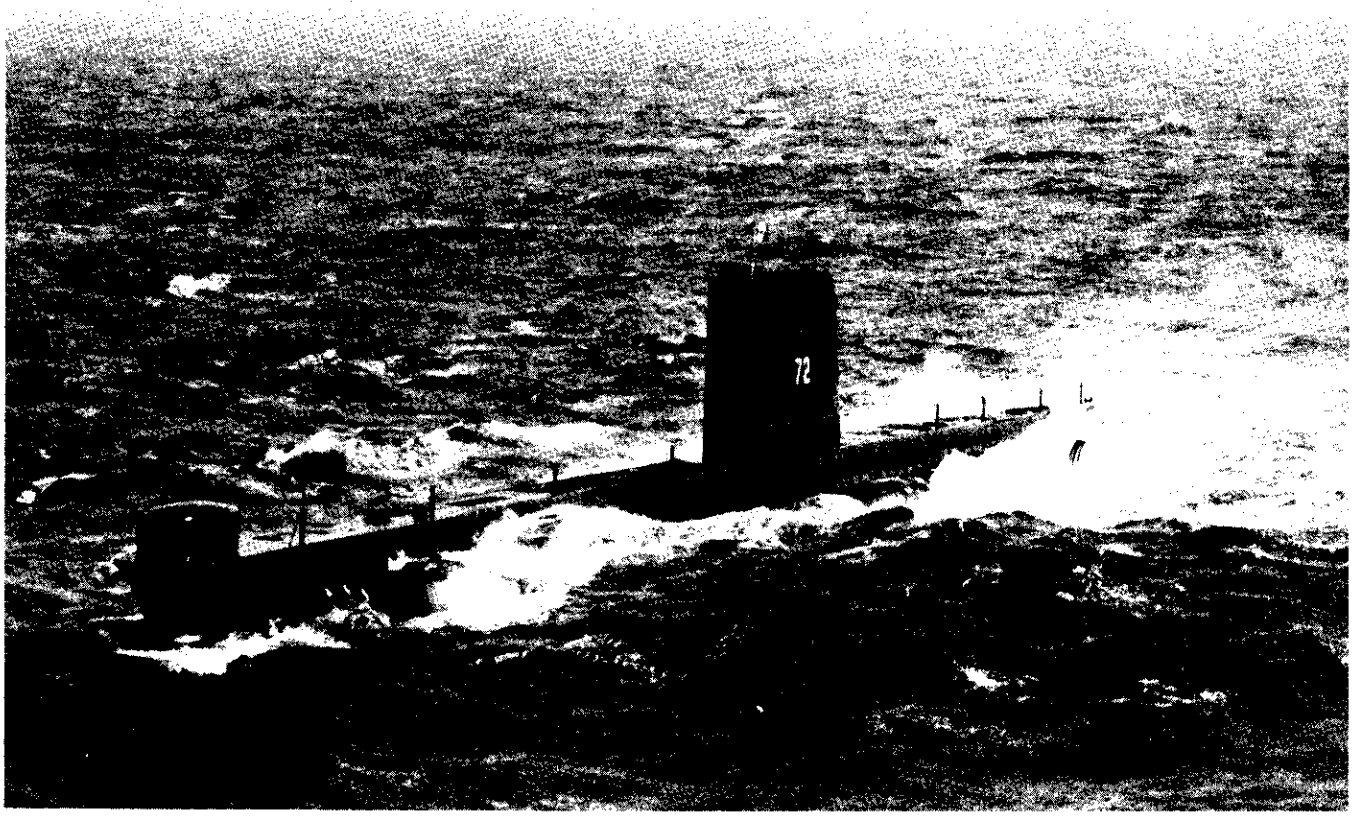
C.F. 'O' CLASS SUBMARINES



TRAINING NOTEBOOK

WEAPONS SYSTEMS

C. F. 'O' CLASS SUBMARINE NOTEBOOK

CONTENTS

CONTENTS (CONTD)

C. F. 'O' CLASS SUBMARINE NOTEBOOK

CHAPTER 12 - WEAPONS SYSTEMS

12.01 INTRODUCTION

A C.A.F. 'O' class submarine has six 21 inch torpedo tubes in the bow and two in the stern. A control system permits pre-firing settings and in some cases post launch guidance to be applied to torpedoes. This system, centered and operated from the Control Room, enables Mk. 37 torpedoes to be fired from all eight torpedo tubes.

Each set of torpedo tubes, forward and aft, extends from within the submarine through the dome bulkheads. The compartments directly inboard of the tubes are the Torpedo Rooms and are where reload weapons are stowed; in addition these spaces have handling equipment for embarking and loading torpedoes.

The submarines are fitted with two Submerged Signal Ejectors (S.S.E.), one in each Torpedo Room. The purpose of these ejectors is to release from the submarine smoke and flare markers, signal grenades and decoys.

Sonar and Fire Control, although nominally a part of the Weapons' system are administered in the submarines by the Operations Department. Due to the classification of these systems and also the types of weapons. No notes about them are included in this publication.

CHAPTER 12 - PART 1 - FORWARD TORPEDO TUBES

12.10 TORPEDO TUBES GENERAL

The torpedo tubes are wet slack fit type and water pressure tested to 400 p.s.i. Each comprises two rolled and welded lengths bolted together, with a muzzle door at the forward end and a breech door at the after end; the two doors being so interlocked with each other that they cannot be open at the same time.

Attached to the muzzle door is a shutter that seals the opening in the bow streamlining, but will open to allow a torpedo to be fired.

12.11 TORPEDO TUBE CONSTRUCTION

A. Inboard Length

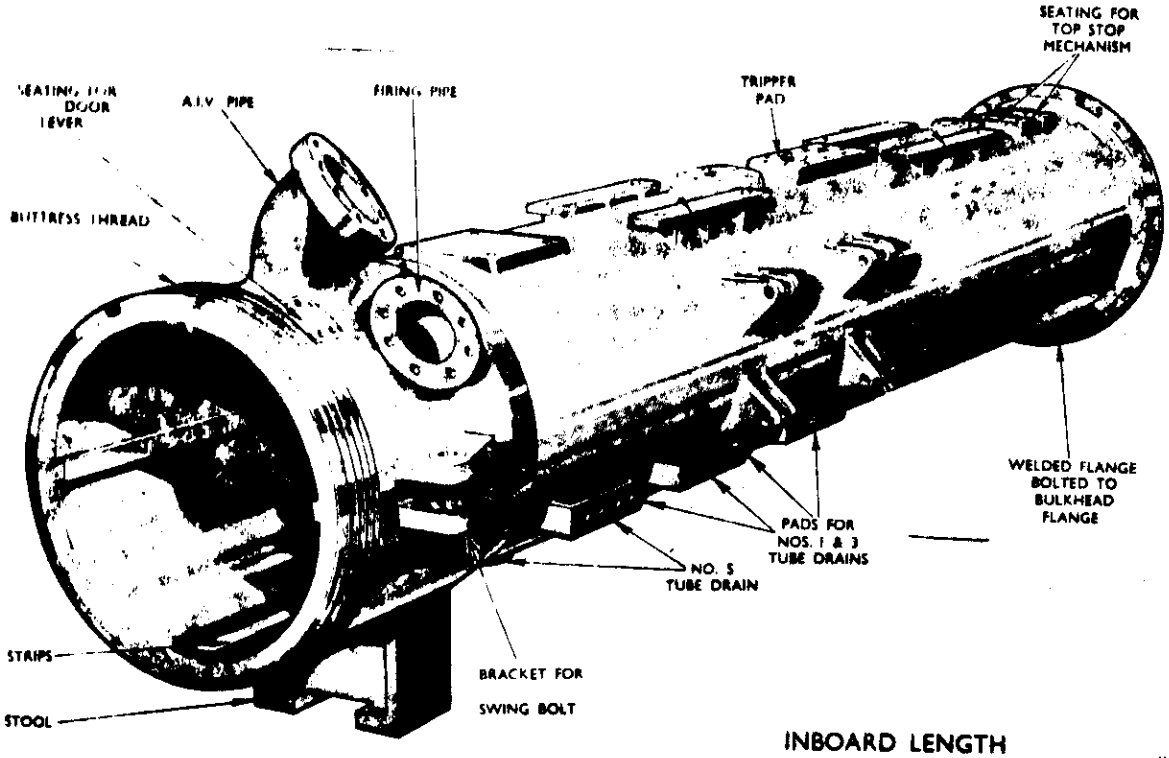
This is of 0.5 in. thick steel plate rolled and welded to form a tube of 22.5 in. internal diam. It has a rear end and a connecting flange welded to its after and forward ends respectively. The continuous tube so formed is about 116 in. long. The rear end is a forging of greater thickness than the middle length; it carries firing and venting tubes, rear door locking gear and a rear door hinge. A flange on the after part of the rear door locking ring, and its after edge forms the joint face for a rear door.

The connecting flange is machined from solid steel. It consists of a heavy flange with a short projecting collar which is welded to the outer end of the inboard length. Both the rear end and the connecting flange are of the same internal diameter as the tube.

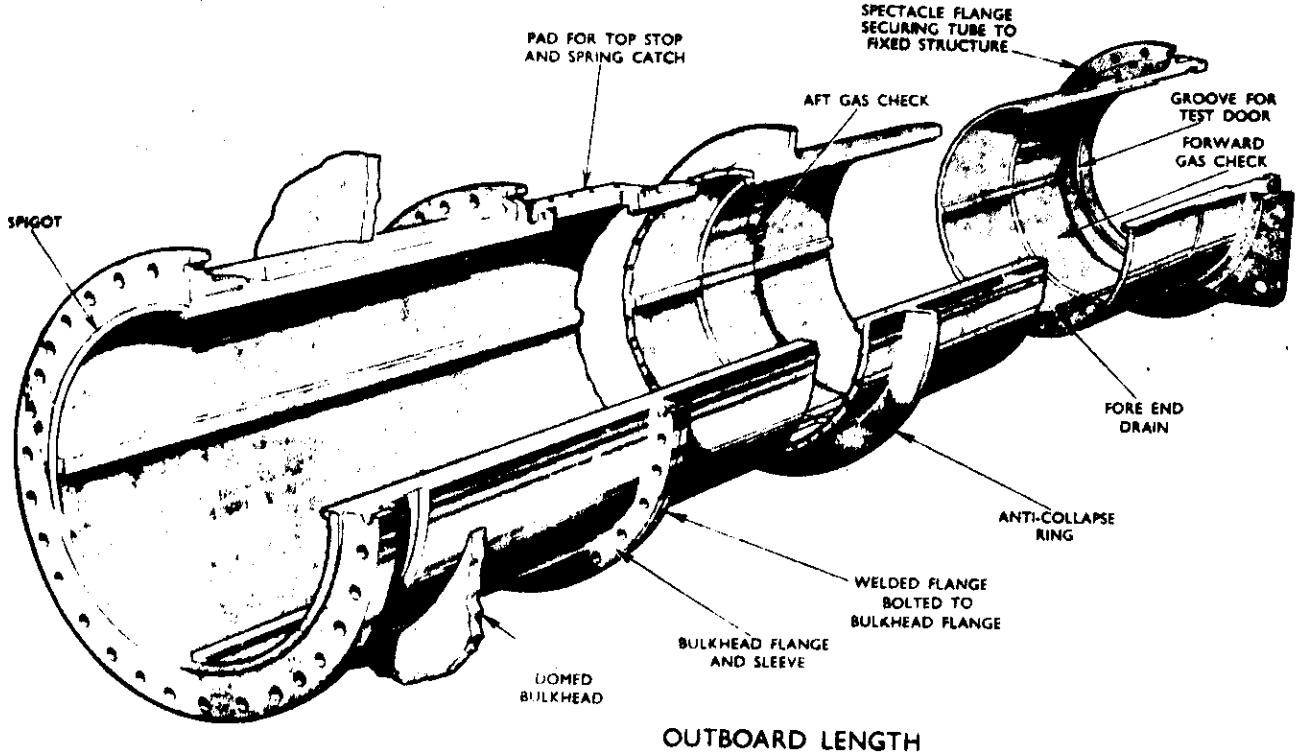
B. Outboard Length

This is also of three sections, namely the tube, the sleeve and the lip end. When welded together they form a tube about 175 in. long. The tube portion is rolled and welded to the same dimensions as the inboard length, but is somewhat longer.

12.11 TORPEDO TUBE CONSTRUCTION



INBOARD LENGTH



OUTBOARD LENGTH

B. Outboard Length (contd)

The sleeve portion passes through the domed bulkhead and, to provide additional strength at this point, is of 1 1/8 in. solid-drawn steel tube. At the forward end of the sleeve is a 1¼ in. thick flange which, when the tube is erected in the submarine, is bolted to the flange of the bulkhead sleeve. The lip end is a short length of solid-drawn steel tube. It is secured to the forward bulkhead by bolts which pass through a flange welded to its, about 6 in. from its forward end. Around the middle of the outboard length a 1 in. thick flange is welded; this provides additional strength to the unsupported part of the tube passing through No. 1 main ballast tank.

C. Bearers

To form bearers for weapons, aluminium-bronze strips are fitted at the top, bottom and both sides of the tube bore. They are riveted to the tube and extend from the rear end of the inboard length to within about 5 in. of the lip end. The top strip is wider than the others and is slotted lengthwise to provide a channel for the top lugs of weapons; the rear end of the slot being bell-mouthed to facilitate easy entry of the top lugs. Both top and bottom strips are cut-away to avoid fouling various apertures provided on or near the centre line of the tube. To guide weapons as they are being loaded, the after ends of all strips are chamfered.

D. Gas Check Rings

Two of these are fitted in the outboard length; one is in line with the forward end of the bearer strips and the other about 6 ft farther aft. Each ring is of gunmetal and consists of four sections shaped to fit between the strips; each section being riveted to the tube. The bearer strips and check rings are bored to an internal diameter of 21.1 in.

E. Muzzle Doors

This is a circular steel door with a dexine sealing ring held in a groove in its inner face by a retaining ring and set bolts. The sealing ring bears against the forward end face of the torpedo tube when the door is shut. A top plate is bolted to a flange on the top of a hinge shaft and has a drilled projection, which is in line with a drilled projection on the upper hinge arm. The projections are linked

E. Muzzle Doors (contd)

to one end of a connecting rod by a keyed pin. The connecting rod is actuated by a hydraulic ram, through an operating shaft and a crosshead; fore-and-aft movement of the operating shaft being converted to an angular movement of the door by the top plate.

F. Bow Shutter

Each shutter is a rectangular plate stiffened by angle bars welded to one face, and, when shut, it fills its torpedo tube orifice in the bow casing. Rollers run on a gunmetal path secured by screws to the bottom plating of the shutter space. The roller shaft is supported at one end by a gunmetal bush, The position of the shutter in the orifice can be adjusted vertically by rotating the roller shaft.

When the muzzle door is being opened or shut, the operating link rollers travel along the slots of guides and, as the operating links rotate, other rollers are brought into contact with either the guide inboard faces or with the outer face of the shutter. When the shutter is wide open, its smooth outer face forms a vertical guide plate for a weapon leaving the torpedo tube.

G. Crosshead and Shafting

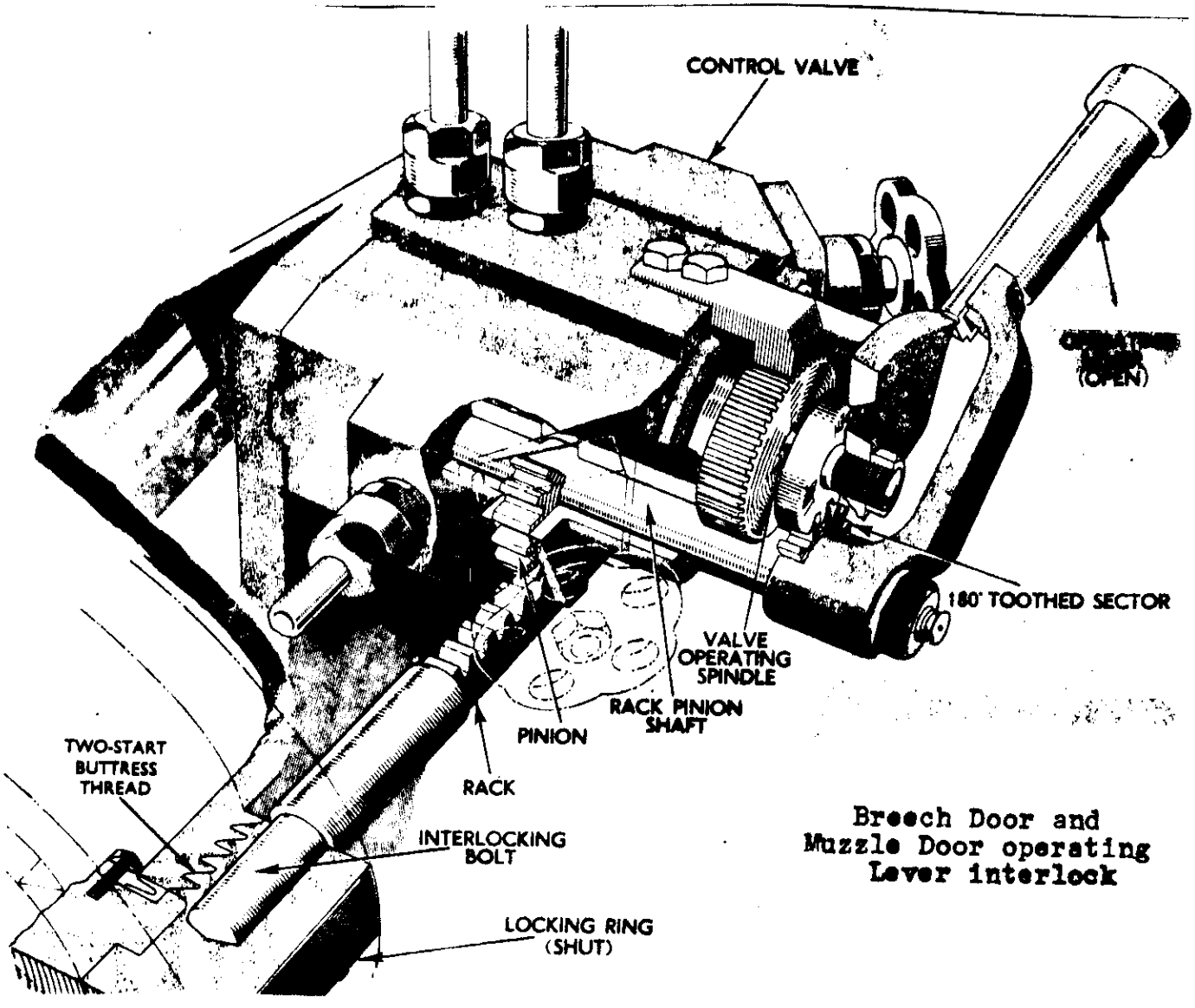
In No. 1 main ballast tank three boxes are welded to the forward bulkhead; they are on the centre line and are in vertical line with each other. The boxes contain the connecting rods and crossheads of the muzzle door operating gear; each box serving the two tubes adjacent to it. Each connecting rod passes through a hole in the forward face of its box, and its after end is pinned in its crosshead.

H. Hydraulic Rams

These are mounted on the forward bulkhead of the torpedo compartment, between the torpedo tubes. Each ram is double-acting and is powered by oil from the hydraulic system. The ram rod is sealed in three glands; one in the cylinder cover, one in the forward end of the cylinder, and one in the bulkhead. A piston assembly is carried on the rod and works in the cylinder. Should hydraulic pressure fail, the rams can be supplied with pressure from a hand pump in the Torpedo Compartment.

J. Muzzle Door Operating Gear Control Valve

Each muzzle door hydraulic ram control valve assembly is bolted to a pad near the rear end of its tube and is of the rotary face type. Each assembly consists of a steel block containing two isolating valves and a control valve. An interlock between the control valve and the breech door is actuated by the control valve lever.



Breech Door and Muzzle Door operating Lever interlock

K. Breech Door and Muzzle Door Operating Lever Interlock

This ensures that:

(a) The muzzle door operating lever cannot be moved unless the breech door locking ring is fully in the 'SHUT' position.

(b) The breech door locking ring cannot be turned for opening unless the muzzle door operating lever is in the 'SHUT' position.

The control valve and assembly is mounted on the inboard side of the tube. The muzzle door operating lever, which moves through 90 degrees, has a 180 degree toothed sector on its boss; this engages with a similar toothed sector on the control valve operating spindle. The lever is keyed to one end of the pinion shaft, the other end of which has a pinion engaging with the rack of an interlocking bolt.

When the locking ring is fully shut and the muzzle door operating lever moved to 'OPEN', the bolt slides into a hole in the breech door, thus holding it tight and immovable. If the locking ring is not fully shut, the bolt will not be aligned with the hole and the operating lever will not be able to open the muzzle door.

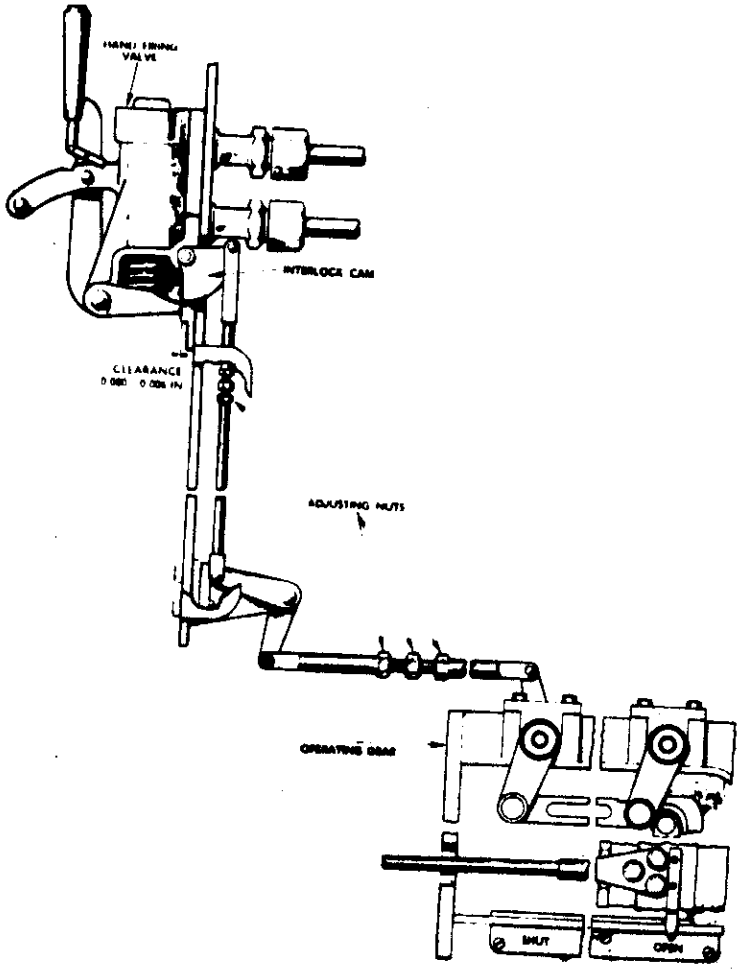
NOTE This interlock is not direct with the actual muzzle doors; it could be, therefore, in the event of a hydraulic failure that the door be open when the indicator shows 'SHUT'. The locking bolt on the breech door test cock and the breech door safety swing bolt will, with correct drill, maintain watertight integrity.

L. Interlock with Hand Firing Valve

The cover of the muzzle door ram cylinder has a frame work welded to it, and a crosshead is screwed on the after end of the ram rod. The frame work supports a link mechanism which operates an interlock between the ram and the firing control valve of its tube.

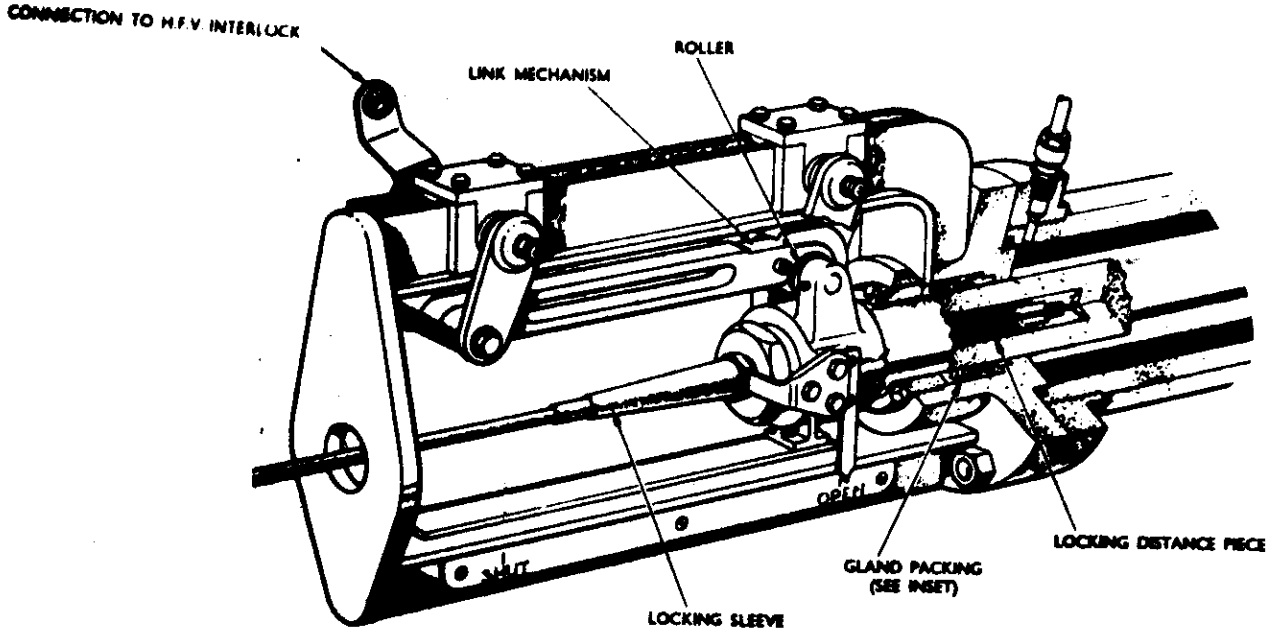
E. Interlock with Hand Firing Valve (contd)

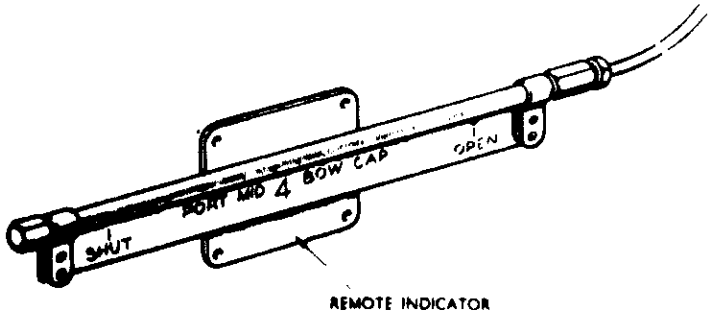
When the ram rod moves from shut to open, the roller moves along the straight length of the cam bar until the muzzle door has opened sufficiently for a weapon to leave the tube without fouling the muzzle door. (the 'just fire' position). The roller then contacts the hook and moves the cam bar; thereby freeing the interlock. Conversely the interlock is re-set when the muzzle door is being shut.



M. Muzzle Door Indicators

To verify the positions of the muzzle doors, indicators are fitted near the inner rear ends of the torpedo tubes and are visible from the firing control panel. Each indicator is a rectangular engraved plate with a pointer which protrudes from a slotted tube secured along the top edge of the plate and is connected by a cable to the ram rod of the operating gear.

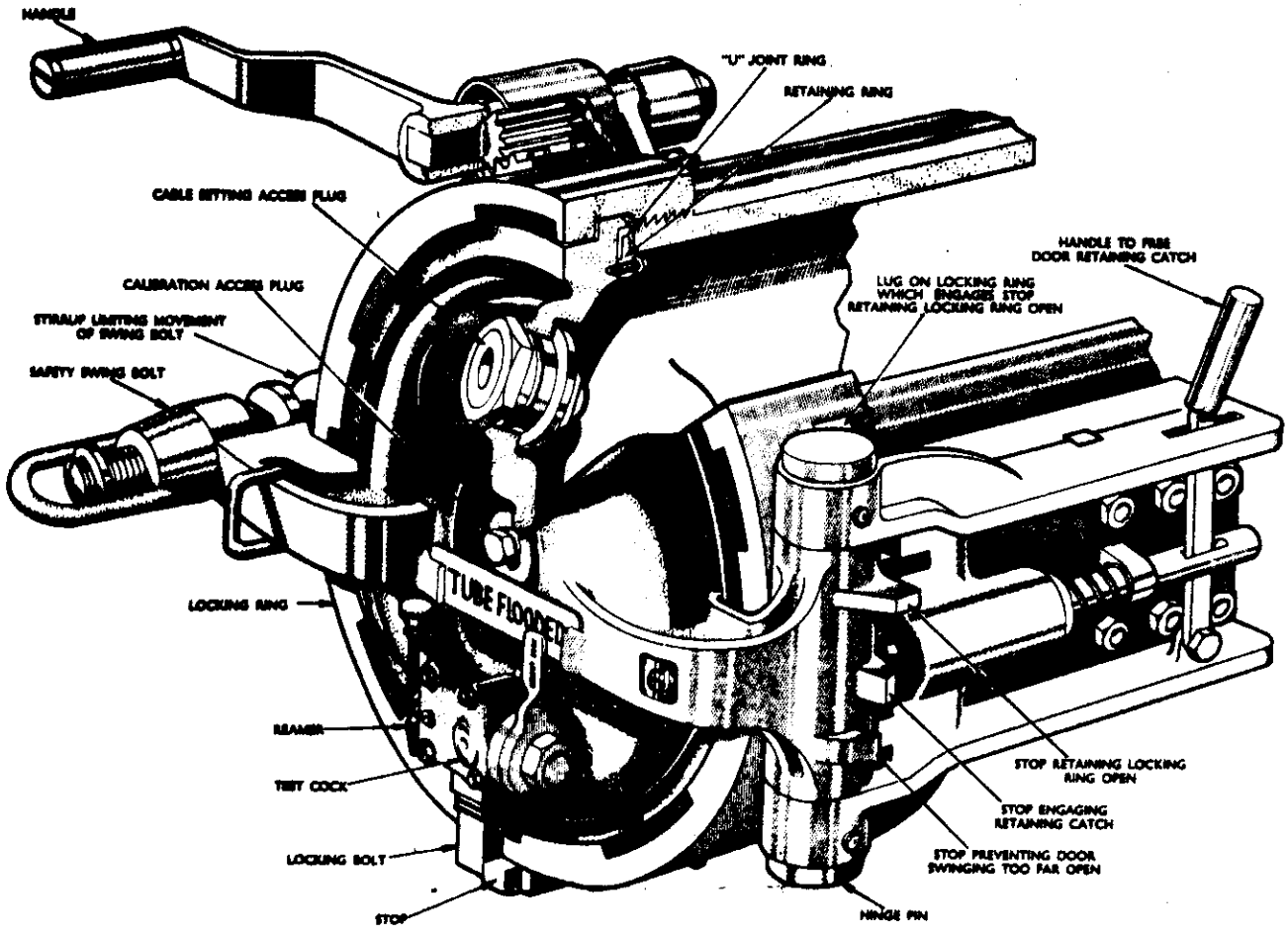




Muzzle Door Indicators

N. Breech Doors

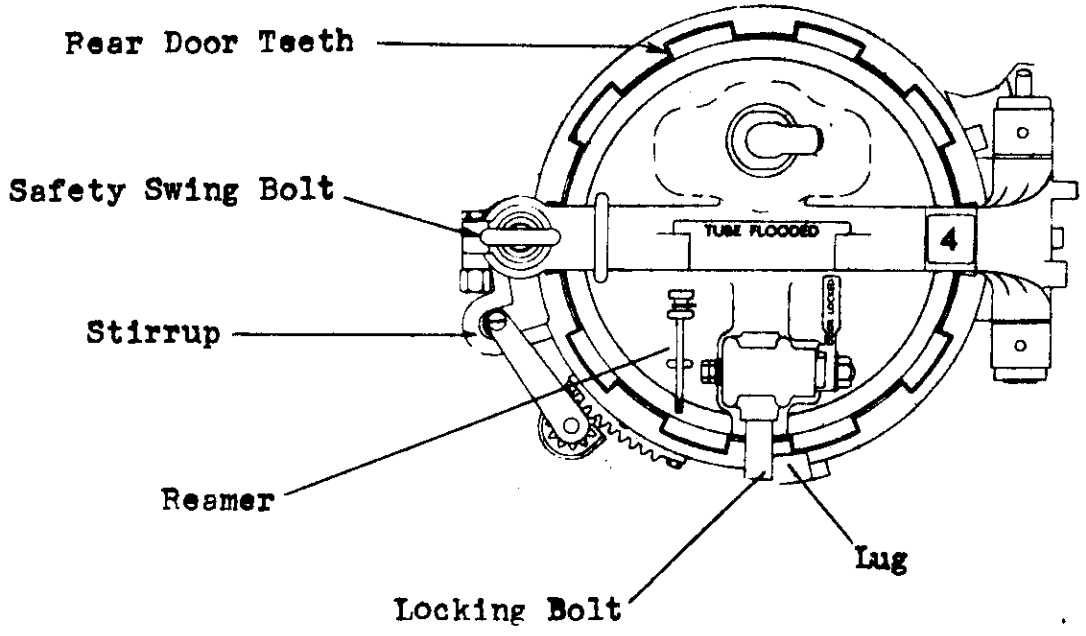
A circular cast-steel door with a neoprene joint ring seals the inboard end of the tube. The door is hinged about its inboard edge, and a locking ring is screwed on the two-start buttress thread of the tube rear end. On the door rim are ten equally spaced teeth, and similar teeth are cut in a flange on the locking ring. On shutting the door its teeth pass through the gaps between the locking ring teeth. A rack is bolted to the locking ring flange and is engaged by a pinion on the end of a door handle shaft. By turning the door handle, the locking ring is rotated and its teeth ride over those of the door; thus, due to the buttress thread, the door is forced bodily against the joint face.



N. Breech Door (contd)

Three stops are fitted on the hinge. A spring-loaded catch engages the centre stop and holds the door fully open; a handle being fitted for withdrawing the catch. A second stop prevents the door from swinging too far open. The other stop engages a lug on the locking ring when the the door is open; it thus prevents the ring from being turned in the shutting direction until the door is shut.

The safety swing bolt is fitted on the side of the tube opposite the hinge, and has a collar which fits into a slot in a lug formed on the door. A locking nut is screwed on the bolt and bears against the lung when the door is shut. Before the bolt can be swung clear of the lug, the door must be opened slightly for the collar to clear a recess in the lug slot. Therefore, if the tube is flooded and an attempt is made to open the door, water will flow from the tube before the bolt can be removed from the lug; the door can then be re-shut easily by tightening the locking nut.



N. Breech Door (contd)

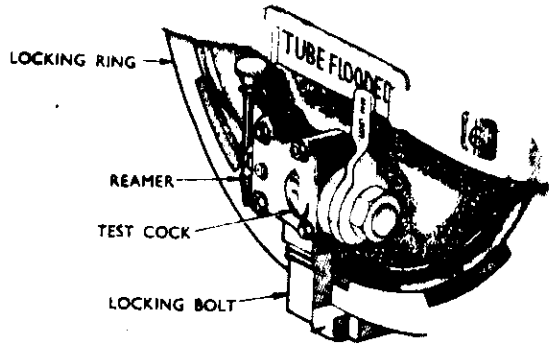
The combined test cock and locking bolt is fitted low down on the door. Its two functions are to secure the locking mechanism when the door is shut, and/or for testing to ascertain whether the tube is dry before the door is opened. When the door is shut, the action of shutting the cock moves the locking bolt downwards by means of a rack and pinion; the bolt bearing against a stop on the locking ring which is thus prevented from turning in the opening direction. Conversely, as the bolt is freed the cock is opened. The hole in the cock uncovers, however, before the bolt is clear of the stop on the locking ring, thus warning of a flooded tube is given before the locking ring can be moved.

The interlock with the muzzle door operating gear prevents the locking ring from turning when the muzzle door operating gear is 'OPEN'. In addition, the following three safety devices are fitted:

(a) A combined test cock and locking bolts which prevents the locking ring from moving from 'SHUT' until the test cock is opened. A reamer for clearing the hole in the cock is clipped to the door.

(b) A safety swing bolt which prevents the breech door from being forced open, lest the door is unlocked when the tube is flooded.

(c) An 'L' shaped stirup which prevents disengagement of the swing bolt before the door has been unlocked. It is so secured to the locking ring that the swing bolt is in the verticle stroke of the 'L' when the door is locked, and is in line with the horizontal leg and therefore free to swing when the door is unlocked.

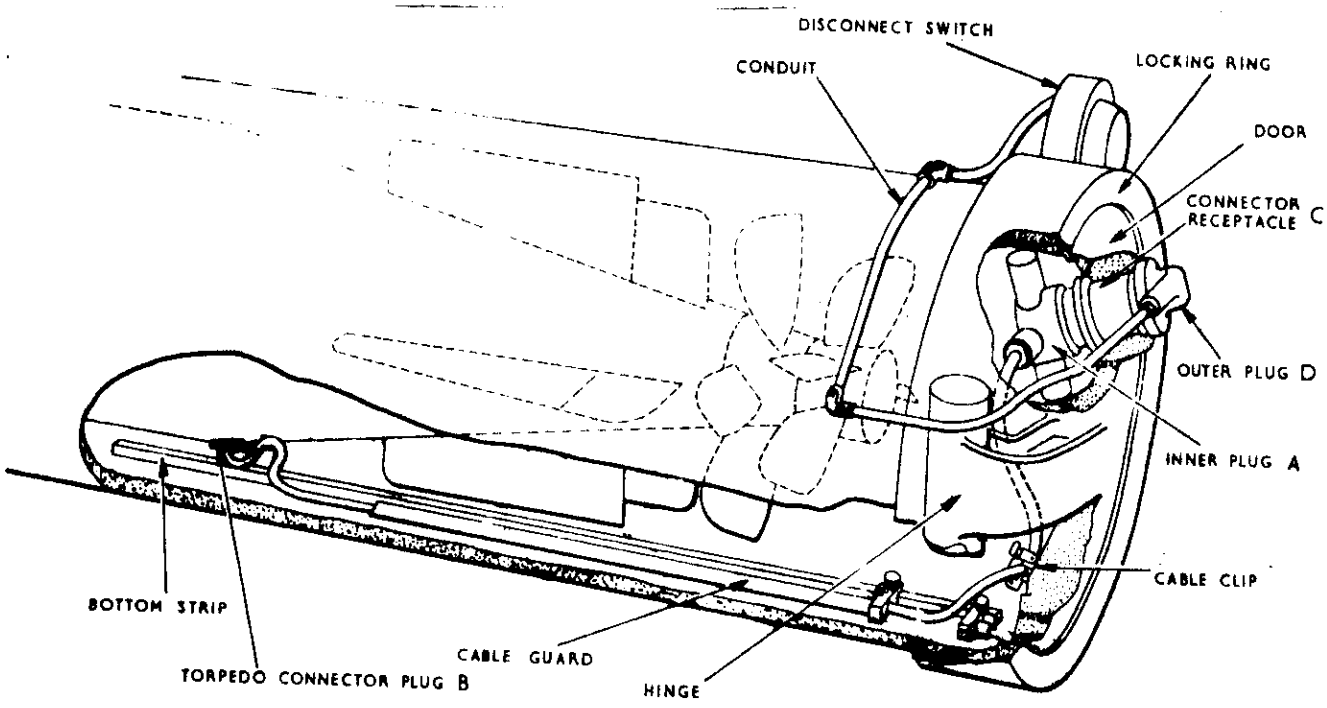


12.11A DRILL FOR OPENING BREECH DOOR

1. Check muzzle door control valve lever is shut.
2. Check muzzle door indicator is to the shut position.
3. Vent tube (via individual tube vent on the 9 valve chest.)
4. Operate test cock and looking bolt using reamer. (if no water is present, continue opening)
5. Turn looking ring until base of 'L' shaped stirrup is flush against safety swing bolt.
6. Slacken safety swing bolt 2 turns and then break the door seal, if no water is present;
7. Continue unscrewing the safety swing bolt and swing it clear into the 'L' shaped stirrup.
8. Open rear door completely allowing the retaining stop to engage.
9. Check the tube empty.

NOTE: The Breech door is never to be opened at sea without the permission of the Captain or the Officer of the Watch.

N. Breech Doors (contd)



12.12 FLOODING, DRAINING, VENTING AND BLOWING

Requirements

For the correct working and firing of the torpedo tubes it is necessary to be able to:

(a) Flood the tube from a tank inside the submarine so that no more water can enter when the muzzle doors are opened for firing, and thus no change in the longtitudinal trim of the submarine will result.

(b) Drain the tubes into a tank inside the submarine after firing so that breech doors can be opened to reload the tubes.

(c) To allow air to enter the tubes whilst they are being flooded or drained.

(d) Use low pressure air to assist in speeding up flooding and draining operations.

These requirements are met by the use of the tanks, fittings and systems described below.

12.12 FLOODING, DRAINING, VENTING AND BLOWING (CONTD)

A. Tanks

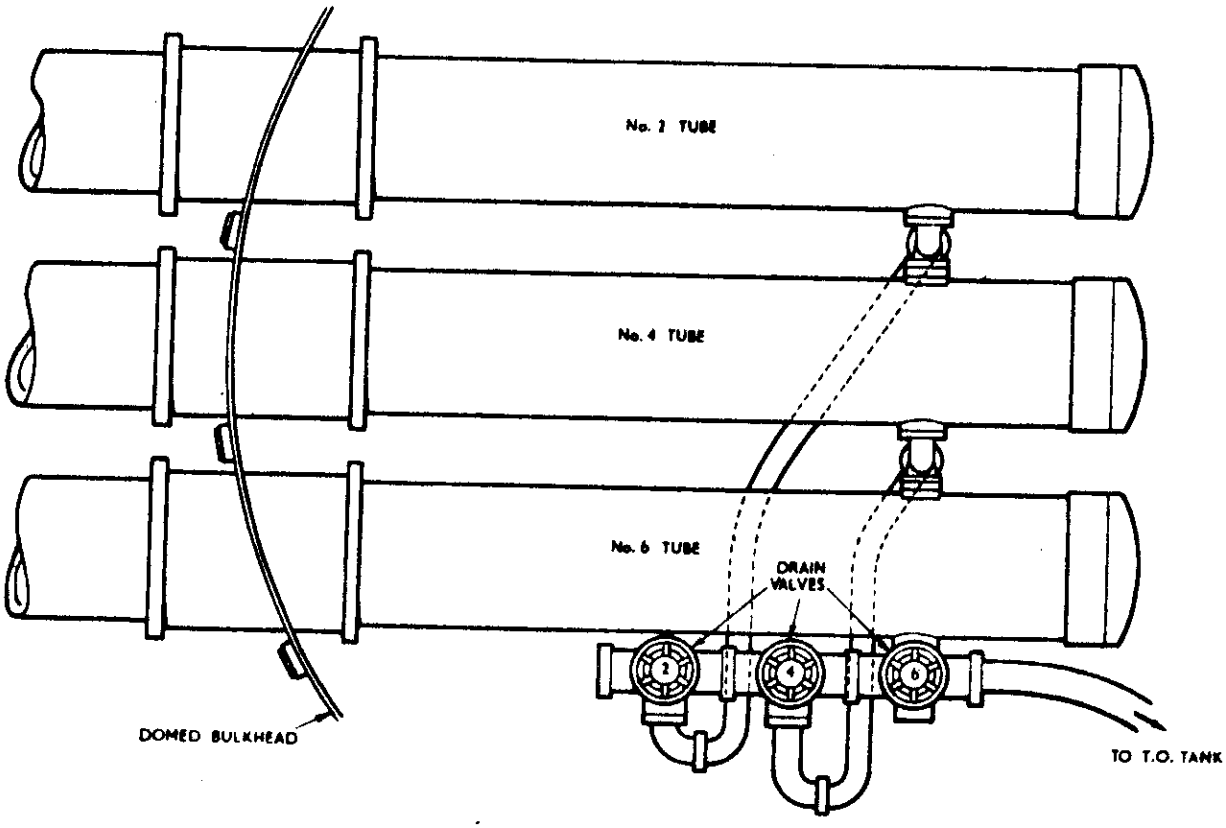
Two internal tanks are provided for use with the bow tubes:

(1) An automatic inboard bent tank (A.I.V. tank), which is an open-topped tank of 9 tons capacity and is immediately below the tube rear ends.

(2) A torpedo operating tank (T.O.T.) which has a capacity of 20 tons and is divided by the central trench of the Torpedo Compartment, to form one port and one starboard tank.

B. Tube Drain System

Each port and starboard set of tubes is connected to its respective half of the T.O.T. by a tube drain system that serves for both flooding and draining of the tubes.



Tube Drain System

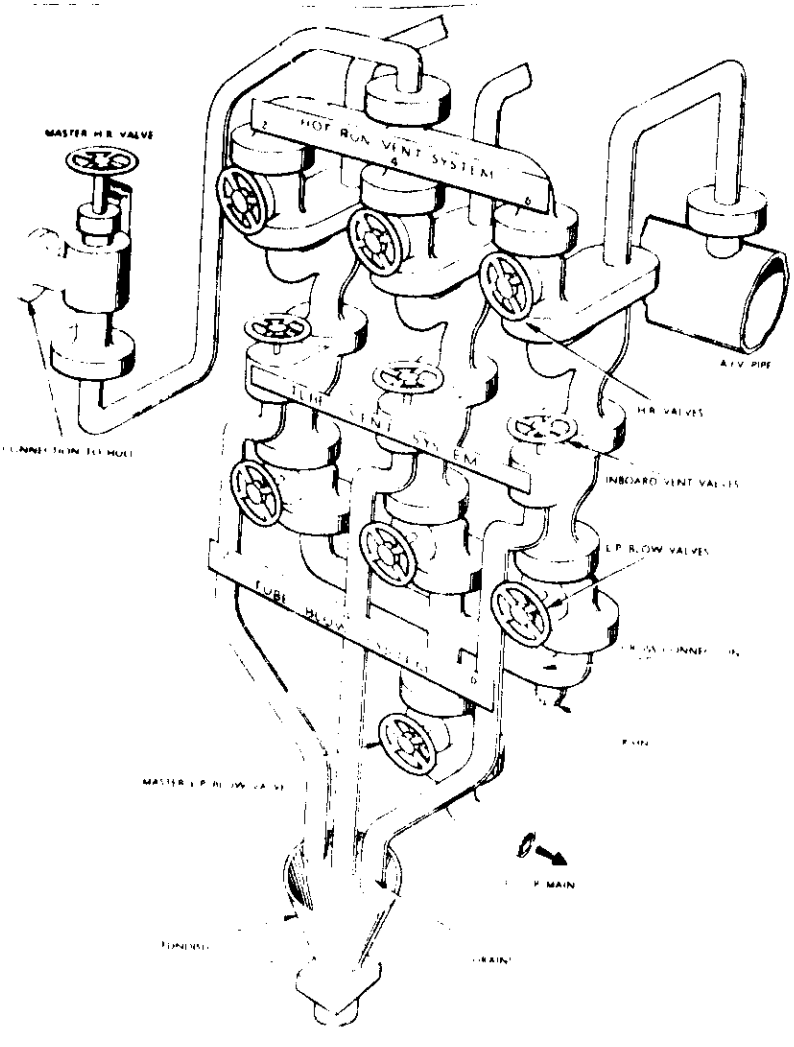
12.12 FLOODING, DRAINING, VENTING AND BLOWING (CONTD)

B. Tube Drain System (contd)

Each tube has a 3.5 in. diam. pipe secured to the bottom centre-line of its rear end and is connected via this pipe and a screw-down stop valve to a 7-in. bore pipe that is led to the T.O.T. and is common to all three tubes of the set. For convenience, the three tube drain valves of each set are grouped on the outboard side of the lowest tube of the set.

C. Combined Hot Run, Vent and Blow System

Outboard of each set of tubes is a panel on which are mounted the valves to interconnect the functions venting, blowing and making provision for 'hot run' torpedoes. The complex is so designed as to allow any one tube in a set or all three of a set to be operated at any one time.



12.12 FLOODING, DRAINING, VENTING AND BLOWING (CONTD)

C. Combined Hot Run, Vent and Blow System (contd)

Each panel has three rows of three screw-down stop valves, which, from top to bottom, are the hot run, the tube vent, and the tube blow valves respectively. The outlets of the hot run valves are interconnected by a cross-connection pipe, which in turn is piped to a master hot run valve on the hull. The blow valves are similarly interconnected and are joined to a low-pressure blowing system through a master blow valve at the bottom of the panel. The design of the castings that connect the hot run valves to the tube blow valves, and of the valve bodies provides a separate continuous channel with two branches between each pair of valves. Each top branch is piped to the A.I.V. pipe of its tube, and each bottom branch forms the body of its tube vent valve. The outlets of the three vent valves are piped to a tundish, which is below the panel and drains to the A.I.V. tank. All the pipes and casting channels of the system are of 2.5 in. bore, and a drain plug is screwed into the lowest part of the blow valve interconnection.

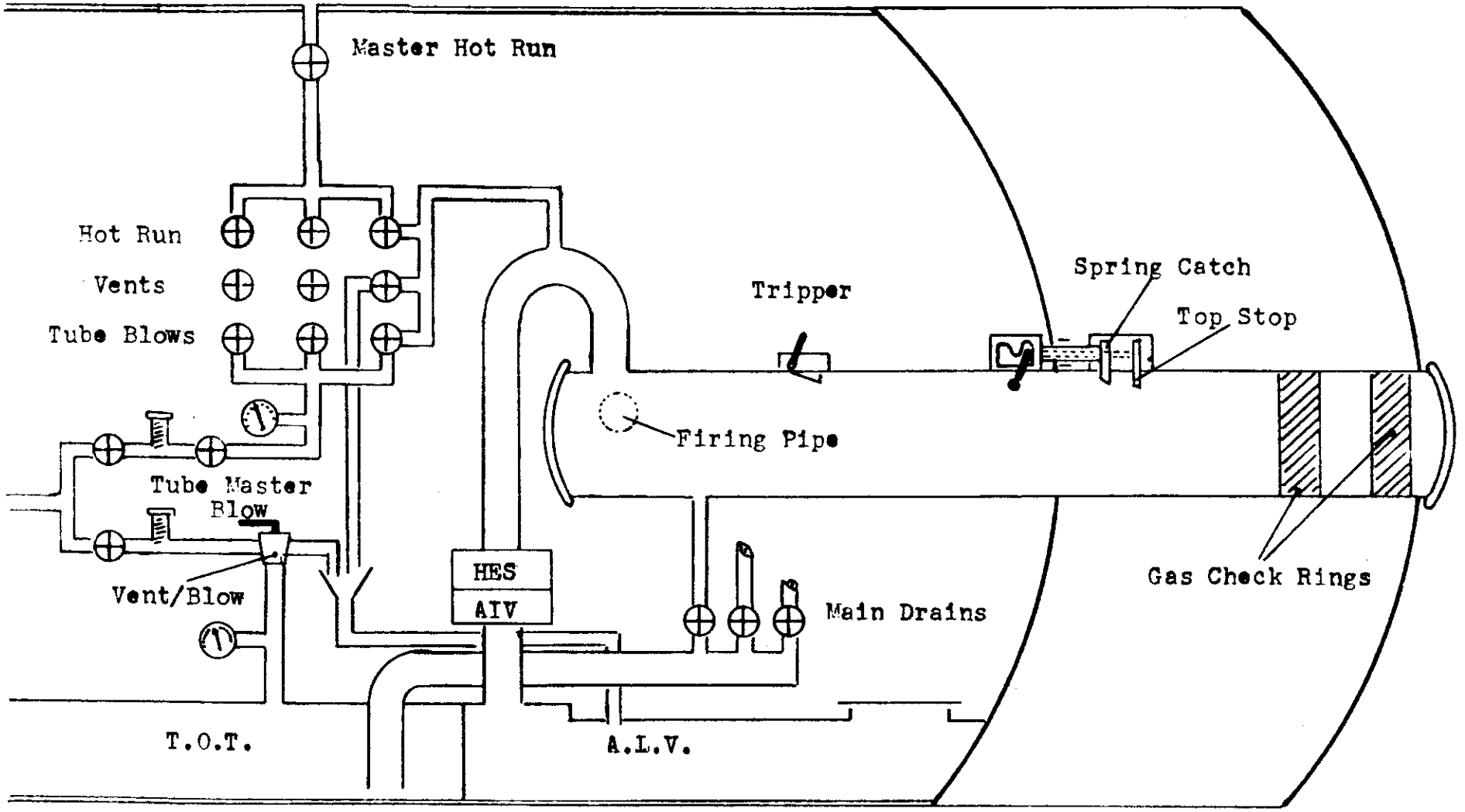
D. Operation

The two systems described above enable the tubes to be flooded, to be drained, and, when speed is essential, to be blown down; in addition, they enable any one of these operations to be performed on all three tubes at once if necessary. For flooding a tube, the tube vent valve and drain valve are opened, a combined vent-and-blow cock on the T.O.T. is put to BLOW, then air is supplied to the tank until water flows freely from the tube vent valve. For draining, the T.O.T. cock is put to VENT, the tube vent valve is opened, then the tube drain valve is opened until the tube is empty. Flow blowing-down, the T.O.T. cock is put to VENT, the tube vent valve is shut, the tube drain valve is opened, then the master and tube blow-valves are opened until the tube is empty.

E. Drain Valve Gratings

To prevent debris from entering the drain systems, gratings are fitted over the drain valve pipe orifices of the tubes.

C. P. 'O' CLASS SUBMARINES



TYPICAL WET SLACK FIT TORPEDO TUBE

12.13 TORPEDO TUBE FITTINGS

A. Top Stop and Spring Catch Assembly

The top stop and spring catch bear against the forward end after ends respectively of the top lug of a loaded weapon; they thus prevent the weapon from moving forward and aft. The spring catch is lifted automatically by the top lug when a weapon is being loaded, but it must be lifted by hand before the weapon can be withdrawn from the tube. The top stop is lifted automatically by an air motor during a firing cycle, so that the weapon is free to leave the tube. They are contained in a watertight stop box which is in No. 1 main ballast tank and is spigoted and secured to a pad on the top centre line of the tube. A slot in the spigot is aligned with the tube stop bearer strip groove, and the stop and catch normally project into the slot. Their operating mechanism is contained in an operating box secured to a pad on the top of the tube, just abaft the dome bulkhead. They are connected to their operating box by one operating shaft each; the top stop shaft passing through the centre of the spring catch shaft. Thus, one dome bulkhead gland suffices for both shafts.

The top stop is a 1.5 in. diameter stainless-steel bolt and is fitted in the foremost of two housings in the stop box. The spring catch is a 1 in. diameter stainless-steel bolt and is fitted in the after housing of the stop box. It is loaded by a spring to keep it IN; the spring being attached at one end to a lever clamped to the operating shaft, and at the other to a bracket secured to the tube.

A plate cover is secured to the operating box and had a slot to guide the clutch handle into either engaged or disengaged positions of the clutch. The handle can thus be used for lifting the top stop or spring catch, or for shaking them up occasionally. For indicating whether the top stop and spring catch are IN or OUT, an indicator plate is secured by screws to the cover and aligns with the indicator pointers.

The mechanism for operating the top stop is contained in a cylindrical hollow housing on the underside of the operating box. The housing has an air motor cylinder at one end.

12.13 TORPEDO TUBE FITTINGS (CONTD)

A. Top Stop and Spring Catch Assembly (contd)

The motor cylinder has two air pipe connections; one from a hand firing valve (H.F.V.), and one from an auxiliary small firing valve (aux. S.F.V.) motor. An exhaust groove in the piston is aligned with the latter air connection, and, when the top stop is DOWN, it connects the aux. S.F.V. motor bore to atmosphere, via a vent plug in the housing.

Thus, the top stop is:

(1) Normally held IN by the sleeve spring force acting through the sleeve, quadrant, top stop operating shaft and pinion.

(2) Lifted to OUT when, during a firing cycle, air is supplied to its motor cylinder from the H.F.V.; the piston exhaust groove being sealed by the housing, and the air passing to the aux. S.F.V. motor.

(3) Returned to IN when the H.F.V. is replaced after firing; the sleeve spring forcing the piston back to its normal position, thus uncovering the exhaust groove and venting the aux. S.F.V. motor to atmosphere; the outer end of the top stop operating cylinder being vented via the H.F.V.

B. Tripper

This forces the torpedo air-starting lever aft when a "steam" torpedo is being discharged. It is fitted in a watertight tripper box which is secured to a pad just off the top centre line of the tube. To indicate whether the tripper is UP or DOWN, an arch shaped indicator plate bridges the spindle and is bolted to the casting.

C. Tube Disconnect Switch

When a tube is loaded with a torpedo it must be connected to a torpedo control system within the submarine. To do this, an umbilical cable attached to the torpedo is plugged into a fitting in the tube breech door, which is connected by an external cable to a disconnect switch on the tube; the switch being permanently wired to control system circuits. On firing, the circuits are broken by the automatic

12.13 TORPEDO TUBE FITTINGS (CONTD)

C. Tube Disconnect Switch (contd)

operation of the switch. An operating arm on the switch is so connected by levers to the top stop shaft that when the tube firing lever is pulled, the top stop operating gear triggers the switch; the levers being so arranged that the switch operates before the top stop is fully raised.

The switch gear is contained in a split aluminium-alloy casing. One part of the casing is bolted to a pad near the top centre line of the torpedo tube, the other part forms the cover. An operating shaft passes through and is sealed in a hole in the back of the casing fixed part. The outside end of the operating shaft is connected by a rod and levers to the top stop shaft.

The shaft of a resetting lever passes through and is sealed in a bush through the centre of the casing cover. The resetting lever is restricted by two stops cast on the cover.

D. Operation of Top Stop Assembly and Disconnect Switch

When the top stop is DOWN, the disconnect switch can be set by moving the resetting lever towards the word RESET cast on the outside of the cover; by doing so:-

(1) The resetting cam plate contacts the pegged arm and rotates the central shaft; thereby engaging the electrical contacts.

(2) The switch catch plate moves, stretches its spring and is held by the toe of the L-shaped pawl.

(3) The peg of the L-shaped pawl traverses the slot in the circular plate and rests against one end of the slot.

The resetting lever can then be released; thus it will be returned to its stop, under the action of its cam plate spring.

12.13 TORPEDO TUBE FITTINGS (CONTD)

D. Operation of Top Stop Assembly and Disconnect Switch (contd)

When the top stop is being lifted on firing:

(1) The operating shaft is rotated by the top stop interlock shaft.

(2) The circular plate rotates and forces the toe of the L-shaped pawl away from the switch catch.

(3) The central shaft then rotates, under the action of the switch catch spring, and the electrical contacts are opened.

When the top stop is replaced, the operating shaft turns and resets the L-shaped pawl in readiness to hold the switch closed when the resetting lever is put to RESET.

12.14 FIRING GEAR

A. Introduction

The system described in the following pages covers the "designed" arrangements; subsequent modifications may take place which will change the system as described.

The normal method of discharge for torpedoes carried in RCN 'O' class submarines, is a 'swim out' release whereby the motor of the weapon is started and a modified Low Pressure air system used to operate the top stop mechanism and Disconnect Switch. Once free to travel, the torpedo swims its own way out of the tube.

Weapons can be discharged from the tubes by the controlled admission of a compressed air impulse; this is cut-off when the impulse pressure has fallen to a pre-determined figure which varies according to the depth of the submarine. Before the weapon leaves the tube, the expanding air is vented into the submarine, thus ensuring that the discharge is splashless; the venting being continued until enough water has been taken in to compensate for the negative buoyancy of the weapon. This sequence is initiated by operating a hand firing lever, and it then proceeds automatically.

B. Air Supply System

Two separate air systems are fitted; one is a high pressure system at 2500 lb/sq.in; the other is a low pressure system in which the pressure varies at each tube on calibration but must be between 1200 and 1500 lb/sq.in. The H.P. system operates the L.F.V. motor and an impulse cut-off (I.C.O.) unit, and also provides a constant impulse pressure for discharge. The L.P. system initiates the firing cycle and controls the venting cycle.

C. Firing Reservoirs

Each tube has a firing air reservoir of 3½ cu. ft. capacity. A 4-way adaptor screwed into the forward end of the reservoir is sealed by a leakproof washer and has two holes in its inner end; one is the charging-pipe connection air hole, and the other is the drain-connection hole, in which a pipe is screwed and sweated. This pipe is so bent that its open end is just clear of the bottom of the reservoir; thus any water that may collect in

12.14 FIRING GEAR (CONTD)

C. Firing Reservoirs (contd)

the reservoir will be blown out first when the reservoir drain valve is opened. Each reservoir has a maximum working-pressure of 2500 lb/sq.in. and a proof test-pressure of 4500 lb/sq.in.

D. Large Firing Valve and Motor

This unit is bolted to the firing air reservoir of its tube; it controls the rate at which H.P. air can enter the tube from the reservoir. When its motor receives air from the aux. S.F.V. and motor its valve opens at a rate determined by a silicone-fluid filled dashpot mounted on its body; it then passes the air to its tube via a water non-return valve (W.N.R.V.) on the tube firing pipe.

When the valve is being opened, ports allow a gradually-increasing volume of air to pass from the reservoir to the tube, via a flanged connection on the tube and the water non-return valve. Through the lowest part of the body is a drain hole, water leakage from which will indicate that the W.N.R.V. is defective, and air leakage will indicate that the L.F.V. is not airtight.

E. Dashpot

This is filled with silicone fluid and is fitted to control the rate at which the L.F.V. will open to admit impulse air to the torpedo tube during a firing cycle. An indicator plate graduated in turns and tenths-of-a-turn is mounted on the dashpot cylinder and is aligned with an indicator attached to a needle valve, the setting of which determines the opening-rate of the L.F.V.

F. Water Non Return Valve

When a torpedo tube is flooded, water is prevented from entering the body of its L.F.V. by a water non-return valve (W.N.R.V.)

The W.N.R.V.s of tubes 3 and 4 are fitted with drain pipes so that they can drain completely into their tubes during blowing-down; but such pipes are not needed for the other four tubes.

12.14 FIRING GEAR (CONTD)

G. Impulse Cut-Off Valve Unit

During a firing cycle, the I.C.O. unit determines the pressure at which the impulse air supply to the tube will be cut-off, this pressure varying in accordance with the firing depth. The valve of the unit is constrained to open by a spring, but it is constrained to shut by both sea pressure and H.P. air pressure. It remains shut during a firing cycle until the H.P. air pressure has fallen enough for its spring to overcome the combined sea and air pressures; it then opens and supplies H.P. air to the shutting side of the L.F.V. motor, the effective piston area of this side of the motor being greater than that of the opening-side.

H. Hand Firing Valve

This is opened to commence the firing and venting cycles. When open, it passes L.P. air to the top stop operating cylinder from which the air passes to the auxiliary small firing valve motor. It is shut after a weapon has been discharged, and it then enables the firing and venting system fittings to vent to atmosphere and subsequently to recock. The H.F.V.s for all tubes are mounted on a panel between the tubes and are interlocked with their bow cap operating gears.

In the top end of the lever is a spring-loaded thumb push for operating. To prevent accidental operation of the valve, a feathered safety pin is fitted through quadrant and hand lever. The toes of the lifting arms are machined to suit bow cap operating gear interlock cams.

J. Solenoid Operated Valve and Motor

The torpedo tubes can be fired from the Control Room. To achieve this, the hand firing valve bracket of each tube is fitted with an air motor which is supplied from a solenoid operated valve nearby. When energised by pushing a button in the Control Room, the solenoid lifts the air valve which passes air to the motor. No extra interlocks are fitted to this system because the bow cap/H.F.V. interlock will prevent movement of the H.F.V. should the solenoid be energised when the bow cap is shut. A TUBE READY push is provided in the

12.14 FIRING GEAR (CONTD)

J. Solenoid Operated Valve and Motor (contd)

Torpedo Compartment so that the Torpedo Officer can inform the Control Room when a tube is ready to be fired.

K. Top Stop Operating Motor

When this is supplied with air from the hand firing valve, it first causes the disconnect switch to open, and it then lifts the top stop and spring catch.

L. Auxiliary Small Firing Valve and Motor

After the top stop operating motor has actuated, it passes L.P. air to an auxiliary small firing valve and motor (aux. S.F.V. and motor), which is actuated by the L.P. air and causes H.P. air to flow to the opening side of a large firing valve motor (L.F.V. motor) and also to an impulse cut-off valve unit (I.C.O. unit); in addition it allows the L.P. air to pass to a capacity chamber, via a differential valve and a compensating unit.

M. Differential Valve, Compensating Unit and Capacity Chamber

After the top stop has been lifted during a firing cycle, L.P. air passes via the aux. S.F.V. and motor to a differential valve and a compensating unit. The air forces the differential valve downwards against the piston of a fluid-filled dashpot and is then allowed to pass to the opening side of an automatic inboard vent valve motor (A.I.V. motor); this then opens to allow expanded impulse air, together with enough water to compensate for the negative buoyancy of the discharged weapon, to enter the A.I.V. tank. During this time, however, the L.P. air passes into a capacity chamber via a needle valve of the compensating unit, the setting of which is controlled by a hydrostat, i.e. in accordance with the depth of the submarine. The chamber is connected to both the shutting-side of the A.I.V. motor and the underside of the differential valve, so that when the pressure in the chamber is sufficient, the A.I.V. valve is forced shut, and the differential valve is forced upwards and causes the opening-side of the A.I.V. motor to vent to atmosphere.

12.14 FIRING GEAR (CONTD)

N. Automatic Inboard Venting

A flanged pipe connection on the top of the tube rear end is joined by a 5.5 in. bore pipe to the A.I.V. tank, via a combined automatic inboard vent and hand emergency sluice valve assembly. This arrangement is for:

(a) Venting impulse air inboard before it can escape from the tube, thus ensuring splashless discharge.

(b) Preserving trim by admitting enough water into the submarine, thus compensating for the negative buoyancy of a discharged weapon.

O. Combined Automatic Inboard Venting and Hand Emergency Sluice Valves

The A.I.V. sluice valve:

(a) Forms a watertight valve between the sea and the submarine when the bow cap is open.

(b) Opens automatically during a firing cycle and shuts automatically after an interval of time which varies according to the depth on firing.

(c) When open, provides a full bore, streamlined passage for air and water being vented inboard.

The hand emergency sluice (H.E.S.) valve:

(a) In normal circumstances, provides a full bore, streamlined passage for air and water being vented inboard.

(b) In an emergency, provides a shut-off valve between the sea and the submarine until either the bow cap or the A.I.V. sluice can be shut.

Two valve boxes are secured together by long studs and nuts; one box houses the H.E. sluice valve and is on top of the other which houses the A.I.V. The H.E. valve is operated by a hydraulic motor bolted to its box, or by a handwheel assembly bolted to the other end. One hydraulic valve supplies the H.E. valve motors of all torpedo tubes so that, in an emergency, all six H.E. valves can be shut at once. The A.I.V. valve is operated by an air motor bolted to its box; it is opened by air supplies from the differential valve and is shut by air from the capacity chamber.

12.15 OPERATION OF D.P.F.G.

A diagrammatic lay-out for one torpedo tube is shown in Fig. 12. For clarity, the differential valve and compensating unit are shown separated, with the latter mounted on the capacity chamber, whereas they are one unit. This does not modify the description of the operation of the gear and sequence of events.

A. Charging Cycle

To charge the firing system and to prepare a torpedo tube for firing:

(1) The reservoir charging valve is opened, thus air at 2500 lb/sq.in. passes to:

(i) The firing reservoir, where it builds-up gradually to the full pressure of the inlet.

(ii) The back of the I.C.O. valve and keeps the valve shut.

(iii) The inlet side of the aux. S.F.V. and assists the valve spring in keeping the aux. S.F.V. shut.

(2) The L.P. air stop valve is opened, thus L.P. air passes to the inlet side of the H.F.V.

(3) The torpedo tube is flooded by 'blowing-up' water from the T.O.T.

(4) The Muzzle Door is opened

(5) The H.E. Sluice valve is opened

(6) The H.F.V. safety pin is removed

The torpedo tube is then ready for firing.

B. Firing Cycle

To fire the torpedo, the H.F.V. is operated by pulling the hand firing lever, or in some submarines by pushing a button in the Control Room.

12.15 OPERATION OF D.P.F.G. (CONTD)

B. Firing Cycle (contd)

On firing:

(1) L.P. air from the H.F.V. enters the top stop operating cylinder and forces over the top stop piston, thus:

(i) The top stop operating shaft rotates.

(ii) The top stop is lifted.

(iii) The disconnect switch is tripped.

(iv) A port in the top stop operating cylinder is uncovered for air to pass to the aux. S.F.V. motor.

(2) L.P. air enters the aux. S.F.V. motor and forces over the piston, thus:

(i) The aux. S.F.V. is unseated.

(ii) L.P. air passes to the differential valve casting annulus.

(iii) H.P. air passes to the I.C.O. valve unit, but the I.C.O. valve remains shut.

(iv) H.P. air passes to the opening side of the L.F.V. motor.

(3) Because of the area of the L.F.V. motor piston is so much larger than the area of the L.F.V. the H.P. air in the opening side of the motor forces over the piston against both the shutting effect of the reservoir air pressure and the retarding effect of the L.F.V. dashpot; the shutting side of the L.F.V. motor being vented via the air release valve. Thus:

(i) The L.F.V. opens at a rate controlled by the setting of the L.F.V. dashpot.

(ii) H.P. air flows from the reservoir, passes through the ports in the L.F.V. shirt, opens the W.N.R.V. and enters the torpedo tube.

12.15 OPERATION OF D.P.F.G. (CONTD)

B. Firing Cycle (contd)

(iii) H.P. air builds-up pressure in the tube at a rate determined by the size of the L.F.V. skirt ports.

(iv) The air in the tube expands and discharges the weapon.

(4) The pressure in the firing reservoir falls until it can no longer keep the I.C.O. valve shut. The I.C.O. valve spring thus forces the valve open against the hydrostat pressure, the air:-

(i) Passes via the 4-way piece and shuts the air release valve.

(ii) Enters the shutting side of the L.F.V. motor.

(5) Because the area on the shutting side of the L.F.V. motor piston is so much larger than that on the opening side, the L.F.V. shuts. Thus, the air supply to the torpedo tube is cut-off at a pressure determined by the hydrostat (i.e. the depth of the submarine) and the firing cycle is terminated.

C. Venting Cycle

During the firing cycle, L.P. air passes to the differential valve casting annulus and then:

(1) Passes to the inlet of the compensating unit needle valve.

(2) Forces the differential valve downwards against the retarding effect of the dashpot, thus:

(i) Air passes to the opening side of the A.I.V. valve motor.

(3) The A.I.V. valve opens; its point of opening being determined by:

(i) The timing of the differential valve dashpot, which is set during manufacture and should not be altered.

(ii) The L.P. air pressure, which is set on the L.P. reducer when the torpedo tube is calibrated.

12.15 OPERATION OF D.P.F.G. (CONTD)

C. Venting Cycle (contd)

(4) Air passes from the compensating unit needle valve to the capacity chamber; the setting of the needle valve being determined by its hydrostat (the depth of the submarine).

(5) At a rate depending on the depth, the pressure builds-up in the capacity chamber until it is sufficient to force up the differential valve and thus:

(i) The port to the air release valve is uncovered and vents the opening side of the A.I.V. valve motor.

(ii) Air from the capacity chamber enters the shutting side of the A.I.V. valve motor and shuts the A.I.V. valve; thus completing the venting cycle.

D. Recocking Cycle

When the H.F.V. is lifted on firing, either locally or from the Control Room, the hand firing lever is locked by a spring-loaded pawl and remains so until it is deliberately replaced. This is usually done immediately after the A.I.V. valve motor has been heard to vent on shutting. However, the lever need not be replaced so soon after firing, but it must be replaced before the Muzzle Door is shut, or damage to the Muzzle Door interlock operating gear will result. When the H.F.V. is replaced:

(1) Exhaust holes in the H.F.V. push rod are uncovered, thus the outlet side of the H.F.V. is put to exhaust and the H.F.V. is shut by inlet air pressure and its spring.

(2) The top stop operating cylinder is vented via the H.F.V., thus:

(i) The top stop piston is forced shut by its spring.

(ii) The top stop operating shaft rotates and resets the top stop.

12.15 OPERATION OF D.F.F.G. (CONTD)

D. Recocking Cycle (contd)

(3) The pressure in the capacity chamber, which also acts on the shutting sides of the differential valve and A.I.V. valve motor, lifts the relief valve of the compensating unit; the air thus by-passes the needle valve and exhausts via the aux. S.F.V. motor and the top stop operating cylinder atmospheric vent.

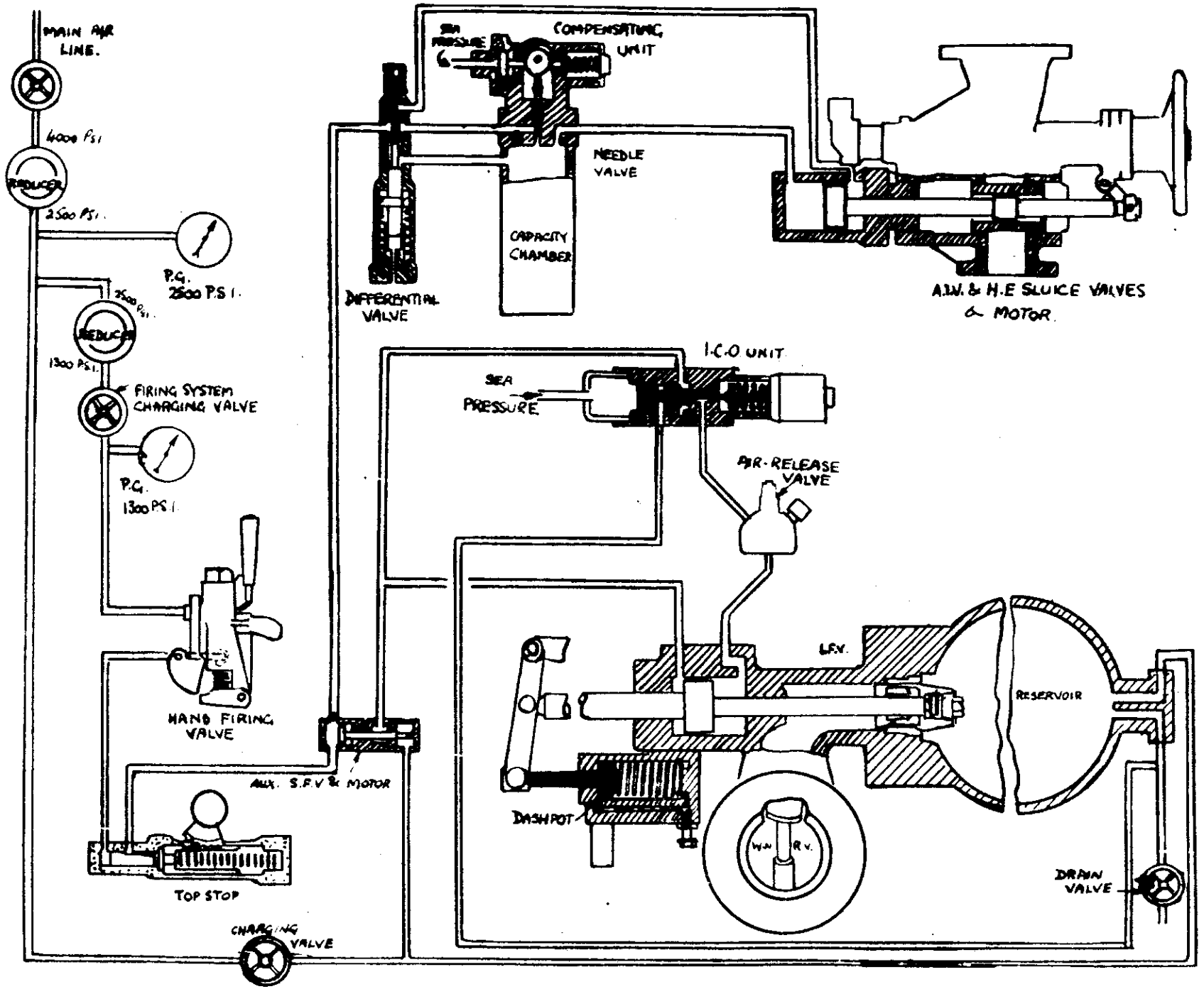
(4) When the pressure on the piston of the aux. S.F.V. motor fails:

(i) The aux. S.F.V. is reseated by its spring and by pressure remaining in reservoir.

(ii) The exhaust channel in the aux. S.F.V. is connected to atmosphere and vents both the opening and shutting sides of the L.F.V. piston; the I.C.O. valve being held open by its spring.

E. Recharging After Discharge

The cut-off pressure, which acts on both sides of the L.F.V. piston and in the I.C.O. valve chamber, may take a considerable time to vent via the small hole of the aux. S.F.V. body. During this time, the pressure in the I.C.O. valve unit will keep the air release valve of the 4-way piece shut. If, therefore, the air reservoir is recharged before the system has fully vented, as might occur when firing water shots in quick succession during trials, the I.C.O. valve might shut whilst a reasonably high pressure is still held in the shutting side of the L.F.V. motor and in the I.C.O. valve unit. This will cause premature cut-off, and therefore, premature shutting of the L.F.V.; this is even more likely to occur at shallow depths where the cut-off pressure is higher. Confirmation as to whether the cut-off pressure is released can be gained by listening for the opening of the air release valve and hearing the air as it vents to atmosphere. However, as a further precaution, at least one minute must elapse between the firing of a shot and the commencement of charging the air reservoir for the next shot.



DUAL PRESSURE FIRING SYSTEM.

CHAPTER 12 - PART II - AFTER TORPEDO TUBES

12.20 AFTER TORPEDO TUBES GENERAL

Each submarine has two torpedo tubes in its stern; they extend through No. 7 main ballast tank and are numbered 7 and 8 from starboard to port. The tubes are short, are fitted with starting-gear instead of firing-gear, and are of large bore to ensure an adequate water supply to the propellers of weapons being discharged.

Each tube is sealed by a muzzle door at its after end, and by a breech door at its forward end. The muzzle door is operated by a hydraulic ram, which is on the inboard side of the tube and is so interlocked with the breech door that neither can be opened while the other is open. The breech door has several safety-fittings to prevent its being opened while the tube is flooded.

12.21 AFTER TORPEDO TUBE CONSTRUCTION

A. Inboard and Outboard Lengths

Each torpedo tube comprises two lengths, namely an inboard length and an outboard length. A bulkhead sleeve is welded in the dome bulkhead; it has an internal diameter of about 25 in. and is 31 in. long.

The inboard length is a forging with its flange welded on its after end. It has a bore of 22.5 in. and is 28.4 in. long. On its forward length is a 2-start buttress thread for a door locking ring, and its forward end face is machined to form a joint face for a breech door. On one of its sides is a pad for a hinge bracket, and on the other is a bracket for a safety swing-bolt. One of two pads on its top is for stop-and-catch operating gear, and the other is bored for a vent pipe connection. On its bottom is formed an elbow piece for a drain pipe.

The outboard length is of $\frac{1}{2}$-in. thick rolled-and-welded steel plate; it has an internal diameter of about 25 in. and is about 106 in. long. Its flange is welded on its forward end, and a lip end is welded on its after end. It extends through No. 7 main ballast tank, and a 1-in.

12.21 AFTER TORPEDO TUBE CONSTRUCTION (CONTD)

A. Inboard and Outboard Lengths (contd)

thick anti-collapse ring is welded around its middle. Near the ring, on its top, is a pad for a stop-and-catch box. Its lip end is welded to a spectacle plate, which in turn is welded to the after face of the tank bulkhead and carries bearings for a muzzle door hinge shaft. The lip end is grooved internally so that a test door can be fitted for testing the tube. Aft of the tube, between the lip end and an orifice in the stern casing, is a guide tube that is perforated to ensure adequate water flow when weapons are being discharged.

B. Bearers

To act as bearers for weapons. aluminium bronze strips are riveted to the top, bottom, and both sides of the tube. They extend from the rear end to within 5.5 in. of the lip end, but gaps are cut in the top and bottom strips, in places where they would foul other fittings or apertures. The top strip is slotted lengthwise to provide a channel for the top lugs of weapons, the rear end of the slot being bell-mouthed for easy entry of weapon top lugs. The inboard ends of all four strips are chamfered to guide weapons into the tube. The bearers are machined to an internal diameter of 21.095 in. after they have been erected.

C. Muzzle Door

This is a circular steel door with a dexine sealing ring held in a groove in its inner face by a retaining ring and set bolts. The sealing ring bears against the forward end face of the torpedo tube when the muzzle door is shut. A connecting rod is bolted to a crosshead and to an operating shaft mounted along the side of the tube in No. 7 ballast tank. The operating shaft extends through a sleeve in the bulkhead and is operated by a hydraulic ram bolted to the bulkhead of the After Ends; thus, as the ram moves, fore-and-aft movement of the operating shaft is converted to an angular movement of the stern cap by the top plate. A stop bracket is fitted on the centre-line of the submarine, near the guide tubes, enabling both doors to be wide open at the same time.

12.21 AFTER TORPEDO TUBE CONSTRUCTION (CONTD)

D. Crosshead and Shafting

The crosshead and shafting for each stern muzzle door is contained in a box in No. 7 MBT.

E. Hydraulic Rams

These are mounted on the after bulkhead of the A.T.R. between the torpedo tubes. Each ram is double acting and powered from the ships hydraulic system.

The operation of both hydraulic rams and associated linkage to the muzzle doors is similar to that found for the forward tubes.

F. Operating Gear and Interlocks

The operating gear for the muzzle door is identical to that for the forward tubes and likewise interlocks with the breech door and firing mechanism are fitted.

G. Breech Door

Both after torpedo tube breech doors are similar in construction, purpose and method of operation to those on the forward tubes.

Part I of this chapter should be consulted for further details.

12.22 AFTER TORPEDO TUBE FLOOD AND DRAIN SYSTEM

Requirement

For the correct working and firing of the torpedo tubes it is necessary to be able to:

(a) Flood the tubes with water from a tank within the submarine, so that, on opening the muzzle doors prior to firing, no more water can enter the tubes, and therefore no change in the longitudinal trim of the submarine will result.

12.22 AFTER TORPEDO TUBE FLOOD AND DRAIN SYSTEM (CONTD)

Requirement (contd)

(b) Drain down the tubes after firing, to a tank within the submarine, so that the breech doors can be opened and reload torpedoes inserted.

(c) Allow air to enter, or escape from, the tubes whilst carrying out (a) or (b).

(d) Use low-pressure air to pressurise the tank and thus flood the tube.

These requirements are met by use of the tank, fittings, and system described below.

A. Tank

Below the inboard lengths of the tubes is an internal tank that has a capacity of 800 galls. The tank fittings include a vent cock, a dip rod, an L.P. air blow and relief valve connection, and two tube-drain valves. These two valves are on the tank top and are 2-in. bore screw-down-stop valves; each is connected by pipes to the underside of its torpedo tube, and is joined also to a pipe that extends downwards to almost touch the bottom of the tank.

B. System

Each tube has a pipe-connection screwed in its top, near its rear end; the connection is joined to two screw-down-stop valves, via 3/4-in. bore pipes and a T-piece. The valve nearest the tube is a hull valve, called 'the equalising-and-hot run valve'. The other valve, called 'the tube vent valve', is joined to a pipe leading to a tundish; this is piped to a bilge nearby.

The equalising valve is normally kept shut, but it must be opened after the tube has been 'blown-up' for the tube and sea pressures to equalise; it must also be opened if a torpedo has a hot run in the tube, for the exhaust gases to vent out-board. The vent valve is also normally kept shut; it must be opened both before and after firing, however, for air to vent from the tube during 'blowing-up', and for air to enter the tube during 'draining-down'. The vent and equalising valves must never be open at the same time as each other, otherwise sea-water will enter the compartment.

12.23 AFTER TORPEDO TUBE FITTINGS

A. Stop and Catch

Each tube has a stop and catch for securing torpedoes in its bore. The stop and catch comprise two circular plates. They are mounted on a shaft in the top centre-line of the ballast tank length, and can be rotated and so set that notches in their rims are in any one of three positions relative to a slot in the top bearer strip of the tube. These positions are for a weapon to be loaded, for securing a weapon, or for a weapon to be free to leave the tube.

B. Disconnect Switch

As with the forward tubes, torpedoes are, and have to be connected to a control circuit. The link between the static 'on board' system and the weapon is through the 65 pin plug on the breech door and the disconnect switch. The disconnect switch is broken by the firing process as the torpedo is fired. Generally, the fittings on the after tubes is similar to that found on the forward system.

C. Tripper

A tripper, previously used on other, more antiquated, types of torpedo is still fitted. Its operation is a part of the firing sequence.

12.24 POWER OPERATING STARTING GEAR

This gear enables the disconnect switch, the stop and catch, and the tripper to be actuated by the pressing of a button in the Control Room, or by the pulling of a hand-starting valve lever in the After Torpedo Room. Air for operating various fittings of the gear is supplied from a 1500 lb/sq.in. air system that is connected to the H.P. air main via a reducing valve.

A. Air System

From a reducing valve of the H.P. air main, the air system for each after torpedo tube comprises the following fittings:

12.24 POWER OPERATING STARTING GEAR (CONTD)

A. Air System (contd)

(a) A stop valve

(b) A pressure gauge

(c) A quick-acting stop valve, which is mounted on the ram cylinder framework of, and is actuated by, the stern cap operating gear; it is open only when the stern cap is wide open.

(d) A three-way piece, which supplies (e) and (g).

(e) A solenoid operated valve, which is mounted together with (f) and (g) on a panel near the tube. It is actuated by its solenoid and passes air to (f) when the Control Room button is pressed.

(f) A hand starting valve motor, which actuates and opens (g) when supplied with air.

(g) A hand starting valve (HSV) which, when open, supplies (h).

(h) A tube disconnect switch motor (T.D.S. motor), which trips the disconnect switch when it is supplied with air from (g). The air then passes to (j).

(j) A gearbox motor containing two pistons; one piston is for operating the stop-and-catch shaft, and the other is for working an interlock shaft between the stop-and-catch shaft and a 3-piston handwheel, which must be set to READY TO FIRE before the air motor can actuate. The stop-and-catch carries a flange that is connected to the tripper and, therefore, this is also actuated when the stop-and-catch are rotated for freeing a weapon.

B. Hand Starting Valve

The H.S.V. of each tube is mounted on a panel near its tube and is interlocked with the muzzle door operating gear via a stop valve in the air supply line. Each valve is housed in a vertical cylindrical casting having a boss and quadrant to take a hand lever, and also a bracket to secure the unit to a panel. The casting is bored vertically and has

12.24 POWER OPERATING STARTING GEAR (CONTD)

B. Hand Starting Valve (contd)

two sweated and screwed pipe connections; one near the top is the inlet and is connected to the air supply; and the other is the outlet and is connected to the gear box air pressure inlet via the T.D.S. air motor.

When the H.S.V. is opened:

(1) Air enters the cylinder and forces the piston downwards against its spring.

(2) The piston spindle strikes the switch trip lever, thereby breaking the control circuits of the torpedo.

(3) The piston seals off the atmospheric port, but the outlet port is uncovered for the air to pass to the gearbox air motor.

When the H.S.F. is shut:

(4) The piston is forced against its spigot by its spring.

(5) Air exhausts from the gearbox motor via the atmospheric vent.

(6) Air exhausts from the top end of the cylinder via the H.S.V.

(7) The piston spindle clears the switch trip lever, in readiness for the switch mechanism to be re-set by hand.

C. Arrangement of Stop-and-Catch and Tripper Shafting

For power-operated starting gear, the stop-and-catch and tripper shafts are arranged differently from those for hand-starting gear. The pedestal bearing is omitted from the intermediate shaft of the stop-and-catch, but an adaptor is keyed on the forward end of this shaft and is coupled to the forward shaft by a flexible coupling. This coupling allows for any misalignment between the two shafts, and for any deflection due to compression of the pressure hull; the adaptor is spaced from the forward shaft by 1/8 in., both stars of the coupling are keyed on their shaft. The forward

12.24 POWER OPERATING STARTING GEAR (CONTD)

C. Arrangement of Stop-and-Catch and Tripper Shafting (contd)

shaft is coupled to a shaft protruding from the power-operated gearbox; the halves of the coupling are pinned to their shafts and are bolted together. As well as a muzzle door interlock flange, the forward shaft has a tripper operating flange pinned to it.

D. Gear Box

This is mounted on a pad near the tube rear end and is closed by an end-cover plate bolted to it. It has three shafts, namely an input shaft, a pinion shaft, and an output shaft, These are pressed in housings formed in the after end face and in the end coverplate, which is dowelled for accurate alignment of the bushes.

The input shaft has both a gearwheel and an interlock plate keyed on its inner end; it extends through a flanged housing bolted to the end cover plate and has an indicator pointer keyed and secured by a washered-nut on its outer end. A circular indicator plate is secured by screws to a flange on the forward end of the flanged housing and is engraved LOAD, READY TO FIRE, and FIRED; these positions correspond with three semi-circular grooves in the rim of the interlock plate. A handwheel some distance forward of the tube is connected to the outer end of the input shaft by rods that are linked with universal couplings covered with grease-filled rubber sleeves. A slot through the forward end of the waisted-spindle engages the toe of an interlock lever, which pivots about a pin in a bracket on one corner of the box. Within the box, a spring surrounding the forward length of the waisted-spindle holds a washer against a collar on the spindle and constrains the waisted-length away from the interlock flange; thus, before the 3-position handwheel can be turned, the interlock lever must be depressed to bring the waisted-length into line with the flange. Because the interlock lever is so close to the stern cap operating gear, a spring-loaded push is mounted on a bracket bolted to the indicator plate and enables the lever to be depressed without risk of injury to the operator.

12.24 POWER OPERATING STARTING GEAR (CONTD)

E. Operation

Assuming that the handwheel is at READY TO FIRE and the muzzle door is wide open then, when the H.S.V. is opened:

(1) Air passes to the disconnect switch motor and trips the disconnect switch.

(2) The air then passes to the gear box motor cylinders.

(3) The waisted-spindle is forced forwards and thus frees the interlock flange of the input shaft.

(4) The rack piston rod is forced against its stop; it rotates the gears and thus turns the indicator pointer to FIRED.

(5) The stop-and-catch rotates and frees the torpedo.

When the H.S.V. is shut:

(6) The gearbox motor cylinders vent to atmosphere via the disconnect switch motor.

(7) The waisted-spindle is forced aft by its spring and resecures the interlock flange.

NOTES

(i) The interlock lever must be depressed before the handwheel can be moved from FIRED to LOAD, and from LOAD to READY TO FIRE.

(ii) The action of turning the handwheel from LOAD to READY TO FIRE returns the rack piston rod to the beginning of its stroke, in readiness for the next discharge.

(iii) The tripper remains stationary while the handwheel is moved from LOAD to READY TO FIRE, because the loose flange of the stop-and-catch shaft is not in contact with the spigot of its tripper flange during this movement.

C. F. 'O' CLASS SUBMARINES

CHAPTER 12 - WEAPONS SYSTEMS

PART III - EMBARKING STOWING AND LOADING

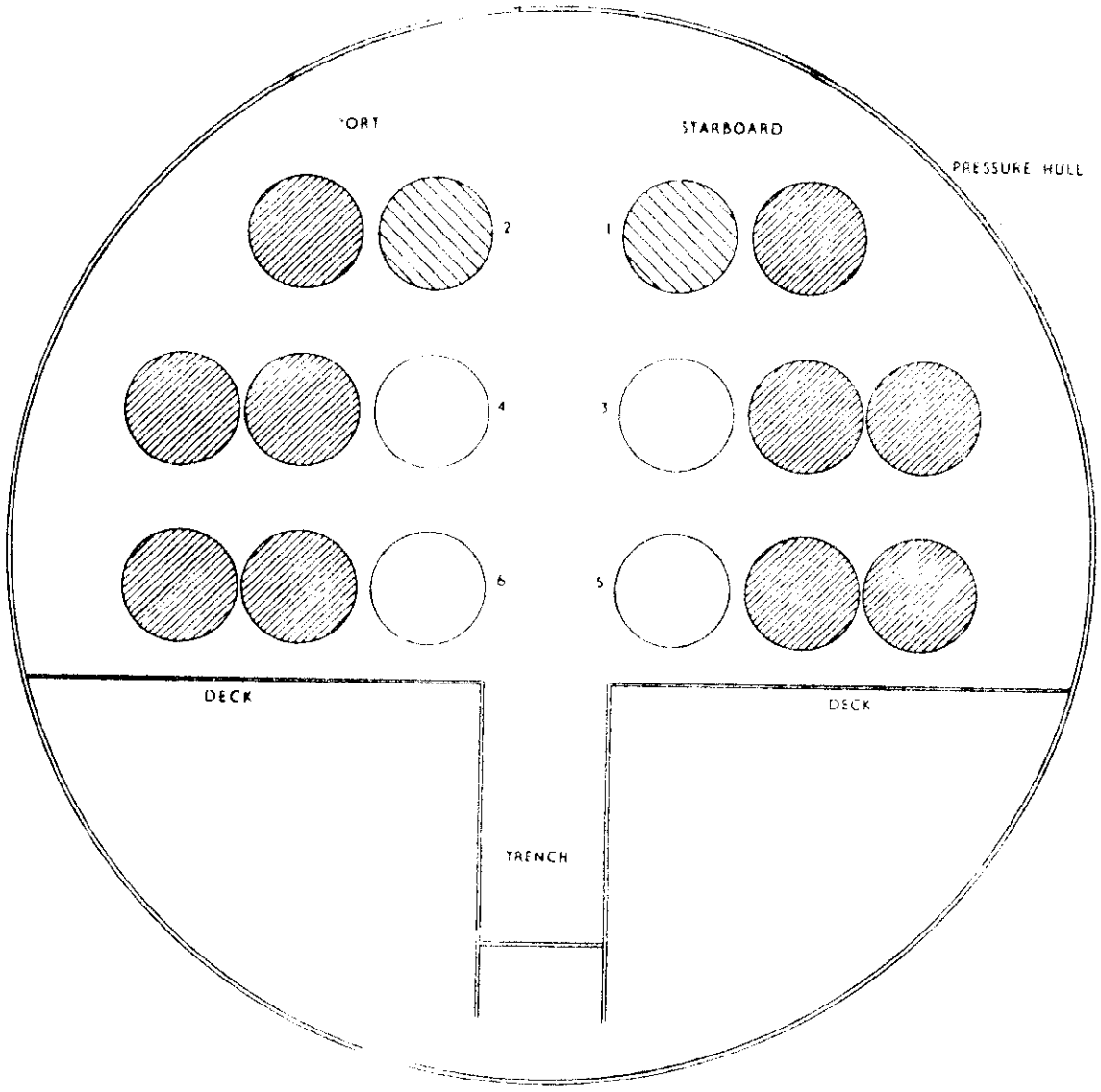
12.31 ARRANGEMENTS FORWARD

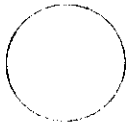
Weapons for the bow torpedo tubes are stowed in the Forward Torpedo Room; they are embarked via an embarking hatch which is near the after end of the compartment and its entrance faces aft. Each weapon is lowered by a shoreside crane on to a pair of portable rails which are rigged on the fore-casing and extend through the hatch into the compartment. Once a weapon has been embarked it is transferred from the rails to its stowage by using a lifting winch, an overhead transporter, and traversing and loading gear. The lifting winch and, in part, the traversing gear and loading gear are hydraulically-operated but, lest hydraulic power should fail, weapons can be traversed by hand, and hand-loading gear is provided.

A. Stowages

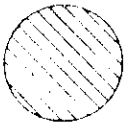
A full outfit of weapons comprises 18 torpedoes. Six of which are stowed in the torpedo tubes, and 12 are stowed on trolleys on transverse trolley paths abaft the tubes. There are three tiers of trolley paths to each side of the compartment; the bottom tier comprises four equi-spaced pairs of trolley paths, and the top and middle tiers each comprise four equi-spaced single trolley paths. Bottom tier trolley paths are resiliently mounted on J-straps bolted to the deck, whereas those of the top and middle tiers are resiliently mounted on J-straps which are bolted to girders welded to the pressure hull frames. The top face of each path is just below the bottom centre-line level of its respective torpedo tube.

The inboard lengths of the top and middle tier trolley paths are hinged to their outboard lengths and are termed 'hinged beams'; they are swung horizontally into line fore-and-aft and secured before weapons are embarked, thus providing maximum clearance for handling weapons in the gangway between the inboard ends of the beams. When the hinged beams are aligned with their trolley paths they are locked by pins, and by adjustable horizontal stays pinned between the inboard ends of the beams. Horizontal stays are permanently pinned

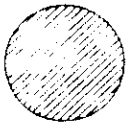




LOADED TUBE



ONE TORPEDO LOADED IN TUBE,
ONE IN LOADING POSITION IN REAR OF TUBE



TORPEDOES IN STOWAGE POSITION IN RACK

STOWAGE OF TORPEDOES

12.31 ARRANGEMENTS FORWARD

A. Stowages (contd)

between adjacent trolley path pairs, and between the forward and after trolley paths and their adjacent pressure hull frames. Gauges are provided for checking that adjacent hinged beams are spaced correctly for trays to be fitted between them. This check must be done after every occasion of embarking weapons.

Each top tier can accommodate two weapons abreast, and each middle or bottom tier three abreast; usually, however, two only are fitted to each tier, thus the inboard weapon of each top tier is in line with a torpedo tube, whereas the stowages abaft tubes Nos. 3 to 6 are left empty.

B. Traversing Gear, Bottom Tier

Mid-way between and parallel with the trolley paths of each pair is a screwed shaft which is driven, through shafting and gearing, by a hydraulic motor; one motor is fitted for the port, and one for the starboard tier. The outboard, or 'driving', trolley of each pair of trolley paths is engaged by its screwed shaft; thus it can be traversed both inboard and outboard. Each driving trolley has a 'driven' trolley pinned to its inboard side. When empty, driven trolleys can be readily unpinned, then be removed from their paths and placed in stowages. To secure trolleys in fore-and-aft line with the torpedo tubes, i.e. the 'loading positions' auto stops are fitted to the top faces of the trolley paths and can engage in recesses in the forward and after sides of the trolleys; they engage automatically but must be withdrawn by pulling hand levers at the inboard ends of the paths. Other auto stops are similarly fitted to secure trolleys in the stowage positions adjacent to the loading positions, but none are fitted to the outboard stowage positions. Hand levers for the stowage position stops are fitted to the underside faces of the trolley paths, outboard of their stops.

12.31 ARRANGEMENTS FORWARD (CONT'D)

C. Loading Gear for Bottom Tier

At the after end of the compartment and in line with the torpedo tubes are two sets of loading gear, one for the port, and one for the starboard loading positions. To form continuous paths for weapons in the loading positions, the gaps between the torpedo tubes and the foremost hinged beams, between adjacent pairs of hinged beams, and between the aftermost hinged beams and the loading gear sets, are bridged by forward trays, collapsible trays, and fixed trays respectively. The forward trays are removable for tube rear doors to be shut, and the collapsible trays can be lowered for weapons to traverse them. The fixed trays are secured to brackets near the after end of the compartment. Trays of one other type are also provided; these are 'portable trays' and are for filling the gaps between the hinged beams when all trolleys are in use. They are secured by the auto stops and can be fitted or removed only when the loading positions are empty.

Torpedo tube Nos. 5 and 6 only can be 'power-loaded'; each has a hydraulic motor which drives gearing in a crosshead, through a vertical splined shaft. A slipper carried on the forward end of the crosshead is secured to one end of a chain engaging with a sprocket driven by the crosshead gearing. The free length of chain hanging from the sprocket emerges vertically from the crosshead and [illegible] and coils into a chain case below. To power-load a weapon, a tail bar attached to the slipper is connected to its horizontal fins, and the chain is then driven forward until it is fully loaded into the torpedo tube; the tail bar must then be disconnected by hand and be withdrawn by the chain.

D. Traversing Gear, Top and Middle Tiers

The trolleys of top and middle tiers have to be traversed by hand. When in use they are locked on their trolley paths, in either stowage or loading positions, by means of latch-operated bolts which are attached to their undersides and engage in 'stowage' slots cut in the edges of the trolley paths. More slots are cut in the edges of the paths, except in the forward edges of the

12.31 ARRANGEMENTS FORWARD (CONTD)

D. Traversing Gear, Top and Middle Tiers (contd)

paths, except in the forward edges of the forward trolley paths and the after edges of after trolley paths. These extra slots are termed 'braking slots' because they prevent trolleys from 'taking-charge' when weapons are being traversed; to do so, they engage spring-loaded plungers which are fitted in the ends of traversing bars. Two such bars are provided; one is for fitting between the two forward, and the other for between the two after trolleys of the four supporting a weapon to be traversed. When a traversing bar is rigged for use, its plungers are secured in holes in the side frames of its trolleys; they extend through these holes into braking slots and thus enable the latch-operated bolts to be withdrawn without freeing the trolleys. To free the plungers, two levers fitted to each bar must be finger-operated while the bar is grasped for pushing the trolleys; the plungers, however, are spring-loaded and will re-engage in the braking slots as soon as their levers are released. Each traversing bar is long enough for two men to push it if necessary.

E. Loading Gear for Top and Middle Tiers

Weapons are loaded from the top and middle tiers into tube Nos. 1 to 4 by a method called 'Power Assisted Loading'. This method entails hauling each weapon into its tube by a wire-rope, which is connected to the weapon by a loading bar and is winched by a drum; the drum is carried on an extension of the chain sprocket shaft on the crosshead and is powered by the same hydraulic motor as that used for power loading of the bottom tier. The winch drum is controlled by a sliding clutch, which is permanently keyed and screwed to the chain-sprocket shaft extension and is operated by a spring-loaded lever. Before the clutch can be engaged, the slipper must be fully retracted and locked. The weapon is loaded by hauling-in on the winch drum while veering on a tail tackle secured between the weapon loading bar and an eye-plate on the after bulkhead.

12.31 ARRANGEMENTS FORWARD (CONTD)

E. Loading Gear for Top and Middle Tiers (contd)

After a weapon has been traversed to a loading position in the top or middle tier, a continuous loading path must be formed by fitting fixed trays between adjacent trolleys or portable trays, between the forward trolley and the vertical support, and between the vertical support and the torpedo tube. The fixed trays are secured to the trolleys, portable trays, or vertical support by drop-nosed pins, and the forward end of the forward fixed tray is machined to fit in the breech door locking ring of its torpedo tube.

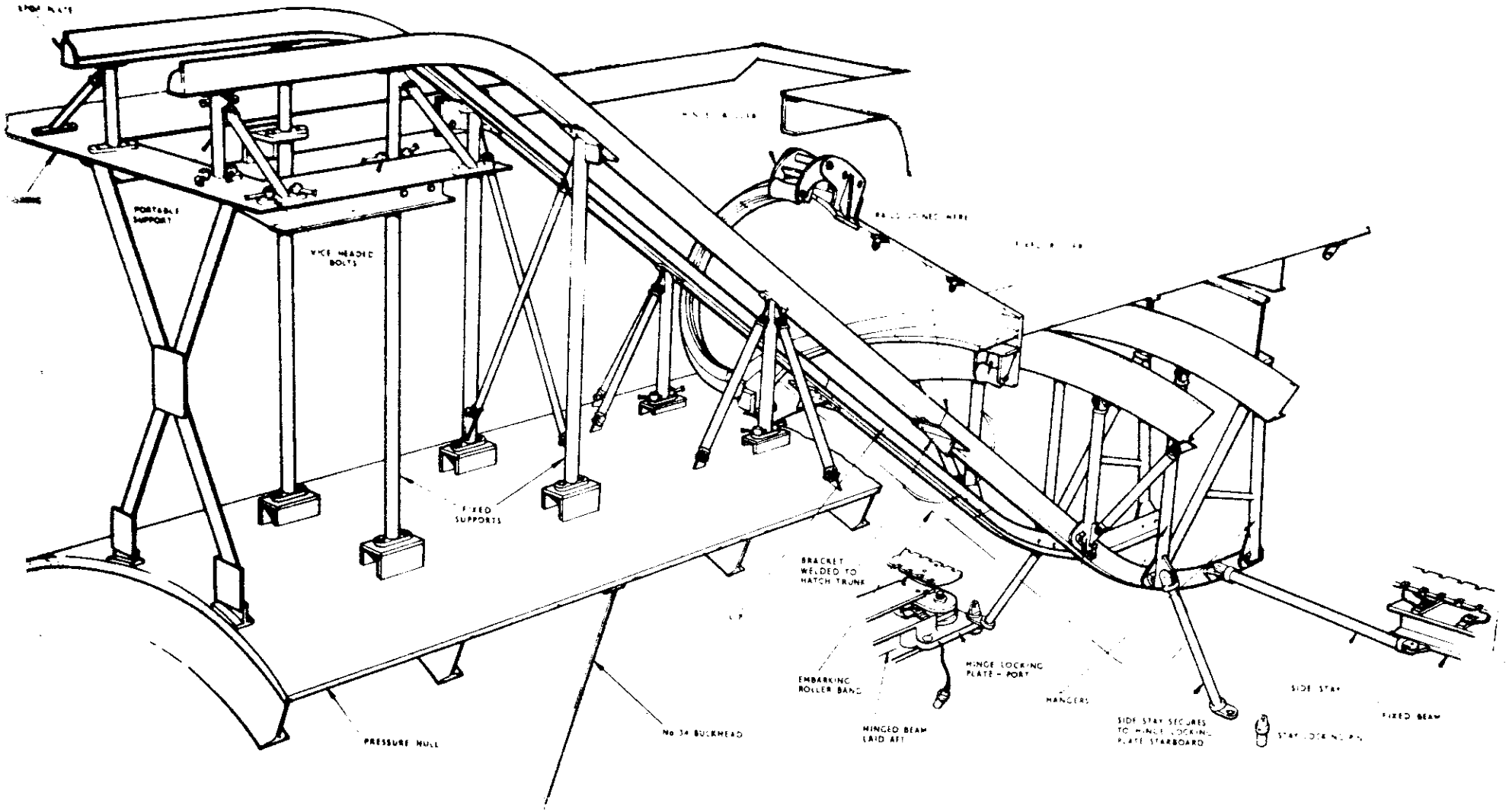
F. Loading Control Positions

Each set of loading gear has two control positions; one is near the tube breech doors, and the other is aft near the bulkhead. Both positions are manned while weapons are being loaded.

12.32 EMBARKING ARRANGEMENTS

A. Embarking Rails

Before weapons can be embarked, a pair of embarking rails must be rigged, leading from the casing through the embarking hatch into the torpedo compartment. They are of steel angle-bar with lips welded to their inner edges and stops welded to their inboard and outboard ends. The lips form paths for the rollers of a weapons-embarking band, and the stops prevent the band from running off the rails. For ease of handling and stowing, they are in two sections, joined at brackets bolted to the inside of the embarking hatch trunk. Their outboard lengths are secured to vertical supports by countersunk-headed bolts and nuts. Some vertical supports are portable and the remainder fixed. The portable types are braced by stays pinned to them, and are secured to pads on the casing and pressure hull by vice-headed bolts. To prevent their being lost overboard, these bolts are wired to their supports. The fixed supports are secured to pads on the casing and pressure hull by set bolts; two are braced by crossed stays pinned to them.



EMBARKING RAILS

12.32 EMBARKING ARRANGEMENTS (CONTD)

A. Embarking Rails (contd)

The inboard lengths of the rails are supported by three pairs of hangers and stays which extend from the three hull frames forward of the embarking hatch. An extra pair of stays extends from lugs bolted to the edges of the rails and is pinned to the fixed lengths of the top tier stowage beams. Thus, when the rails are rigged, the hinged beams cannot be moved. All the embarking rail fittings are galvanised. When not in use, they are stowed in rattle-proof stowages between the casing and the pressure hull.

B. Embarking Bands

1. Embarking Band

Before a weapon is lifted, an embarking band must be clamped around its middle. The band is then shackled to an embarking pendant which is attached to the hook of a shore-side crane. Rollers fitted on either side of the band run on the embarking rails and take the weight of the weapon as it is embarked. On the top centre of the band are lifting lugs to take a drop-nose lifting pin which carries a lifting tumbler. This has three eyes, one for the lifting pin, one for the embarking pendant shackle-pin, and one for the pin of a lifting press wire shackle; this shackle is connected to the band after the weapon has been lowered into the compartment.

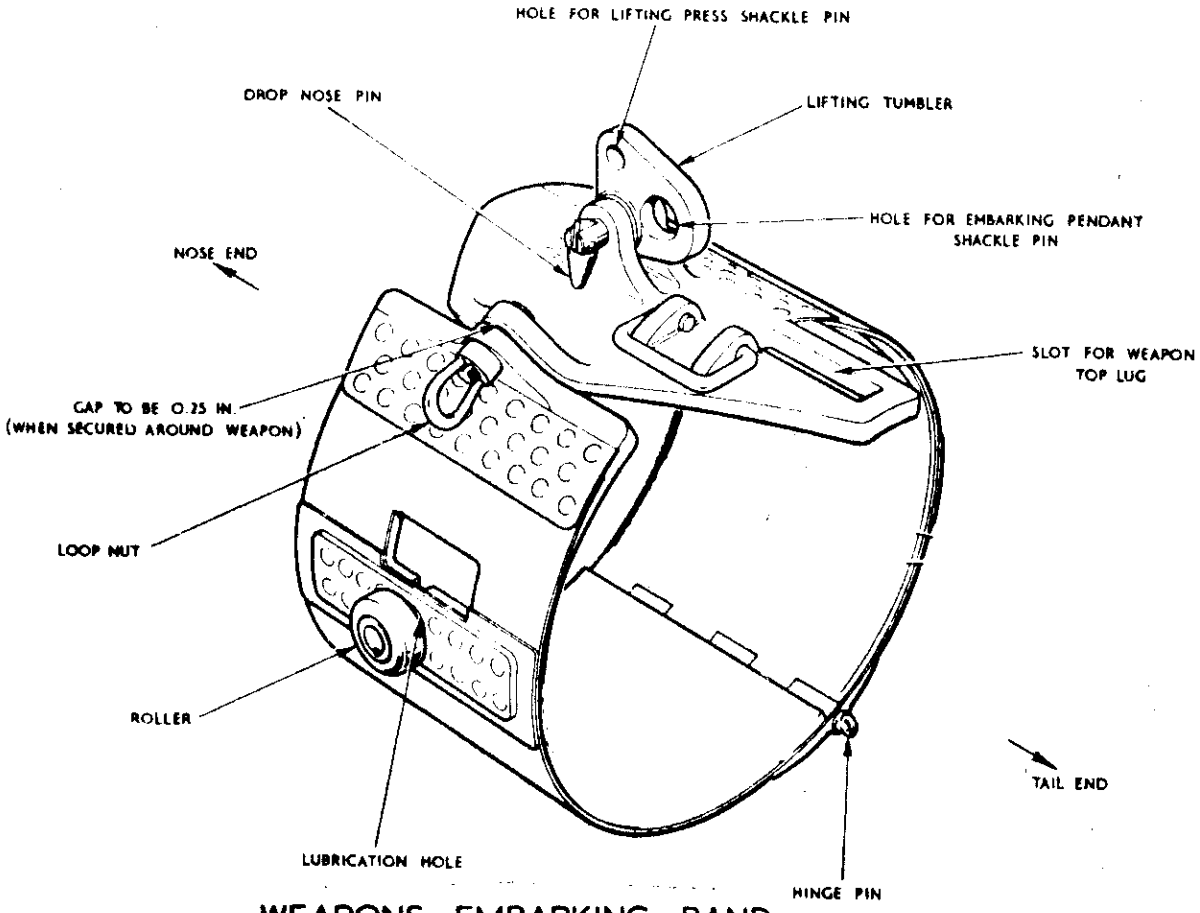
2. Lightweight Lifting Band

During embarkation each weapon is lifted from the embarking rails by overhead lifting gear and then rested on portable cradles between the beams. The embarking band is then removed and is replaced by a lightweight lifting band. This type of band is used to lift and transport all weapons inside the submarine; it is articulated and easy to handle, but it must be treated with care to protect it from damage or distortion.

C. Embarking Pendant

This is an E.S.F.S.W. rope with an eye at each end; it is long enough to ensure that the hook of the crane is clear of the embarking hatch coaming when the embarking band rollers bear against the stops at the inboard ends of the rails.

12.32 EMBARKING ARRANGEMENTS (CONTD)



WEAPONS - EMBARKING BAND

D. Rollers

As it passes through the embarking hatch, the embarking pendant is guided by two rollers. The first is carried on a hinged, crescent-shaped arm which is pinned to a bracket welded on the lip edge of the hatch coaming; it can be hinged back and pinned when not in use, to avoid the hatch lid, or it can be pinned in its after position so that the embarking pendant is kept clear of the hatch lip when weapons are being embarked. The second roller is pinned to a bracket welded on the top centre of the pressure hull, just inside the submarine; it prevents the embarking pendant from fouling the pressure hull frames. The pins of both rollers have grease nipples which connect with grooves machined in their roller bores.

12.32 EMBARKING ARRANGEMENTS (CONT'D)

E. Overhead Lifting Gear

This is used to convey weapons from the embarking rails and land them between or on the trolley paths. It is carried on a gantry comprising a pair of beams resiliently mounted on brackets welded across the faces of Fr. Nos. 26 and 27. A toothed rack is secured to the top face of the forward beam and engages with a set of gears in a trolley. This is carried on the beams and can be moved athwartships by turning a chainwheel driving the set of gears. For securing the trolley in any desired athwartships position, a locking device is fitted to its underside. Between each end of the pair of beams is a sheave guiding a lifting winch wire. The wire passes over sheaves in the trolley and carries a lifting sheave block suspended below it. The starboard end of the wire is anchored to a bracket welded between Fr. Nos. 26 and 27.

F. Hydraulic Winch (Ratchet Brake Type)

This consists of a McTaggart Scott, Mk.5, Series 2 Hydraulic Motor driving a spirally grooved concentric drum, through planetary gears. The motor shaft is secured to two pedestals welded to a bed plate which is resiliently mounted to port, between Fr. Nos. 26 and 27. The winch can lift 1 ton 7 cwt. when supplied with oil at a pressure of 1800 lb/sq.in. The lifting rope is secured to and wound round the drum which can accommodate 45 ft. of 1 3/4-in. 6/37 E.S.F.S.W. rope. The winch assembly is protected by a sheet-metal guard.

12.33 ARRANGEMENTS AFT

Weapons for the after tubes are embarked on rails similar to those used for weapons forward. Two weapons are stowed in the tubes, and stowages for two more are provided, one on either side of the After Ends. The weapons are stowed and loaded by using a hydraulic lifting press, overhead trolleys and hand loading-gear.

12.34 EMBARKING PROCEDURE FORWARD

A. Precautions When Embarking or Disembarking

(1) Nose and tail lines must be attached for guiding and steadying each weapon.

(2) For electrically-powered weapons, starting lever safety chocks must be sighted in place.

(3) Torpedo propeller guards must be fitted.

(4) When loading a weapon into its tube, the first movement of lifting the spring catch and loading against the top stop must be performed with great care to prevent damaging the top stop.

B. Portable Equipment Required

(1) 1 set of Embarking Rails and associated fittings:

- Embarking Pendant
- Weapons Embarking Bands
- Lightweight Lifting Bands
- Portable Rails
- Trays and cradles
- Tackles for positioning weapons fore-and-aft

(2) 1 set of Gear for Power-assisted Loading and Withdrawing

(3) Hand Loading Gear

C. Preparation will include these actions:

(1) Ensure that all muzzle doors are shut, and that all tubes are drained and clear.

(2) Rig rails.

(3) All traversing and ramming gear.

(4) Rig the embarkation rails; for ease of assembly, do not tighten the supports and stays until all components have been loosely erected.

(5) Secure the rollers in positions.

(6) Remove all unnecessary gear from the Torpedo Compartment.

C. F. 'O' CLASS SUBMARINES

CHAPTER 12 - WEAPONS SYTEMS

PART 4 - SUBMERGED SIGNAL EJECTORS (S.S.E.)

12.40 GENERAL

A C. F. 'O' class submarine is fitted with two submerged signal ejectors; one in each Torpedo Room. The purpose of the ejectors is to provide a method of releasing, at will, any one of a variety of pyrotechnics from the submarine. Decoys can also be fired from either ejector.

The forward ejector is a MK II; an RN designed piece of equipment for use with all British manufactured pyrotechnics and decoys. An after ejector, a MK IV, is also a British designed item and is capable of being used with either RN or USN submarine pyrotechnics and decoys.

12.41 S.S.E. MARK 2

This ejector is designed to discharge pyrotechnics and decoys of British manufacture silently down to 625 ft. without giving a visible indication on the surface. The primary method of discharge was intended to be by air operated ram; all existing stores, however, are suitable for 'air' discharge only and accordingly, the ejector is capable of either Air or Ram discharge. The impulse pressure in both cases is obtained from a Sea Compensating Reducing Valve. This gives a differential of 200 p.s.i. above the external sea pressure at the depth of charging the firing reservoir.

The ejector consists of a barrel 6 in. in diameter which fits into a pad piece welded to the pressure hull. At the outboard end a Flap Valve closes the barrel off from the sea. At the other end is a Breech attached to which is the ram cylinder. A Selector Valve selects either Air or Ram discharge. A loose sleeve inside the barrel is raised or lowered by operating the Selector Valve, being positioned for either Air or Ram discharge. When firing by ram the sleeve is lifted, allowing the water to circulate between the sleeve and barrel, preventing a vacuum when the store is discharged. For air discharge the sleeve is lowered, thus restricting the firing air to the inside of the sleeve.

12.41 S.S.E. MARK 2 (CONTD)

A lever operated on the outside of the barrel gives an indication whether or not the store has been discharged.

A. Multi-Valve Unit

Drain Valve. Connected to a pipe from the lower end of the barrel.
Vent Valve. Connected to a pipe fitted between the barrel and the sleeve.
Equalising Valve. Connected between the lower end of the barrel and a hull valve. Enables the barrel to be flooded up and equalised before opening the Flap Valve.
Linkage gear automatically opens the vent valve when the equalising valve is opened, and the vent valve when the drain valve is opened.
Firing Valve. This admits air from the firing reservoir to the Selector Valve which is positioned for air or ram firing.

B. The Ram Gear

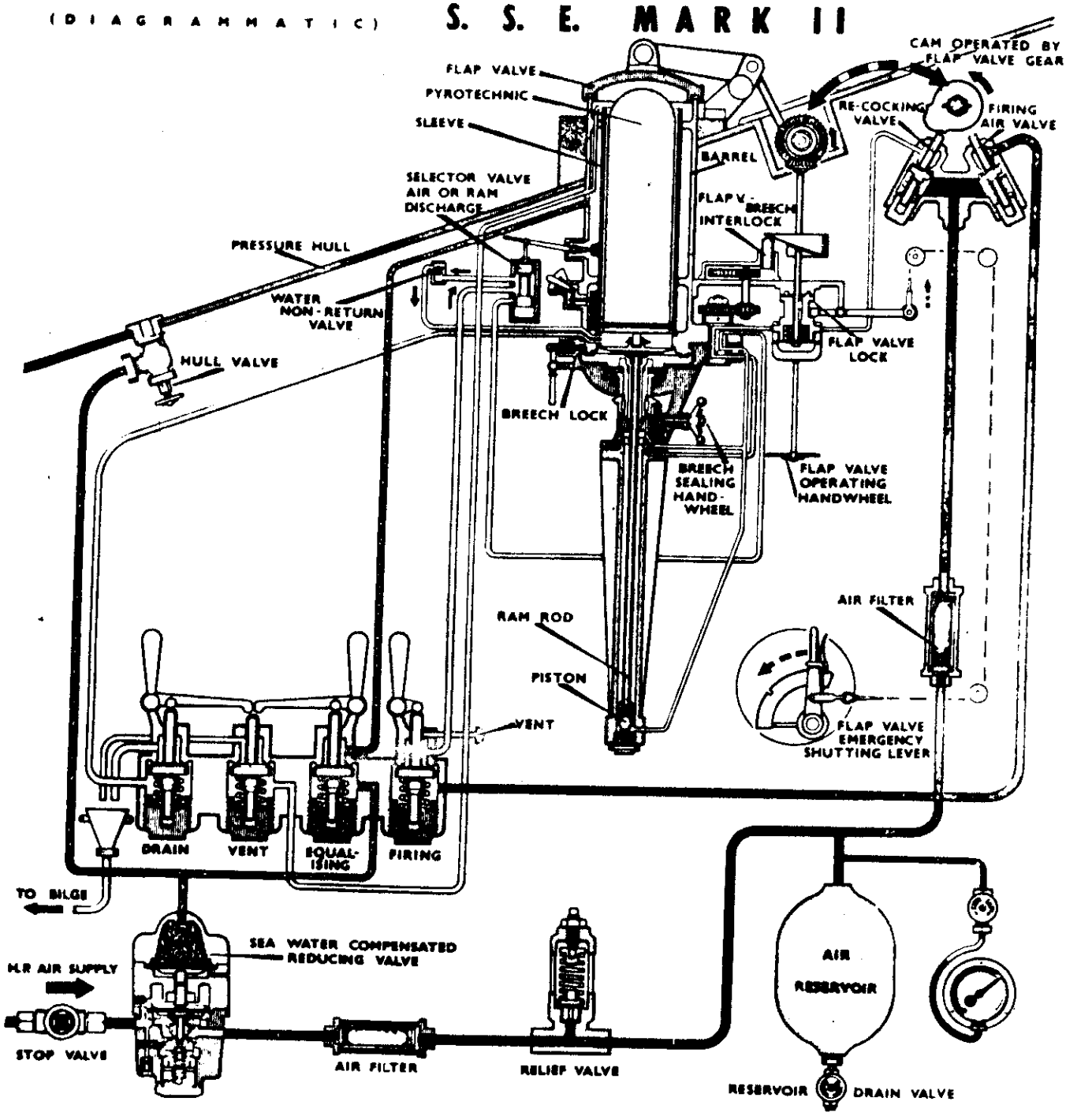
The ram rod is screwed to a piston which works in a ram housing. The piston is made airtight by means of an 'O' ring to prevent air escaping from the firing dide to the recock side and vice versa. An air loaded piston is fitted in the lower end of the breach to retard and suppress the noise of the ram rod at the end of its firing stroke.
The breech, which is made watertight by a sealing ring, is locked in the shut position by an automatic locking device. This ensures alignment of the ram with the base of the store. A handwheel on the breech, when rotated, completes the sealing of the lower end of the barrel.

C. Flap Valve

A Bow Cap type Flap Valve forms the hull outlet for the ejector barrel. This valve cannot be opened until the Breech is fully shut.
The Flap Valve operating mechanism is spring-loaded to allow any excess pressure in the barrel to escape when the Valve is shut, and to retain it in the open position when so operated.

SUBMERGED SIGNAL EJECTOR

(DIAGRAMMATIC) S. S. E. MARK II



12.41 S.S.E. MARK 2 (CONTD)

D. Interlocks

There are three interlocks fitted to the ejector:

(1) To ensure that the ejector cannot be fired with the Flap Valve shut. A cam operated by the Flap Valve mechanism, rotates over an air valve in the line from the Firing Reservoir to the Firing Valve. Thus, until the Flap Valve is fully opened, the air supply is not available at the Firing Lever.

(2) To ensure that the ram rod is returned to the 'Recock' position after discharge by ram. A second valve in the same casting as the Air Valve is also operated by the cam. This admits air to the recock side of the ram piston as the Flap Valve is moved to the SHUT position, ensuring the ram is clear of the breech before it is opened.

(3) A mechanical interlock between the Flap Valve and the Breech prevents both being opened at the same time.

E. Emergency Shutting of Muzzle Door

A lever is provided to release the 'T' handle catch and so shut the Muzzle Door. This is operated remotely by Bowden cable. When the cable is pulled it releases the spring-loaded Stop and allows the Muzzle Door to drop shut.

12.42 PROCEDURE FOR FIRING BY AIR

A. Loading

(i) Move selector Valve handle to 'Air' position.
(ii) Charge Firing Reservoir.
(iii) Check ejector drained down.
(iv) Open breech and inspect bore with torch.
(v) Insert smoke candle.
(vi) Shut breech and ensure locking pin engaged
(vii) Operate Equalising Hand Lever and when equalised, open Flap Valve.
(viii) Report "White/Yellow candle loaded".

12.42 PROCEDURE FOR FIRING BY AIR (CONTD)

B. At the Order "Fire"

(i) Pull the Firing Lever
(ii) Operate plunger on barrel to check candle has been discharged.
(iii) Report "White/Yellow candle fired".

C. "Draining down and Sighting Ejector Clear"

(i) Shut Flap Valve.
(ii) Move Selector Valve handle to 'Ram' position, operate drain and vent hand lever. When drained down, open breech, remove baseplate and inspect the bore using a torch.

12.43 FIRING BY RAM

A. Loading

(i) Move Selector Valve handle to 'Ram' position.
(ii) Charge Firing Reservoir.
(iii) Check ejector drained down.
(iv) Open breech and inspect bore.
(v) Insert smoke candle.
(vi) Shut breech and ensure locking pin engaged.
(vii) Operate Equalising and Vent hand lever. When equalised open Flap Valve.

B. Firing

(i) Pull the Firing Lever
(ii) Operate the plunger to check candle has been discharged.
(iii) Shut Flap Valve and drain down as ordered.

12.44 S.S.E. MK IV

This ejector is designed to discharge pyrotechnics and stores of both American and British manufacture. Its principle of operation is that of 'water ram discharge'; which has a primary benefit of a totally invisible relese. Unfortunately the equipment is expensive and requires considerable maintenance.

12.44 S.S.E. MK IV (CONTD)

The size difference between British and American pyrotechnics is nominally 1" in store diameter; the former being 4", the latter 3". This difference is made up by fitting an American pyrotechnic or store with a glass fibre sleeve. Considerable differences in length exist between the various stores; to allow for this the ejector's barrel is sufficiently long to accommodate all stores.

The ejector assembly consists of two parts each having several components.

A. Ejector Barrel Assembly

Comprising:
(i) The Barrel
(ii) The Breech
(iii) The Muzzle Door
(iv) Sleeve Catch

B. Firing Gear Assembly

Comprising:
(i) The Air Reservoir
(ii) Ram Firing Valve
(iii) Air and Water Rams
(iv) Water Isolating Valve

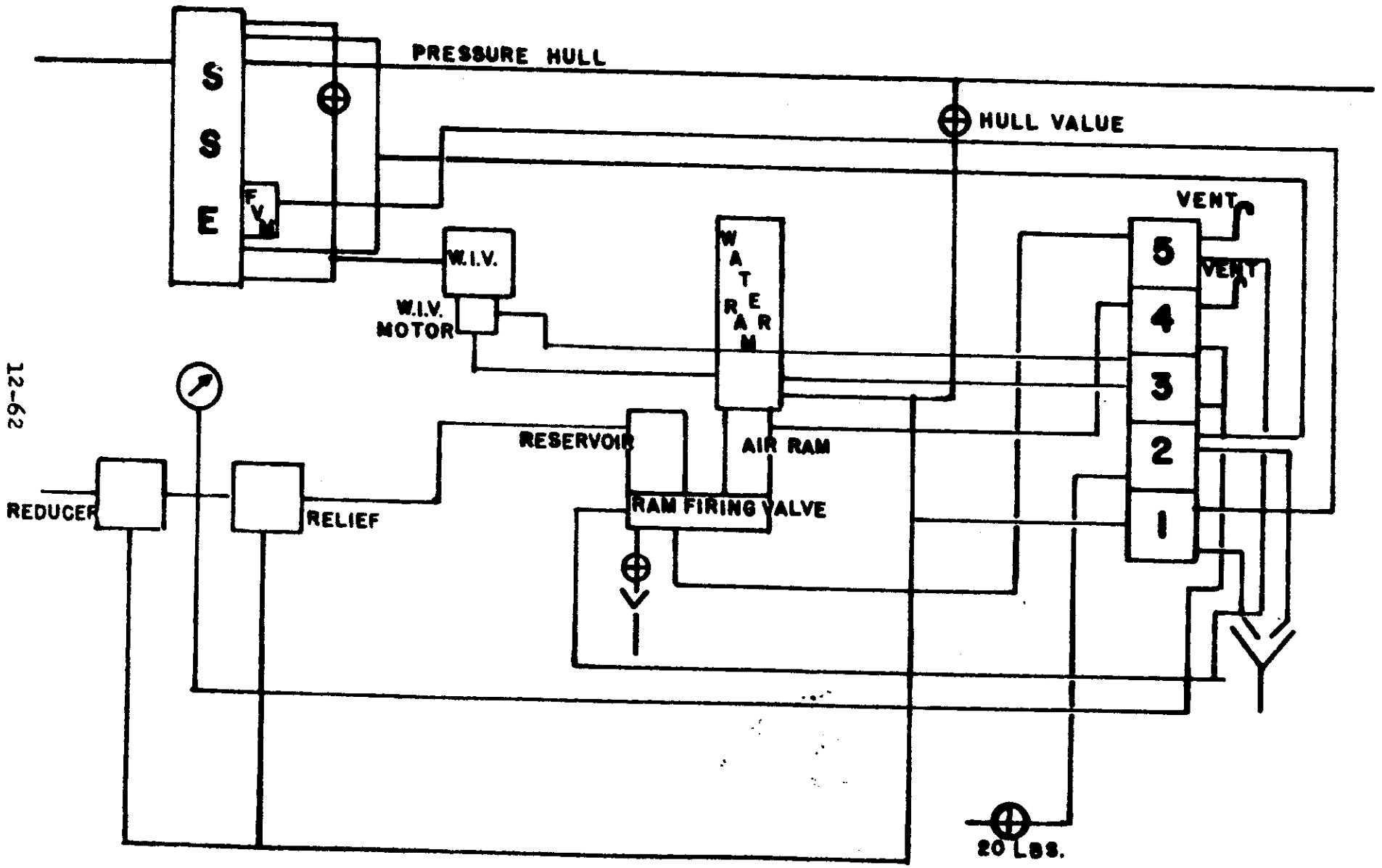
Other parts and the operation of the ejector are:

C. Interlocks

Interlocks are fitted to the ejectors to prevent the following:

(i) The breech being open at the same time as the Muzzle Door
(ii) The breech being opened when the water isolating valve is open
(iii) The firing valve (Valve 5) being operated with the muzzle door shut.
(iv) Incorrect operation of the valves by not following the sequence.
(v) The breech ring being rotated with the breech door open of the breech face.

SSE MK 4


PRESSURE HULL
S
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HULL VALUE
VENT
VENT
W.I.V.
W.I.V.
MOTOR
WATER RAM
5
4
3
2
1
RESERVOIR
AIR RAM
REDUCER
RELIEF
RAM FIRING VALVE
20 LBS.

12-62

12.44 S.S.E. MK IV (CONTD)

D. A pyrotechnic, decoy or radio buoy, with or without the glass fibre sleeve according to type is loaded through the breech into the ejector barrel. The store is held in position within the barrel of the sleeve catch.

Once the breech door is shut the ejector is flooded and the pressure equalized with the sea through the water isolating valve.

Prior to firing the air system is changed.

The ejector is fired, on order, by admitting air from a reservoir, via the Ram Firing Valve to the air ram which is linked by a piston rod to the water piston.

As the water piston is forced across, so water is pushed through the water isolating valve into the ejector.

This method of discharging pyrotechnics can be operated without depth limitation on the submarine. After each firing the ejector is checked clear by an indicator showing that the barrel is empty. Finally the firing gear is re-cocked, the water isolating valve shut and the barrel blown down.

12.45 S.S.E. MK IV - PREPARING AND FIRING

A. Loading and Charging

(i) Charge the Air Reservoir
(ii) Check the muzzle door and all valves in the group 'Shut'.
(iii) Check barrel clear of water (through Blow Down Valve)
(iv) Open Breech
(v) Put Sleeve Catch to 'Withdraw'
(vi) Load Ejector

B. Preparation

	Action	Result
(i)	Check both hull valves open	

12.45 S.S.E. MK IV - PREPARING AND FIRING (CONTD)

B. Preparation (contd)

	Action	Result
(ii)	Open Valve No. 1	Water admitted from sea to inner and outer ends of barrel.
(iii)	Put Valve No. 2 to the Mid position	Connects vents in muzzle door seat and sleeve catch to the tundish.
(iv)	Fully open Valve No. 2	When full bore of water into tundish (ejector fully flooded). This position on the valve shuts the vents.
(v)	Open Valve No. 3	Admits air to the top of the Water Isolating Valve air motor and opens the W.I.V.
(vi)	Open Muzzle Door	Operating handle is moved in a downward direction.
(vii)	Open Valve No. 4	Vents the recock end of the air ram.

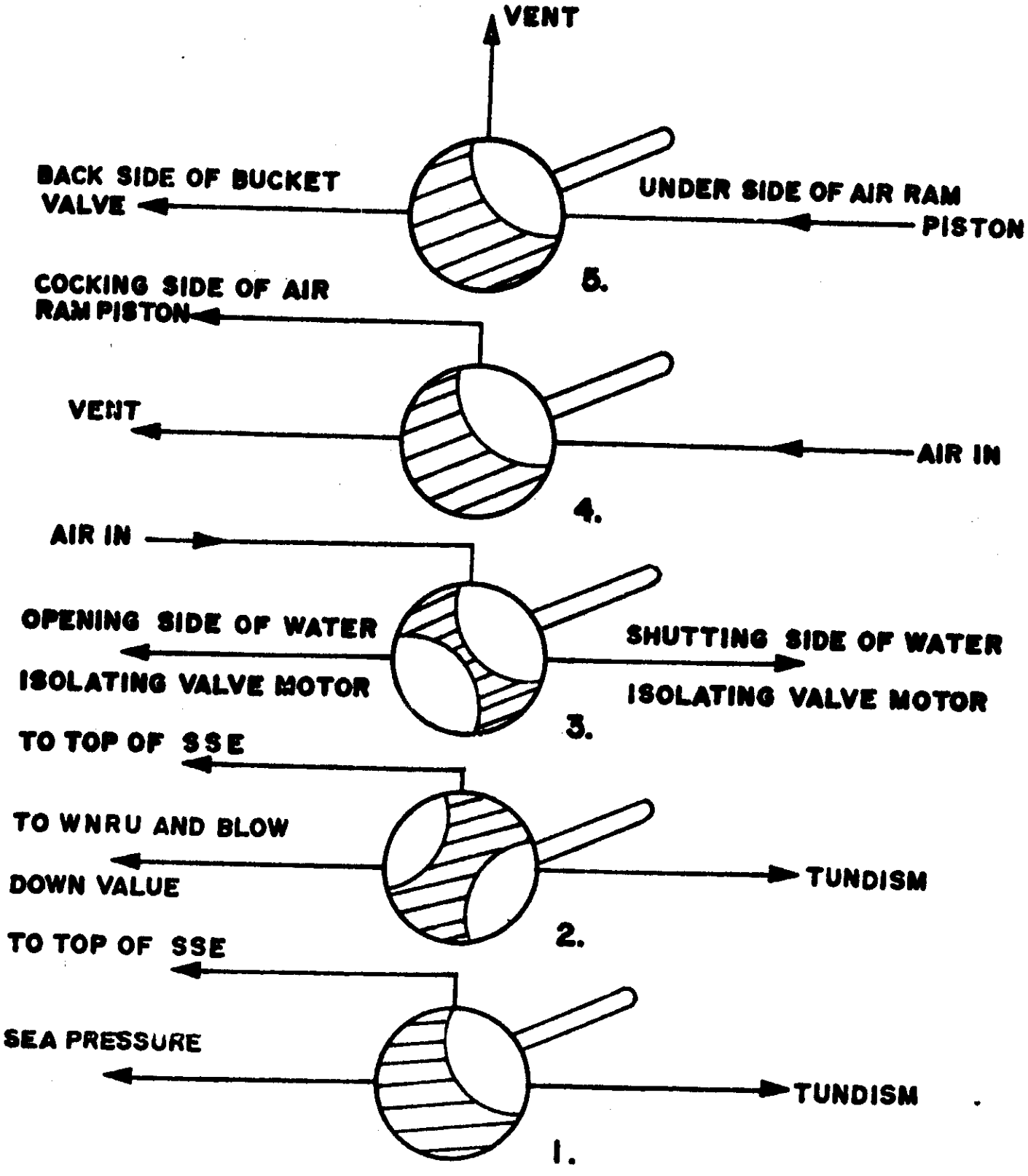
The ejector is now ready to fire.

C. Firing

	Action	Result
(i)	Open Valve No. 5	Opens the ram firing valve and air from the reservoir operates the air ram. As the air ram moves, so the water piston is forced up and water is forced through the W.I.V. into the ejector barrel. During the water piston's travel, water enters behind the ram from sea through the main hull valve.
(ii)	Shut Valve No. 5	When the ram stroke is complete. This shuts the ram firing valve.

EJECTOR OPERATING VALVES

SSE MK4



12.45 S.S.E. MK IV - PREPARING AND FIRING (CONT'D)

C. Firing (contd)

	Action	Result
(iii)	Shut Valve No. 4	Admits air to the top of the Air Ram cylinder and so recocks the ram. The top of the water ram cylinder is filled with water from the ejector barrel and through the W.I.V.
(iv)	Shut Muzzle Door	

D. Blowing Down

	Action	Result
(i)	Shut Valve No. 3	Shuts the W.I.V.
(ii)	Shut Valve No. 2	Connects the ejector barrel vent pipes to a 20 p.s.i. blow.
(iii)	Shut Valve No. 1	Connects the ports in the ejector barrel at the inner and outer ends to the tundish by a drain pipe.
(iv)	Open Blow Down Valve	Admits air via valve No. 2 to the ejector and blows down the assembly through Valve No. 1
(v)	Shut Blow Down Valve	When ejector clear of water.

PART 5 - PYROTECHNICS AND SSE STORES

12.51 The uses of these stores are various; amongst the more important are:

A. Marking the submarine's position for surface and air units during exercises.

B. Indicating the simulated firing of torpedoes and missiles by the submarine.

C. Decoys, chemical and electronic to assist the submarine in evading surface units.

D. Indicating the position of a sunken submarine or a submarine in distress.

As previously mentioned stores of both British and American origin can be used by a CAF 'O' class submarine. Currently (1967), only British pyrotechnics are in use; no decoys are available and a special USN communications buoy for use in Submarine Search and Rescue has not been implemented.

12.52 <u>TYPES OF BRITISH PYROTECHNICS</u>

A. Smoke Candles

The type currently available are:

Mk N4 White	Fired to 300' only gives off white smoke.
Mk N6 White	Fired to full diving depth and gives off white smoke;
Mk N6 Yellow	Fired to 300' only, burns with yellow flare
Mk N7 Yellow	Fired to full diving depth and burns with a yellow flare.

N6 White candles can be fitted with message carriers and dye markers for use in submarine accidents.

12.52 TYPES OF BRITISH PYROTECHNICS

A. Smoke Candles (contd)

Under normal conditions white smoke markers are used by day and the yellow flares by night; this, of course depends upon surface visibility.

B. F.S.S. (Float Signal Submerged)

These are pyrotechnics that may be loaded with either RED, GREEN or YELLOW grenades. Once fired, the grenade ejects about 80 feet above the surface.

The types currently available are:

Mk2 Fired down to 300' for any type of grenade
Mk3 Fired to Full Diving Depth
Mk4 Fired to Full Diving Depth and also ejects a dye marker. Is used for submarine accidents only.

C. Grenades

Red For Emergency Only

Green To mark simulated torpedo attacks

Yellow For special exercises

12.53 EMERGENCY PYROTECHNICS

The following pyrotechnics are kept by each SSE at all times and never used for other purposes.

4 Mk N5 or Mk N6 White
4 Mk N7 Yellow
4 Mk 4 F.S.S. Fitted with Red Grenades

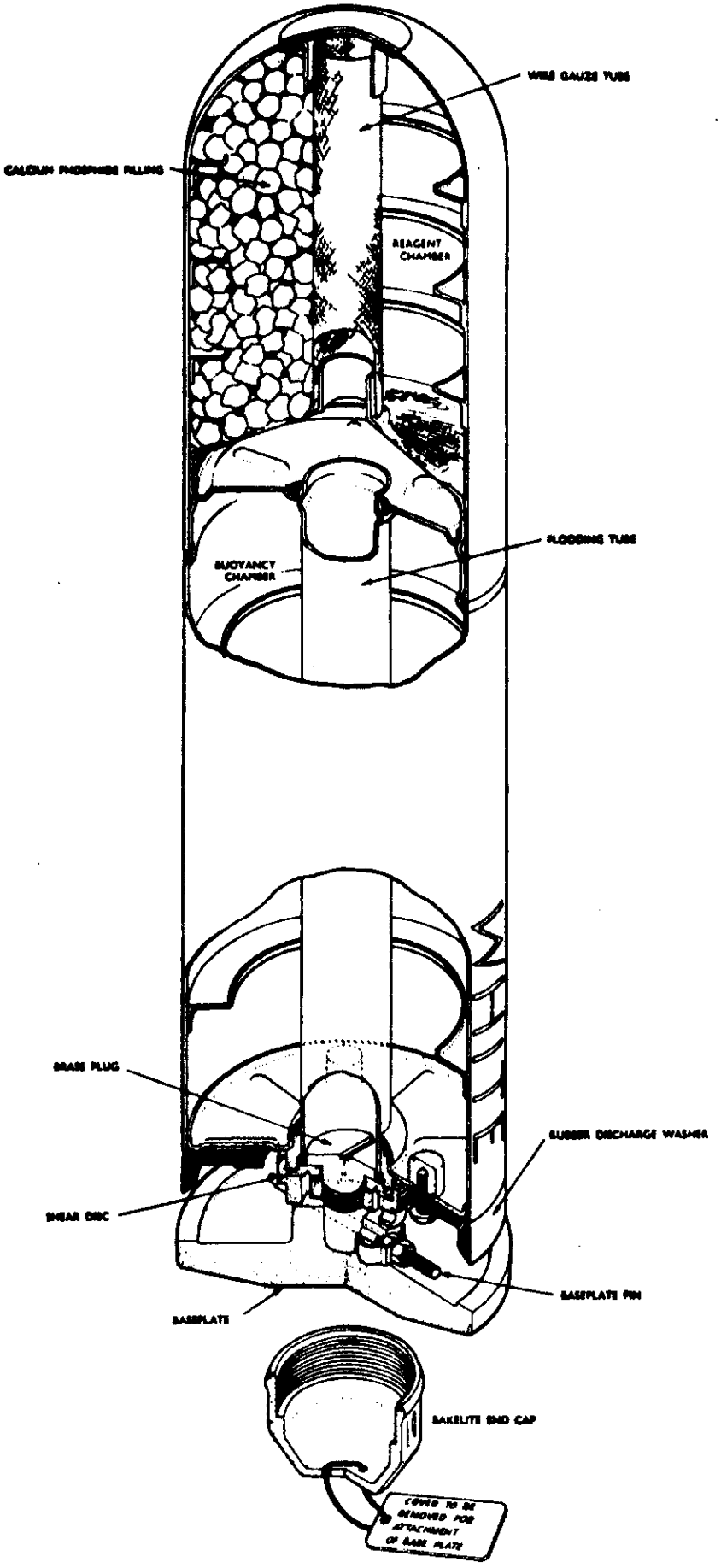
12.54 PYROTECHNIC SAFETY PRECAUTIONS

Type of Store	Filling	Action in event of Accidental Firing on loading	Action in event of Accidental Firing in a compt: and gun cannot be loaded immediately	Firefighting Equipment Required
Candle Smoke White Mark 4	Calcium Phosphide	Keep dry in secure dry stowage	Keep in secure dry stowage and ditch as soon as convenient.	Nil
Candle Smoke White Mk. N6	Red Phospherous	Load and Fire	Turn face away from candle. Remove metal nose cap. Place nose downwards in bucket. Douse with water but avoid splashes and spillage.	Water or Ansul
Candle Smoke Yellow Mk N6	Smoke Composition	Load and Fire	Remove metal nose cap, Keep pointed away from personnel for approx. 30 secs. until a stick is blown out from top. Cover with foam to absorb smoke or smother using a wet blanket.	Ansul
Candle Smoke Yellow Mk N7	Smoke Composition	Load and Fire	Remove metal nose cap and place nose downwards in bucket (there is no stick) and cover	Ansul

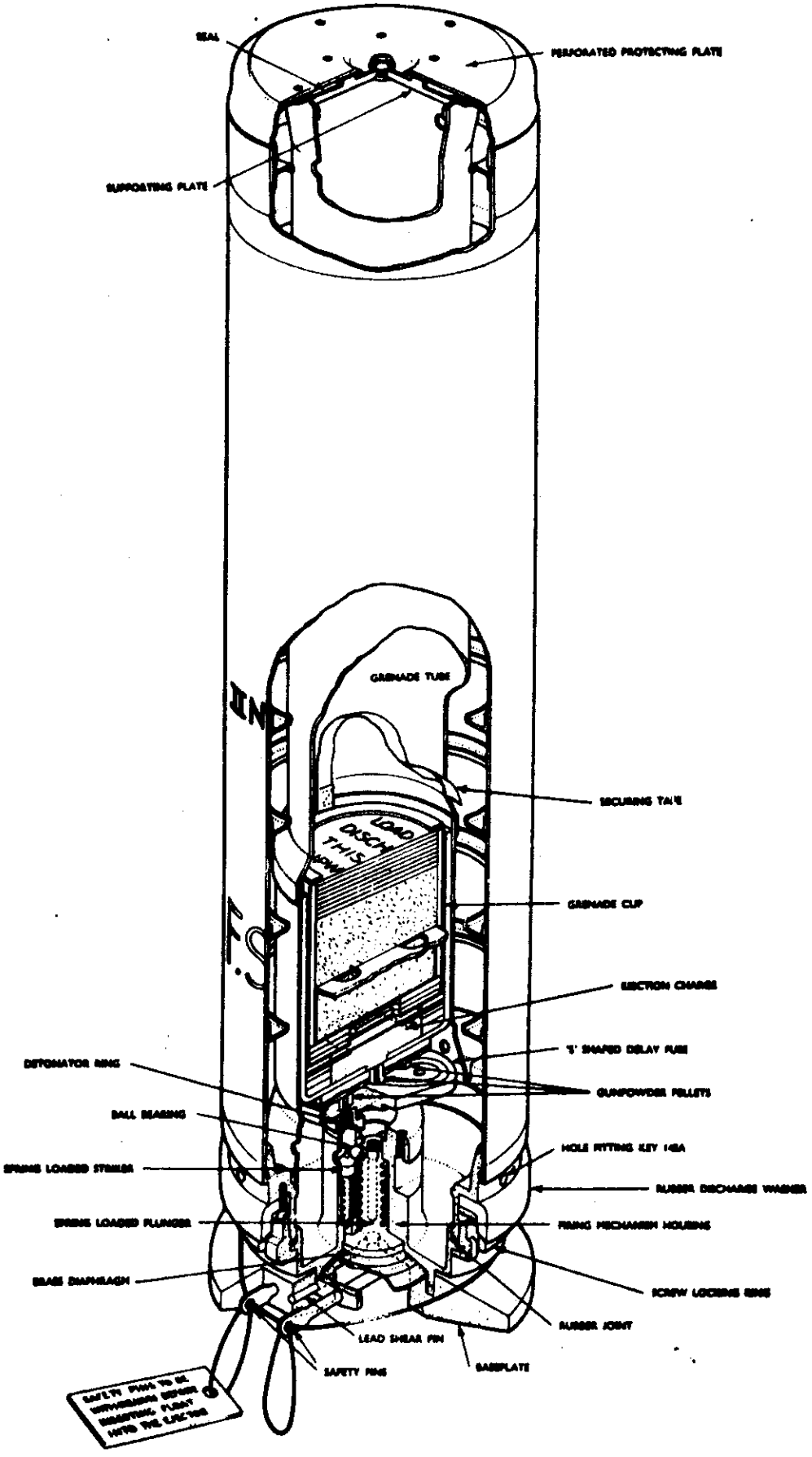
12.54 PYROTECHNIC SAFETY PRECAUTIONS (CONTD)

Type of Store	Filling	Action in event of Accidental Firing on loading	Action in event of Accidental Firing in a compt: and gun cannot be loaded immediately	Firefighting Equipment Required
Float Signal Submerged Mk.1 - 3	Pyrotechnic Composition Grenade. Explosive Charge.	Load and Fire	Evacuate compt: until after the grenade has been heard to fire. Grenade itself cannot be extinguished. Cover with asbestos blanket and spray any combustible materials within vicinity with water.	Asbestos Blanket Nuswift
Float Signal Fluorescein Mk.N.4	Liquid Fluorescein Explosive Charge	Load and Fire	Evacuate compt: until after the fluorescein container has been heard to fire.	Nil

CANDLE, SMOKE, WHITE, MARK 4



FLOAT, SIGNAL, SUBMERGED, MARK 2



CANDLE, SMOKE, YELLOW, MARK 6