloading instructions and procedures, Chapter 5, OP 1180 (Volume 2).

69. Ammunition unloaded from a gun may be reloaded if the service of the gun is resumed within a reasonable time. When it is apparent that the service of the gun will not be resumed within a reasonable time, the powder unloaded from a gun shall be disposed of as follows:

The cartridge shall be turned in to an ammunition depot at the first opportunity if-

(1) The gun was warm when loaded;

(2) An attempt was made to fire the gun;

(3) After careful examination the cartridge is found injured or out of alignment.

Crimped cartridges shall not be broken down before being turned in. Uncrimped cartridges shall be broken down and the powder immersed in fresh water before being turned in.

70. When a gun is being unloaded, all personnel not required for the unloading operation shall be kept at a safe distance from the gun. The division officer shall supervise the unloading.

72. Marks or indicators shall be provided to indicate whether or not the gun returns to battery ..... The service of the gun shall be stopped should the gun fail to return to battery.*

73. On guns equipped with hydropneumatic counterrecoil systems, the safety link, locking the gun to the slide, shall be connected up at. all times except when firing, or when testing and overhauling the counterrecoil systems, or when the battery is in a condition of readiness for action. These safety links shall be disconnected after checking the pressure on counterrecoil

officer who authorizes the unit to be moved by power shall, except at general quarters, insure that a safety watch is maintained in areas where such injury is possible both outside and inside the unit, and shall have telephone or other effective voice communication established and maintained between the station controlling the unit and the safety watch. These precautions are applicable to turrets ..... Under the conditions stated above, the station controlling shall obtain a report "all clear" from each safety watch before starting the unit. Each safety watch shall keep his assigned area clear and if unable to do so shall immediately report his unit fouled, and the controlling station shall promptly stop the unit until again clear.**

83. In turrets ..... a warning signal shall be installed outside the turret ..... and whenever power train is used, except at general quarters, the officer or petty officer in charge of the turret ..... shall cause warning signals to be sounded before using power and at intervals during its use.

84. When using director train while firing at gunnery exercises, an observer from the firing vessel for each gun or turret shall cause the firing circuit to be broken whenever the gun or turret is trained dangerously near any object other than the designated target.

86. Except in action, whenever a circuit breaker becomes so sensitive as to function due to the shock of firing, the circuit breaker shall be either overhauled or replaced and shall not be tied or fixed in position so as to be inoperative for the purpose for which designed.

87. The covers of switches, circuit breakers, etc., shall be kept securely closed while powder is exposed in the vicinity.

system and prior to firing.

79. Fired cartridge cases shall, before storing below, he stood on their bases in the open air for ten minutes in order to avoid danger from inflammable gases. 81. In testing primers outside of closed firing locks, no magneto or other device which can possibly supply current sufficient to fire the primer shall be used.

82. Whenever any motion of a power-driven unit is capable of inflicting in jury on personnel or material not continuously visible to the person controlling such motion, the officer or petty

88. Whenever the guns of a vessel are fired, the fire hose shall be connected and pressure shall be maintained on the fire main. This does not require water to be running through the hose. ***

89. Turret and handling room sprinkling systems shall be tested and all tanks of these systems filled before firing.

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** This regulation is particularly applicable to CA 139 class turrets.
** It does in the instance of the firemain supply of this turret design.

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* Gun will not fire if it is 0.25 inch, or more, out of battery. Thus observation of the indicator marks is one of the checks for cause of misfire.



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91. (a) Before firing any gun, other than a saluting gun, in time of peace, the recoil cylinders shall be inspected and filled in the presence of the gunnery officer or assistant gunnery officers, and such officer shall check the pressure being carried by the pneumatic counter-recoil cylinders and verify that the air systems are properly charged and that the valves of the gas-ejector system operate freely; and a report thereof shall be made to the commanding officer.

(b) Whenever there is a possibility of action, the commanding officer shall require all recoil and counterrecoil systems to be kept ready for immediate use and inspected as frequently as safety demands.

93. Before firing primers, the division officer will see that the gun tompions are removed ..... In preparing the battery for firing he shall, in addition, see that the gas-ejector system, and the and ammunition hoist until all personnel have been cleared from the slide and the gun pits.

**DANGER**. Never fire the guns with personnel on or in the truss girders or in the gun pits.

**DANGER**. Always close and secure the pan plate hatches, the projectile flat hatches, and the turret circular foundation doors before firing the gun.

**DANGER**. Always start the ventilating systems and open the gas-ejector system valves before firing the guns.

**ORDNANCE EQUIPMENT PRECAUTIONS**

**Personnel danger**

Always be sure that all operating ways of the gun, slide, and ammunition handling equipment are clear of personnel before operating the gun. When starting

turret-blower system are working satisfactorily and that the bore of the gun is in satisfactory condition.

94. Steel constrictions of the bore, usually caused by the gun liner overriding the retaining shoulders in the tube, are a source of possible danger in firing. It is not always possible to distinguish copper constrictions from steel constrictions. Therefore no gun shall be fired in target practice unless the bore gage will pass through the entire bore without undue forcing. After target practice the gage shall be tried in each gun and the bore enlarged, if necessary, until the gage will pass.

**TURRET GENERAL PRECAUTIONS**

**DANGER**. Live 440-volt leads are exposed whenever covers of the bus transfer panel, equipment panels, controllers, motor terminal boxes, and many of the control panels and connection boxes are open.

**DANGER**. Never enter the cable trunk at the foot of the central column or the wiring recess at the top until the 440-volt supply switches are open at NORMAL and EMERGENCY supply switchboards.

Always open the 440-volt supply switch at the equipment panel as well as the controller concerned when preparing to work on any power driven assembly.

Never close the supply switches of the automatic control circuits of guns, elevating drives, operations, never shift gun and hoists control supply switches A, B and C from their stowed OFF positions, nor shift the hoist function control selector levers from their stowed positions at STOP, until all hoist loading stations report CLEAR and personnel are out of gun pits.

Never fire the guns without first checking the recuperator air pressure and differential fluid.

Man the gun captains' control panels at all times; never tie down the rammer controls.

Never put hands, feet or head into a hoist way or path of a cradle, transfer tray, slide, or housing when power is ON.

**DANGER**. Never climb through the archways of the projectile flats when the projectile ring power drives are operating; always stop the electric motor of the inner drive ring.

Never attempt to parbuckle projectiles through the gates of the inner ring; always man-handle projectiles through the gates and then only when the power drive is stopped.

Always use the steady arm mechanism to load the projectile hoist; it is safer than manhandling.

Never start the elevating gear until the gun pits are cleared of all personnel.

**DANGER**. Never perform gun sliding-out exercise without setting the securing pin in its 20° elevation socket.

Never enter the gun pits except when the slide securing device is engaged.

Always lash all projectiles carefully, inspecting all toggle links, before going to sea.

Always latch the transfer trays when manually unloading the cradles to return ammunition units to the hoist.

Never return H.C. projectiles from the cradle to the hoist without first moving switch BW to SAFE for an elapsed time of at least 30 seconds.

Always operate the elevating gear separately in HAND control, slowly, when setting the slide securing and steady rest pins at secured position.

Always latch the transfer trays in firing position before working in the slide loading-tray area.

Never perform maintenance work on gun equipment with valve T open.

After any dismantling or repair work involving the cradle control switches, perform a thorough continuity check of the circuits. This is extremely important; the connections can be reversed so that the cradles can operate without the pawl functioning to hold ammunition.

Do not unscrew hydraulic adjustments excessively. There is danger of injury to personnel and equipment because of the hydraulic pressure.

If a cradle is raised to the slide to facilitate repair work in the gun pit, secure it with timber or lashing before proceeding with the work.

Never adjust the gas-ejector pilot valve to cause air ejection for less than 2.5 seconds.

**WARNING**. Always observe all cautions listed under "Turret general precautions," page 149.

Uncouple the manual breech operating mechanism.

Make certain that all operating ways of breech and slide are clear.

Prove the gun control action by operating breech, rammer, and trays through two power cycles.

Observe the hoist operating precautions, under "Ammunition handling equipment precautions," page 151, before serving ammunition.

## FIRING PRECAUTIONS

Man the gun control panel at all times, never tie down the rammer control. Observe the continuity of the control ready light system for every round; shift the ready switch to SAFE immediately if the action stops.

## MISFIRE PRECAUTIONS

Shift the READY switch to UNLOAD position at once. Unload or fire the gun, observing Navy Regulations. See pages 147-148.

Never attempt to remove a jammed empty cartridge case from the case-ejector rear compartment by operating the transfer trays to FIRE; always extract through the portable cover at the rear end of the case ejector.

## STOWING PRECAUTIONS

Secure the gun locking device immediately after "Cease fire."

Always seat the securing pin and run-out the steady rest pin.

**Equipment casualty**

**Gun equipment precautions**

PREPARATION PRECAUTIONS

Check recuperator air pressure and differential fluid.

Check recoil cylinder fluid level.

Check the fluid level of all slide equipment buffers.

Check firing circuit interlock switches in transfer trays.

Unship the tompions.

Unlatch the case ejector cover and tighten the securing bolts to their stowed positions.

Disengage and stow the gun locking device.

Retract the slide securing and steady rest pins.

Always stow with valve T closed.

Always install tompions or canvas covers on gun muzzles.

Always close and secure the empty-case tube covers.

MISCELLANEOUS PRECAUTIONS

Do not attempt power operation of the breech with the manual mechanism clutch engaged.

Use utmost care to avoid damaging the breech mechanism when removing a drill or live projectile from the gun chamber by means of the backing-out rammer. If practicable, have guns trained fore or aft to minimize the effect of the roll of the ship.

Use clean, soft cloth only to wipe the recuperator plunger. Scratches will cause loss of air charge. No rust-protection oil film is required.

Never use an organic or heavy oil or grease to coat the gun bore, chamber, or gun and slide



bright work, or to lubricate the firing pin. Use authorized lubricant only.

Never use abrasives or detergent or caustic solutions to remove discoloration or smoke rings from the gun bore; use an oil-soaked cloth.

Always adjust the manual drive breech mechanism handwheel release to slip at a maximum of 30 pounds pressure on the handwheel grip. This is a safety release which is less effective if set higher.

**Ammunition handling equipment precautions**

shutter handle to swing the shutter to open detent position.

The preferred safe direction for operating the projectile rings to load center and right projectile hoists is clockwise; for loading left hoist, counterclockwise. These directions of rotations give more clear working area for the projectile men and do not move loaded areas of the projectile rings toward the steady arm operators.

When unloading the powder hoist, use the powder can tool to unload the powder cases from the scuttles.

Before raising ammunition into the cradles, verify that the ram retractor is at SAFE. Complete ejection into the transfer trays cannot be obtained with the retractor lug in the path of the ram.

Never depress a hoist trigger with the hands, always use the trigger handle to actuate the cycle.

Always retract the fuze setter when hoisting A.P. projectiles.

Always secure the fuze setter in retracted position when stowing the hoist or when preparing to lower projectiles.

When handling powder between the magazines and hoist scuttles, avoid rough treatment that may cause the primer bridge to break.

Always stow the cradles in their lowered positions.

If a cradle is raised to the slide to facilitate repair work in the gun pit, secure it with timber or lashing before proceeding with the work.

Never feed ammunition units into a hoist with the shutters detented open.

At "Cease fire," after ammunition has been returned to the conveyor, restore the ram retractor to SAFE position before securing.

Never use the steady arm mechanism to unload projectile hoist. Loop the snubbing rope over the projectile to withdraw.

Never loop snubbing rope above the copper rotating band on a projectile when parbuckling (without the steady arm); always loop the rope below the rotating band.

Always stow projectile rings with both centering pins of each securely seated.

Always lash all projectiles carefully, inspecting all toggle links, before going to sea.

Always secure the steady arm mechanisms before going to sea.

Never attempt to load or unload a projectile ring when it is in motion.

Always check the correct functional arrangement of circuit RP for the outer projectile ring warning system before starting operations.

Always inspect the projectile ring for loose tools or other obstructions before starting operations.

When reversing the direction of projectile ring rotation, permit the ring to come to a full stop before reversing handwheel rotation.

Keep projectiles secured on the projectile ring until rotation stops; then unclamp only the projectiles which are to be parbuckled. In rough weather, unclamp the projectiles one by one as needed for parbuckling.

Always latch the transfer trays when manually loading the cradles to return ammunition units to the hoist.

Always stow the pawl handle for the projectile hoist upper loading level pawls in nonoperating position; assemble in its operating position only when projectiles are to be lowered to the lower projectile flats. When the pawl handle is used, secure it; do not let it hang free.

Never return H.C. projectiles from the cradle to the hoist without first moving switch BW to SAFE for an

Never loop a snubbing rope more than three turns around a gypsy head; two turns are usually sufficient.

Never attempt to unload a hoist without latching the shutters open; always use the elapsed time of at least 30 seconds.

Always stow switch BW at OFF position.

Never adjust a gypsy head slip clutch to release at a snubbing rope pull in excess of 650 pounds.



Refer to the "Personnel danger precautions" on pages 149-150.

**Gun laying equipment precautions**

Always man the pointer's station whenever any elevating gear is operating.

Never attempt to start any elevating gear drive with the control selector switch in any position other than HAND. When shifting the elevating gear controls from HAND to LOCAL, match the pointer's handwheel dial to gun position before shifting the selector switch to LOCAL.

Always synchronize gun position with gun order before shifting to AUTO control.

Always shift the control selector switch of each elevating gear drive to HAND position before stopping the drive.

Protect each elevating drive from backlash vibration and seaway stresses by setting the securing and steady rest pins at 0° secured position when the drive is not operating.

Never attempt to adjust the elevating gear limit stop without first disengaging the regulator response-plus-tilt and elevating inputs.

**WARNING**. After servicing an elevating gear, do not operate it with the inputs coupled until the position with the train order before shifting the control selector.

Always shift the control selector to HAND before stopping the drive.

Operate the drive slowly in HAND when locating center pin positions.

Protect the train drive from backlash and the roller path from deformation by setting both centering pins tight whenever the drive is not operating.

Never attempt to improve the operation of the train receiver-regulator if the performance is satisfactory.

**Fire control equipment precautions**

Never attempt to set the sights when any appreciable effort is required to turn the sight setter's hand cranks. Stop and investigate. Find and remove the cause of the abnormal load before resuming operation.

Exercise the sights and gun attachments periodically and frequently through full range of movements.

Dry out and ventilate sight hoods daily. Clean and dry telescope objectives. Always keep the sight hood shutters closed when the sights are not in use. Never make internal adjustments or open any fire control instrument without cause.

fire control instruments have been synchronized with turret and gun laying movements.

Never attempt to improve the operation of an elevation indicator-regulator if the performance is satisfactory.

**Training gear equipment precautions**

Always man the trainer's station whenever the drive is operating.

Always retract both centering pins before starting the training gear drive.

Always place the control selector lever at HAND before starting the drive.

When shifting from HAND to LOCAL and then to AUTO control, synchronize turret

When securing fire control equipment after operations, open all transmission, communication, and lighting circuits at the instrument controls as well as the turret officer's transfer switchboard.

Never adjust sights and gun attachments without cause, and then only in the prescribed order. Adjustments made out of order will upset other adjustments. Never attempt to improve the operation of fire control equipment if performance is satisfactory.

Whenever trouble occurs, test the equipment in all types of control, to isolate the cause, before resorting to disassembly or adjustment.



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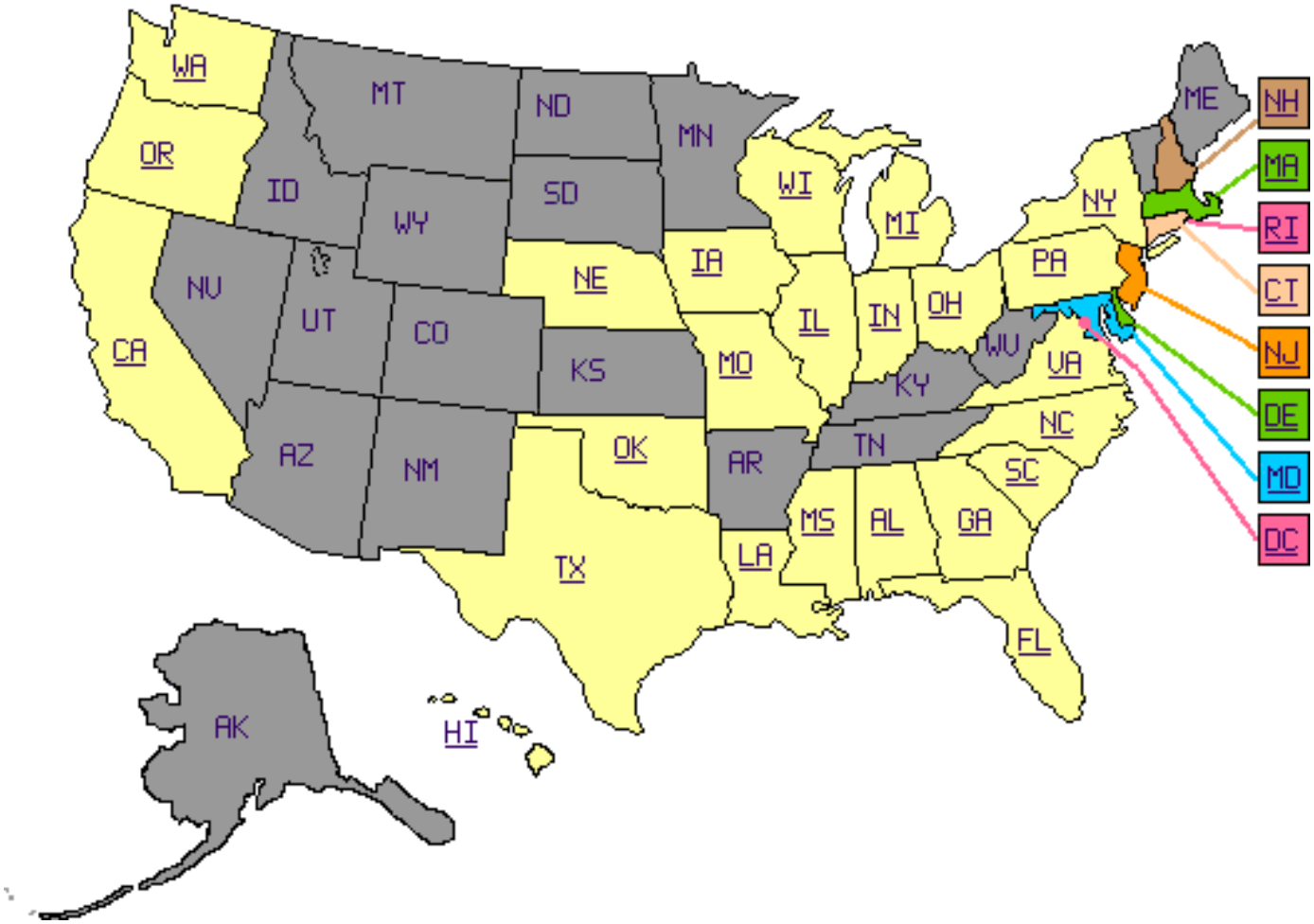


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