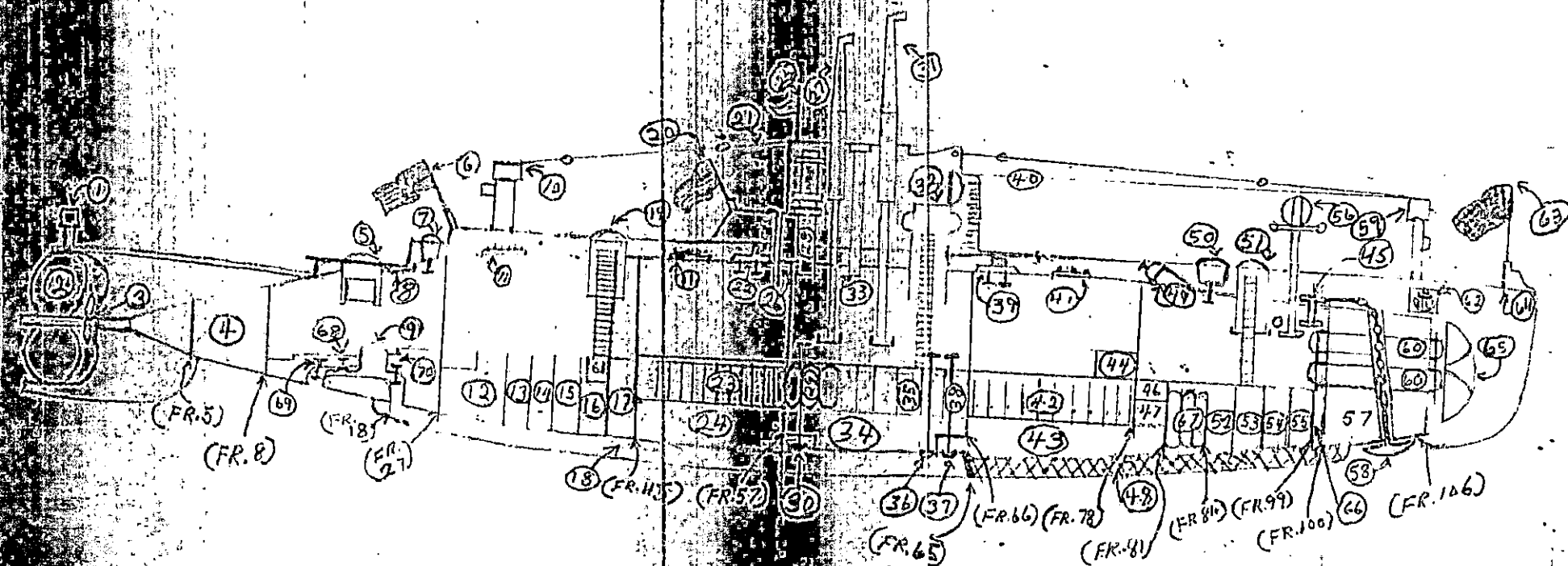


First Week. Nat-hank.  
 "O" BOAT CLASS

NOTES  
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 IN



in and jacked closed when  
 R. 00 + . . .

- 1 Low Stern Light
- 2 Vertical Rudder
- 3 Propellers
- 4 After Trim Tank.
- 5 M. R. Escape + R Hatch
- 6 Colors at anchor
- 7 Aft. marker Buoy
- ~~8 Low P. Pump.~~
- 8 Motor R. Soft Patch
- 9 Low Pressure Pumps
- 10 after Stibmast
- 11 Engine Room Soft Patch
- 12 No. 9 F.O. Tank
- 13 No. 8 F.O. Tank
- 14 No. 7 F.O. Tank
- 15 No. 6 F.O. Tank
- 16 No. 5 F.O. Tank
- 17 Main Lub. Oil Tank
- 18 Main Drain
- 19 E. R. Escape Hatch
- 20 Colors at sea
- 21 Radio Antenna
- 22 "B" Vent + Stop
- 23 Aft. Batt. 60 Cells
- 24 No. 2 M.B.T.
- 25 Com m. - Permanent

- 26, Signal gun
- 27, No. 2 Periscope
- 28, Radio Tank
- 29, 9 air Bottles
- 30, No. 2. Main Bat. Tank. drain.
- 31, No. 1. Periscope
- 32, Upper C. T. Hatch
- 33, Main Induction
- 34, Aux. B. tank
- 35, Reg. Tank
- 36, A-B. T. Drain
- 37, No. 1 M.B.T. Drain Vent
- 38, Fresh Water tank
- 39, "A" Vent + Stop
- 40, Clearing Line
- 41, Fuel - B. Soft Patch
- 42, F.B. 60 Cells
- 43, No. 1 M.B.T
- 44, 2 Batt. W. Tank
- 45, Sub anchor Drum
- 46, Small arms Magazine
- 47, 4 - Batt. W. Tanks
- 48, False Keel
- 49, Torpedoe Loading hatch
- 50, Fuel. Marker Buoy
- 51, F. R. Escape <sup>T.R.</sup> Hatch
- 52, No. 4. F.O. Tank
- 53, No. 3. F.O. Tank
- 54, No. 2. F.O. Tank.

- 55, No. 1 F.O. Tank
- 56, J. K. Sound Dev.
- 57, Fuel Trim Tank
- 58, Sub. Anchor.
- 59, Fuel. Stub mast
- 60, Torpedoe tubes
- 61, Lump Tank
- 62, Deck Anchors
- 63, Union Jack
- 64, Bull nose
- 65, Bow Cap.
- 66, Torpedoe R. Bilgee
- 67, 21 air Bottles
- 68, Low P. P. Stop Val.
- 69, Low P. P. Sea Val.
- 70, Low P. R. Suc. Val.

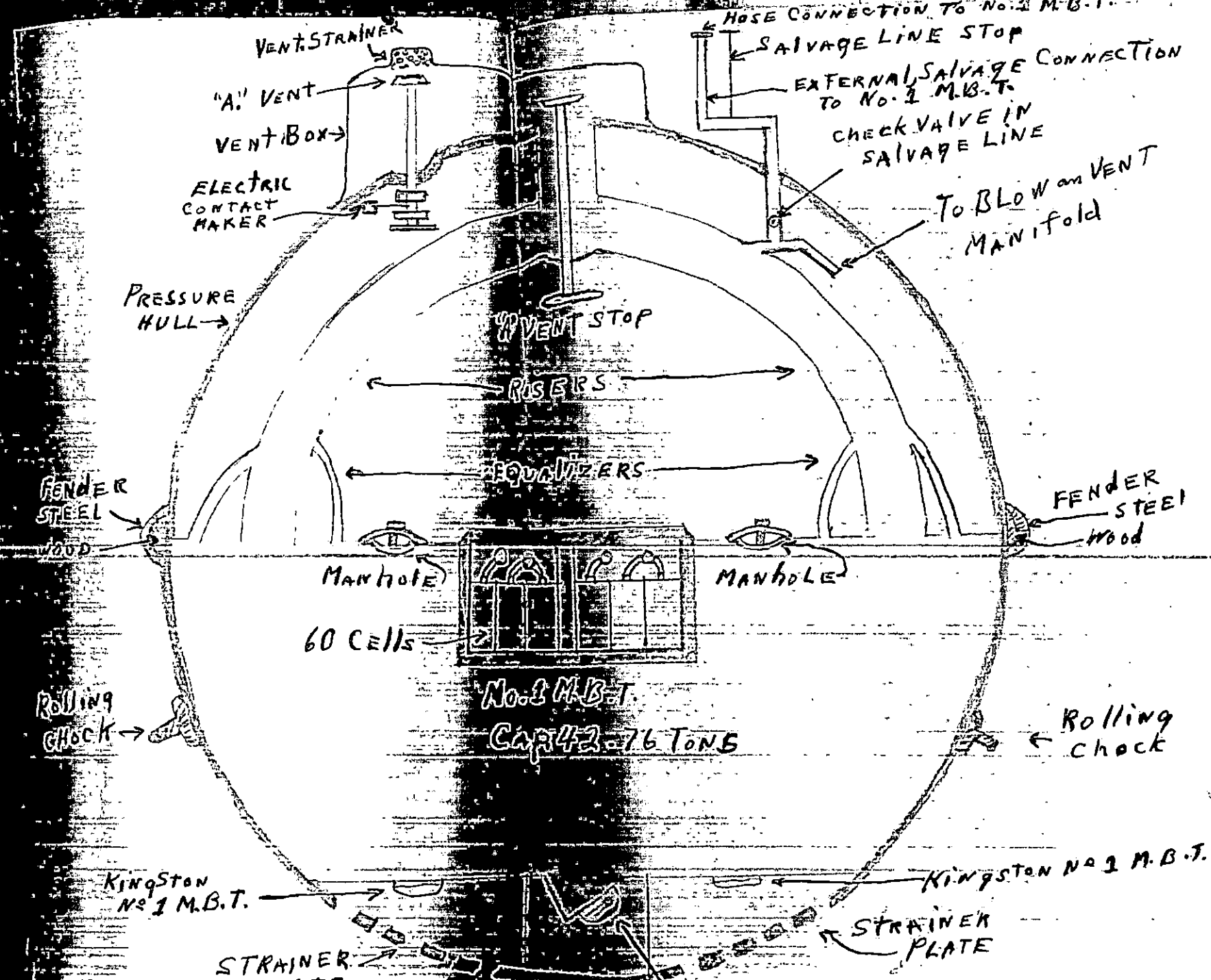
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NOTEBOOK  
SKETCH  
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No. 1 M.B.T.  
CAP. 42.76 TONS



## FIRST WEEK NOTEBOOK WORK

① Describe the keel of an "O" boat.

The keel is ~~the~~ first longitudinal member laid down, to which bottom plates are riveted. These members are  $17\frac{1}{2}$ " by 3" placed  $4\frac{1}{2}$ " from centerline and run from frame #18 to frame #106. At frame #106 the bow casting is riveted in place and this vertical extension of keel at the bow is known as the stem.

This gives keel a depth of  $17\frac{1}{2}$  inches and is 9" wide. The after section of keel from frame #18 to frame #65 is watertight but hollow. This is known as main drain and is used as the main pumping connection between #1 + 2 main Ballast tanks, auxiliary tank to the high + low pressure pumps. (Main drainage system) The bottom plate of main drain from frame #18 to #61 to frame #65 is removable for easy access to drain valves when in Navy Yard so that they may be ground in and jacked closed when testing main Ballast tanks and auxiliary tanks.

The forward section of the keel is filled in and made solid, generally with red leaded wood, this is to take and absorb the shock of grounding. Bottom plate is 20 lbs. plating, the strong watertight hull extends from frame #5 forward to frame #106.

② What are the frames, the bulkheads ③

Frames are numbered from aft forward, are spaced 18" apart, and are of 6" by 3½" angle iron. The hull plating in the midship section is 17½ lb. equal to 7/16" thickness and at the forward and after ends is 14 lb. equal to 7/16" in thickness all plating is riveted. The hull terminates forward and aft. in steel bow & stern castings. The watertight hull from frame #5 to #106 is built to withstand pressure of 88.8 lbs. equal to a submergence of 200 feet. Within the watertight hull are six watertight compartments, six ballast tanks, ④

all the fuel tanks and the operating machinery (SEE SKETCH #1). Bulkheads are ~~water~~ watertight athwartship platings, dividing the pressure hull into compartments having a watertight door opening and packing gland. fixtures for allowing air, fuel and water lines to pass through them.

③ What pressures are bulkheads built to withstand?

The control room bulkheads are built to withstand 88.8 lb. pressure per sq. inch, while the other bulkheads withstand 25 lbs. per sq. inch.

④ What is the pressure hull. What is the thickness of the hull from what frame to what frame does the water tight pressure hull extend.

The strong water tight hull extends from frame #5 forward to frame #106. Frames are numbered from aft forward, are spaced 18" apart, and are of 6" by 3½" angle iron. The hull plating in the midship section 7½" thick equal to 9/16"

11

thickness and at the forward and after ends is 14 pounds - equal to  $7/16$  in thickness. All plating is riveted.

⑤ How many compartments (rooms) in an "O-Boat" List important gear in each room.

⑥ The torpedo room is located between frame #78 and #100. The breeches of torpedo tubes together with firing valves, stop valves, muzzle door and bow-cap operating mechanism and water gauges extend into this room. There are storage racks for four spare torpedoes, torpedo spare parts, oil and testing equipment. The main induction forward, J.K. listening device anchor gear marker ~~box~~ release, a torpedo loading hatch, escape and rescue access hatch, under the deck of torpedo room #1 M.B.T., extend into torpedo room. Three frames to frame #81 in U shape of this tank are four battery water tanks, also a magazine

for the storage of ammunition for the ordnance equipment on board and between frame #81 and frame #84, is the air-bottle well containing 21 of 30 air-bottles for storage of compressed air. Between frames #84 and 99 are the four fuel oil tanks of forward group. Frame #99 to 100 is torpedo room forward ledge.

Aft torpedo room is the forward Battery room between frames #66 and #78. sixty cells comprising the forward battery arranged in six rows of ten cells are installed in a battery well in the U-shape of #1 M.S.T. This well is lined with concrete, mica, and sheet lead for ~~insulation~~ insulation and protection of the tank top and sides against grounds and corrosion. a wood deck in portable sections covers the battery wells, a rubber mat is placed ~~of~~ over section, and a shellac'd canvas cover to protect the rubber forms the deck of this room. special brass retaining strips dogged

in place are provided to make this deck covering water tight. Above the deck are bunks for crew, officers <sup>living</sup> quarters; battery ventilation system including blowers, suitable flapper valves to insure watertightness of ventilation system; lockers for storage of charts navigation instruments, confidential documents, effects of officers and crew. There is a soft patch on pressure hull at frame #70-72 on overhead (old gun housing) for pass purposes of removing battery cells for reconditioning or replacement. #1 M.B.T. riser pipe, stop and vent valve (A vent).

Aft. forward battery room between frames #57 & 66 is the control room. The auxiliary tanks has the same shape as main ballast tanks and in V-shape of tank are 9 air-bottles, making a total of 30, a volume tank of 5 cu. ft. capacity, regulator tank.

(capacity 99 ton of Water and tested to 150 lbs hydraulic), the ship's fresh water tank (capacity 747 gallons for drinking & cooking (10 lb. air test for lightness)

The deck of this compartment is supported on steel angle irons with portable deck plates covered with canvas. This room contains the main control apparatus of the boat. On forward bulkhead amidships is the hand and electrical steering ~~control~~ control. Just to port of this station is main motor control, outboard of this is radio sending and receiving equipment, port side aft the bow and stern planes controls both hand and electrical with motors under platform, dept gauges and sensitive gauges, barometer for measuring atmospheric pressure. In after bulkhead in port corner is the air manifold including the banks distributing and blow and vent manifolds with pressure gauges for sea.

high pressure, 200 lb. air 100 lb. air and  
 one for each ballast tank. ~~on~~ after  
 bulkhead starboard side of door is the  
 interior communications panel board.  
 forward of this are the Kingston levers  
 water gauges for regulator and auxiliary  
 tanks. drain valves operating hand  
 wheels are <sup>here</sup> on starboard side near top of  
 tank in forward starboard corner is  
 trim pump with control panel and  
 water manifold. On centerline of over-  
 head from forward aft. is the conning  
 tower with upper or outer hatch and  
 lower or inner hatch, #1 periscope, radio  
 trunk with hinged flaps and strong back  
 make lower end of trunk watertight  
 and just aft of control room hatch  
 skirt are the Lorpeloe impulse tank  
 repeater gauges. the bulkheads at the  
 forward and after end of this room are  
 built to safely withstand 88.8 lbs.  
 pressure (equal to 200 ft. depth).

all other bulkheads between rooms are built to withstand a pressure of 25 lbs. Rooms (compartments) are tested to 10 lbs. pressure for tightness only during Navy yard overhauls.

⑦

Aft the control room, between frames #5 and #7 is after battery room similar in design as the forward battery room. In the "U" shape of #2 M.B.T. are 60 cells comprising the after battery, above the deck circling in counter clockwise direction from water tight door on forward bulkhead. - Master Gyro Compass, galley sink pumps and discharge line with sea valve, galley range with hot plates and oven (electrical current supplied from batteries). meat gear locker and under it refrigeration machinery, Ice box; Scuttlebutt, ~~butt~~ provision lockers, across after end are uptakes for battery ventilation system, Watertight floor to engine room. (this door has a safety

latch), starboard side starts the electricians work bench, main switchboard for all connections, between batteries and electrically operated machinery, gyro compass panel board with motor generator for <sup>and</sup> gyro interior communications in center of compartment is the mess table. In the overhead from forward aft are the Identification signal gun, battery ventilation outboard exhaust line, riser pipe stop and Vent Valve to #2 M.B.T. ("B" Vent), motor generators for sending and receiving via radio. A soft patch frame #46-47 for same purpose as forward battery.

- ③ Aft the after Battery room from frame #27 to 45 is engine room containing the port and starboard main engines with their necessary circulating water system pumps and manifolds, fuel oil pumps, throttles for control of fuel oil and air, exhaust lines, engine clutches operating gear contact panels for main motors,

11  
Head with operating gear, are forward  
to port and starboard, auxiliary control  
panel for main motors, head with operating  
gear are across forward end of engine room,  
escape and access hatch through pressure  
bulk overhead at frame # 41 - 43, a large  
soft patch is riveted in place on over-  
head at frames # 32 - 36, quick operating  
valves levers and stops for outboard engines  
exhaust valves extend through this patch,  
the purpose of which is to remove large  
sections or pieces of main engine to  
large to be taken in or out <sup>through</sup> the  
deck hatch. The deck in this room  
is supported by angle iron, with  
portable steel plating called flats. Top  
of fuel oil and lub. oil tanks form the  
bridge. Fuel oil tanks under flats extend  
from frame # 27 to 43, this group is the  
after fuel oil group. tanks # 5-6-7-8-9.  
Frame 43 to 45 is the main lub. oil  
tank, these tanks are structural tanks

The sump tank is a separate tank built in #5 fuel oil tanks in the centerline, with a capacity of 2.51 gallons of lubricating oil.

⑨ Aft the engine room from frame #8 to 27 is the motor room containing the port and starboard main motors, line shafting from engines clutch out through stern tubes in after trim tank to propellers, the two ships service air compressors driven by friction clutches from main shafting, main induction inlet ~~clutch~~ shaft clutches, thrust blocks, rudder and stern plane quadrants, steering motor and clutches, lathe for small machine work driven by an independent motor and penel, high and low pressure pumps, motor room water manifold, motor room escape and rescue hatch frame #16 - #18, large soft patch on overhead frame #19-23 for purposes

of lifting out main motors or other equipment in motor room is large to be taken through hatch. The diameter of motor room being small there is nothing located under the "flat" except piping and lower projection of various gear.

(12) Aft motor room frame # 5-8 is after trim tank having a capacity of 2.7 tons, tested hydraulically to 88.88 lbs pressure per sq. inch stern tubes for main drive shafts pass through this tank in a fore & aft. direction, forward end of tube has watertight packing gland around shaft and after end of tube is open to sea with a sectional hardwood shaft bearing (Legnum Vital) and is water lubrication.

(13) Aft aft trim tank frame 0-5 is mon-watertight hull support for stern planes, steering rudders, skegs that support outer ends of stern planes, and propeller shaft strut bearing made of bronze.

(12)

The normal complement of an "O" boat is ~~thirty~~<sup>three</sup> officers and thirty men. The ~~Bureau of ships is~~ The lung disposal on board in accordance with the Bureau of ships is

Torpedo Room ----- 36

Motor room ----- 36

Control room ----- 10

Affixed to ready bds. --

with smoke filter etc. 6

Total ----- 88

~~are done~~

(13)

What is a main Ballast tank a variable tank a trimming tank

Main Ballast tanks - #1 & 2, main Ballast tanks are tanks provided primarily to furnish buoyancy on the surface and which are habitually carried full of water when submerged it is the flooding of these tanks which destroy the buoyancy.

Variable tanks, Ballast tanks not habitually carried full of water when submerged, designed for use in weight compensation. Forward trim, after trim, auxiliary and regulator come under this designation.

Trimming tanks - The variable tank located forward near the bow known as the forward trimming tank and the variable tank located near the stern known as the after trimming tank.

Q What and where is the submerged anchor hawse pipe?

The submerged anchor is of the mushroom type and weight 2,000 lb. It is stowed up against the hull under forward trim and from here a submerged anchor hawse pipe leads up through the trim tank, slanting slightly aft. At the top, at top of hawse pipe, is a sheave and cable cutter to cut the submerged anchor cable in case it is desired to

to cut the anchor ~~haws~~ ~~pipe~~ ~~leads~~  
~~up~~ ~~the~~ ~~line~~ ~~by~~ ~~standing~~ ~~lightly~~  
~~aft~~ ~~at~~ ~~the~~ ~~top~~ ~~end~~ ~~to~~ ~~free~~ ~~due~~ ~~to~~  
 any reason or for fouling, this cable  
 cutter is operated in the overhead of  
 the torpedo room over the breeches of  
 the tubes. shackled to submerged anchor  
 we have a five foot shot of  $7/8$ " chain  
 with a swivel and to this is attached 50  
 fathoms of  $3/4$ " ~~plow~~ ~~old~~ steel wire cable

The cable leads up through the room  
 over sheave and back through ~~superintendence~~  
 to submerged anchor drum where it  
 is slowed around drum this drum is  
 fitted with a brakeband and gear which  
 may be operated in torpedo room only

A dial located in torpedo room is geared  
 to drum and as drums rotate the dial  
 shows how much cable is out to the  
 anchor ~~is also~~ ~~is~~ located a controller  
 for the anchor motor is located in  
 torpedo room it is equipped with

selector switch to hoist or lower anchor and a variable speed controller to regulate speed of anchor motor as desired

Which of the hatches are fitted for escape? Which for rescue, What is escape equipment? What is rescue equipment?

There are 2 hatches fitted for rescue and 4 fitted for escape

Rescue equipment Equipment carried on board salvage vessel necessary for effecting the rescue of crew and possible salvaging of the boats.

Logging Escape equipment carried in the submarine for use in effecting an escape

(16) Describe the deck anchor as to type and weight, How is the chain marked, Length and type of chain, how is the anchor raised and lowered, how is the chain stowed and where

The deck anchor is a short shank patterned anchor of 800 pounds weight. The anchor is carried on a billboard on

the starboard side of the bow.

Anchor chain is made up of four shots of 15 fathom shots (60 fathoms total) of  $3\frac{1}{2}$ " studded link chain which leads from the river a sheave and through a covered channel under the deck and back over the wildcat and down into the chain locker where chain locker must be carefully fused to prevent ~~burning~~ kinking and piling up. The deck anchor or wildcat is fitted with brakeband and pawl which may be controlled from deck only.

12

Describe the submerged anchor as to type, weight, lengths of wire cable how hoisted and lowered, how and where is cable stowed, how tell how much cable is out.

The submerged anchor is of the mushroom type and 2,000 lbs. weight. It is stowed up against the hull under forward trim tank and from here a submerged anchor hawsepipe leads up through the trim tank slanting

slightly aft at the top. at the top of the  
house pipe is a sheave and cable cutter to  
cut the submerged anchor cable in case  
it is desired to cut anchor free due to  
any reason or for fouling. This cable  
cutter is operated in the overhead of  
the torpedo room over the breeches of  
the tubes. shackled to submerged anchor  
we have a five foot shot of  $7/8$ " chain  
with a swivel end to this is attached  
50 fathoms of  $3/4$ " plow steel wire  
cable. The cable leads up through the  
house, over sheave, and back through  
superstructure to submerged anchor  
drum where it is stowed around drum.  
This drum is fitted with a ~~to~~ brake band  
and pawl which may be operated in  
torpedo room only. A dial located in  
torpedo room is geared to drum and as  
drum rotates the dial shows how  
much cable is out to the anchor.  
A controller for the anchor motor

is located ~~on deck~~ in torpedo room. It is equipped with a selector switch to hoist or lower anchor and a variable speed controller to regulate speed of motor as desired.

8 Explain why the main induction the hatches and doors from conning tower to <sup>the</sup> engine ~~room~~ and motor room should never be closed, while running on the main engines.

When operating on the surface with main engines in use, deck hatches are usually closed with exception of conning tower hatch therefore path of air to supply ~~main~~ main engines is through the conning tower control room, and after battery into engine room. The main air induction system will not supply enough to main engine while running full speed. Therefore it is necessary that no door, nor hatch

in path of air supply to main Engines  
 Be closed, to do so ~~would~~ would endanger  
 endanger lives of the crew

19 What is the superstructure, the  
 conning tower shears, the periscope  
 shears

~~The superstructure in the past~~  
~~added on to the hull. It is not water-~~  
 tight

Upon the strong pressure hull,  
 from stern to stem, is worked  
 the non-watertight superstructure,  
 which is suitably reinforced in  
 vicinity of the cleats and anchor gear.

This forms a working platform,  
 (deck) Lockers for lines, stanchions and  
 other gear are built into superstructure.

- (20) See that all deck lockers and gear stowed in superstructure is properly secured.

When underway, always keep all gear in superstructure, especially mooring lines, secured in such manner that it cannot get out of the lockers.

Reason. A line wrapped around a propeller will disable that shaft. Other gear striking the propeller will do it more or less damage causing vibration.

- (21) What rooms have soft patches, what are they? What are the marker bouys.

Soft patches are in the following compartments Motor Room, Engine Room, ~~forward~~ <sup>after</sup> battery room, forward battery room. They are used for removing heavy machinery at the Marker buoys. <sup>main</sup> are located on deck forward & aft. They are equipped with a telephone, they are

released when boat is sunk.

(2)

What is the towing pendant release, the cable cutter, the signal gun, the J.K. device.

Towing pendant - a one hundred feet length of one inch wire, with an eye in each end. The end made fast to the boat has a length of chain with a large open link that fit towing pendant release mechanism, this mechanism is operated from inside Torpedo room by a vertical shaft and wrench with proper gears, to turn release lug to release position. This pendant is used to tow a disabled submarine until repairs can be made at sea or in port.

The J.K. In the torpedo room we have installed the J.K. and Q.C. equipment which is to obtain ranges and bearings in a submerged condition or in a surface condition and also used on surface craft.

at present standard installation, the model J.K. equipment is used for the detection of and taking bearings on other vessels but cannot be used for echo ranging.

Cable Cutter - at the top of the hawsepipe is a sheave and cable and cable cutter to cut the submerged anchor cable in case it is desired to cut the anchor free due to any reason or for fouling. This cable cutter is operated in the overhead of the torpedo room over the breeches of the tubes.

(23)

What is the main difference between the gyro compass and the magnetic compass

The gyro compass gives a true bearing whereas the magnetic compass would give a magnetic north and south reading. Repeated readings are checked for accuracy by comparing repeated readings.

(24) In what compartment are emergency rations and water stored

There is stowed in each room throughout the boat emergency rations emergency, fresh water.

(25) Is smoking permitted on a dive?

Why is silence necessary on a dive?

Silence is absolutely necessary so that any orders passed shall be heard,

Whenever ordered and a word is passed make certain that the crew in the next room gets the word, in other words "pass the word!"

Smoking while on a dive is not permitted except at such times as the commanding officer shall order

"the smoking lamp is lighted" and emergency thereafter shall automatically put the smoking lamp out."

(23) Describe how to shift to hand power on the bow and stern planes.

To shift to hand control on the bow and stern planes, grasp clutch operating lever in one hand and turn wheel with other hand until clutches slide up then engage clutch and operate planes with handwheels. Report when shifted.

(24) What precautions must be taken before a man can enter a tank? What precautions are made while the man is in the ~~enter~~ tank.

Never enter tanks which are normally closed, such as fuel tanks and main and variable ballast tanks, until they have been thoroughly aired out. Then all men working inside must be watched by men outside tank also attach line to men going into large tanks. Such tanks may contain air lacking in Oxygen or

harmful gases which may produce unconsciousness and death. fuel tanks may in addition contain explosive gases.

(26)

What precautions must be taken, while fighting a fire in a confined ~~place~~ space?

When using a fire extinguisher in an enclosed space, wear a gas mask which protects against  $\text{CO}_2$ .

Fire extinguishers have as their principle the smothering of fire by excluding the air. it will do the same thing to humans producing suffocation.

(27)

What precautions are taken in fighting electrical fires?

The use of water in extinguishing fires in a submarine should be avoided to avoid electrical shocks; to avoid spread of oil; to prevent formation of Chlorine

② What precautions are taken where there are explosives at the scene of fire

If fire is in compartment where explosive are stored stand by to flood magazines, on orders from officer in charge, Explosives not in the magazines shall if possible be removed from the scene of the fire but if too large to be moved, <sup>should be</sup> protected by cooling or tarpaulins.

29

What necessary connections must all tanks have?

There are five necessary connections to all tanks namely, flood valve, vent, gangleline, blow valve & drain.

## SECOND WEEK NOTEBOOK WORK

I Why are the regulator and auxiliary tanks fitted with a kingston and a stop valve?

II The Auxiliary tank is equipped with a lever stop valve and screw type kingston valve. Two valves are necessary because of the fact that auxiliary is a variable tank, and leaks cannot be permitted. The two valves are always left securely closed and a dive. The normal way to flood water into the tank is by way of the brim line to which it has a connection. The tank is also fitted for blowing and venting at the air manifold in the control room in the same way as the main ballast and other variable ballast tanks.

The regulator tank is the strongest tank on the boat being built to withstand a pressure of 150 lbs. pressure

1 30  
per sq inch. It is a separately built tank not a structural tank. As regards flooding it has the same kingston and stop valve system as used in auxiliary and the same method of blowing and venting as the main Ballast and trim tanks. This tank is also fitted with a pressure gauge and a float type water gauge.

15 How do regulator tanks and auxiliary tanks kingston valves differ from those of the main ballast kingston valve?

16 On the regulator and auxiliary tank there are screw type kingstons while on the main ballast tanks there are lever type kingstons.

17 What feature of construction of the main ballast tank, allows the kingston valve to be grouped together so as to be operated from the control room.

In order that the kingston valve maybe located under the control room

and thereby eliminate complicating operating rods through the bulkheads. floating tunnels are lead from the after part of No. 1. M.B. and the forward part of No. 2. M.B. The kingstons are located within these tunnels and are therefore within control room and close to each other and to auxiliary kingston. While submerged the kingstons are normally left open to permit blowing of water from the tanks to be done readily.

IV You are stationed at "A" vent. You are on a dive; the vent and stop valve are both open, what do you do when the surface alarm sounds.

V When the alarm sounds you immediately close the stop valve, and stand by for orders to close the "A" vent.

VI Describe the high pressure, low pressure and trim pumps. ~~State~~ state their purpose and capacities.

The trim pump on an O'boat submarine is a single acting, duplex plunger type pump having a capacity of 35 gallons per minute, at 176 lbs. pressure. This pump is non-reversible and has valves so arranged on the water manifold as to allow the pump to take a suction from either end of the manifold. The discharge connects to the line going to sea with a line leading back to both sides of the water manifold connecting to valves number 3 & 6.

The high pressure pump is a Kinney type gear pump and is non-reversible, only discharging to sea through a high pressure pump sea and stop discharge to sea on the starboard side motor room. This pump can pump from the main drain or the trim line to sea. Its capacity is 200 gallons per minute at 300 ft. head and it runs by its

own independent motor controlled in the motor room.

The low pressure pump is a centrifugal water pump, pumping 1500 gallons per minute at a 20 ft ~~dept~~ head. Used generally to quickly pump the main ballast tanks through the main drain to sea, on the surface only. This pump also has a suction from the trim line on the motor room manifold. Through this pump from sea is the means of flooding the main drain by opening sea and stop discharge to sea for pump, opening suction from main drain, and opening main drain vent which is located near pump.

What is the trim line, what is it made of how and what pressure is it tested, and what is it tested, and what is its purpose?

The trim line of an O-boat runs along the starboard side of the boat from frame 3 to 106. This line is made of copper except the flanges where put together, which are made of brass and brazed on to the copper. Bolted together, this line

is tested to 88.8 lbs. per sq. in. hydrostatically, except the sea connection which are tested to 150 lbs. as in the regulator tank this is a 3" line known as the secondary drainage system for the purpose of transferring water from tank to tank or from tank to sea. Starting at the torpedo room, there is a drain manifold which in turn can be connected to the tubes for pumping and forward trim flood valve, Each tube has two drain connections but only one valve.

There is a stop on the trim line in the torpedo room; also a torpedo bilge connections and a drain plug for draining the line in freezing weather. In the after end of the torpedo there is a small manifold connected to the trim line for the purpose of pumping the port and starboard side of the air flask well and battery. battery water tank bilge and a magazine flood valve connected to this manifold. all bilge connections have check valves in the lines to keep from flooding the bilge. The trim line has no connection

in the forward battery.

VIII Describe how to use the trim pump and manifold, how start and stop pump. What three main things to remember when using the trim pump or manifold?

When pumping the discharge valve must be open on the side leading to the tank that the pump is discharging to, and the trim pump suction valve from the side of manifold from which you are pumping must be open. The trim pump suction valves are not on the manifold, they are on the suction line. Located near the pump is a push button switch for starting and stopping the pump. To control the speed of the pump, this rheostat must be in the low speed position when starting the pump; so as to avoid too great a strain on the pump motor.

Caution - When using any pump the following precautions must be taken -

1. Be sure the valves to the tanks you are pumping to and from are open.
2. Be sure the pump suction and discharge valves

are open.

3. Be sure the tanks now are Pumping to and from are vented.

HA State exactly how to pump torpedo tubes & lift to sea with high pressure pump. You must handle all valves & pump your self.

Your first operations is to vent the torpedo tubes. then you open the four drain valves on the torpedo tubes. After that you open the trim line stop, then you open your cross connection, then you come <sup>to</sup> the two way cock which you put athwartship (on the trim line, then you open the forward trim ~~line~~ trim line, then the H.P.P. through the strainer, H.P.P. suction, H.P.P. Sea and stop discharge valve, turn on high pressure pump.

IX State exactly the procedure followed on board ship: 3 blast of the diving bellows in relation to handling of main vents, blow valves, drain valves Kingston valves inboard vents and pumps.

3. Blast one the blaxon close main ballast tank main vents A & B, Diving officer directs man on air manifold to blow specified tanks. Plasterman brings boat to surface by means of bow and stern planes. Batteries are usually shifted to series combination. Quartermaster in conning tower. Diving officer watches dept. gauge. When boat has positive buoyancy and is on surface, the diving officer shall order "Secure air on Main Ballast tanks" "Close Kingstons on #1 and #2 M.B.T." "Low pressure pump on main drain" "#1 or 2 M.B.T. drain valves open as soon as suction is reported by man on air manifold he shall order other ballast tanks be put on main drain." "Report to commanding officer, suction on both main ballast tanks."

After suction has been obtained the commanding officer may order the flapper opened and main induction cracked. The diving officer shall observe barometer and when pressure is equalized he shall report same to

commanding officer. The Commanding officer then orders "open the hatch." In pumping up all main ballast tanks will be left on main drain until the motor room reports suction has been lost on the low pressure pump. When granted permission by commanding officer tanks will be vented through the outboard vents until after pump has lost suction on main drains. When all main ballast tanks are dry, Kingstone and vents secured and all the pumps are secured, the diving officer shall report to bridge (C.O.D. + C.O.) "All main ballast tanks dry, Kingstone vents & low pressure pumps are secured." The D.O.D. will man the periscope continuously except when secured by commanding officer, from time orders are given to surface until control of ship has been shifted to bridge. The torpedo tubes will be pumped as ordered by diving officer.

X State exactly how to flood magazine and control flooding from the control room, ~~putting on main drain.~~

(To flood the magazine and control the flooding we would first open the sea and stop. To flood the magazine you would first open your valve to the magazines then you open your forward trim line and the sea valve, next open the sea <sup>and</sup> stop valve you ~~can~~ control the flooding by the forward trim valve or sea valve on the water manifold.

11 State exactly how to put high pressure pump on main drain.

You open your high pressure pump section to main drain, Open the high pressure <sup>pump</sup> section and your sea and stop valve.

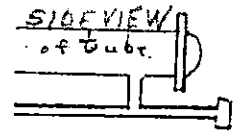
12 State exactly how to put low pressure pump on main drain.

You open your low pressure pump suction valve, vent to main drain and your sea and stop valve.

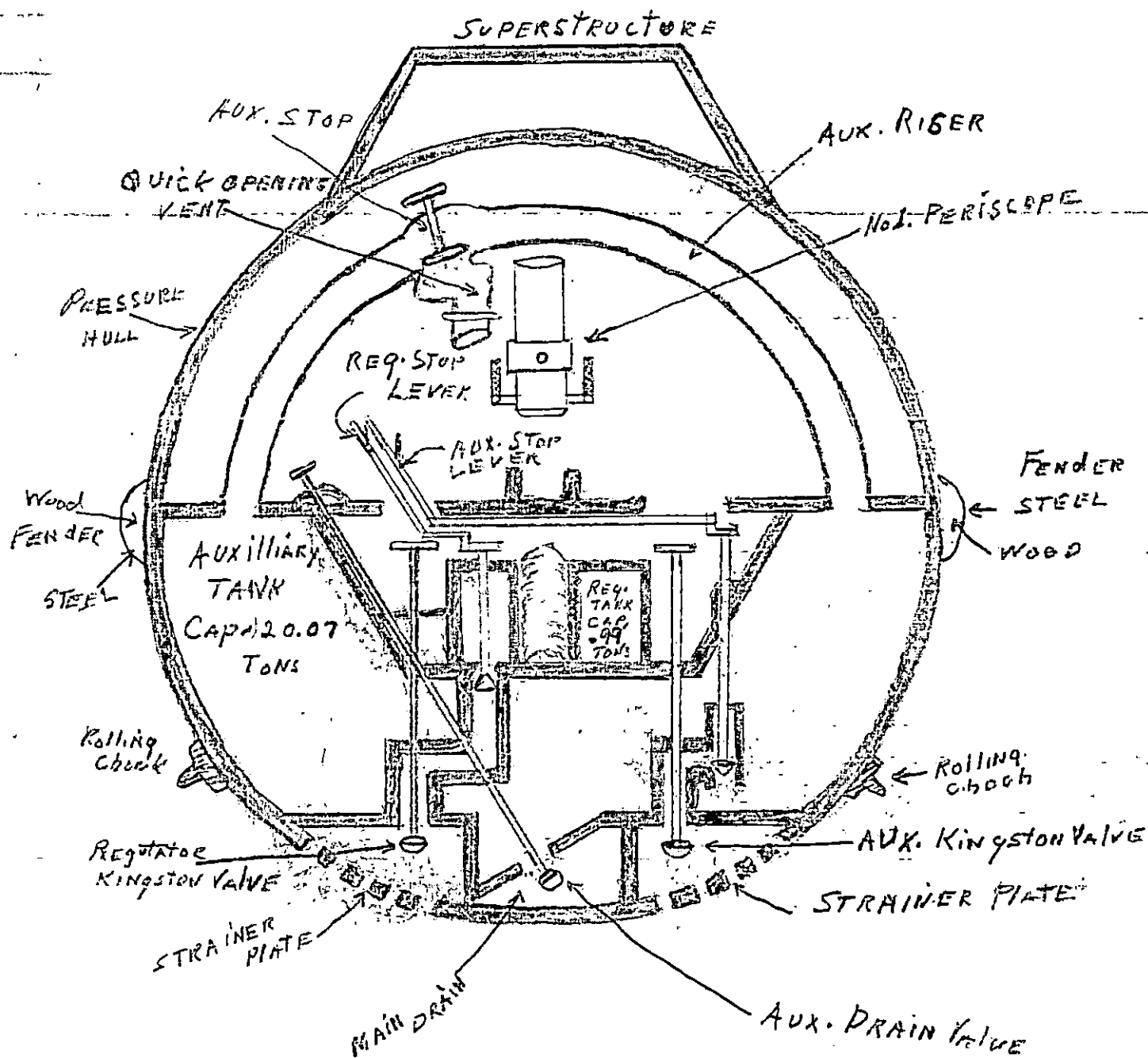
(13) State exactly how to pump engine room bilges to sea, Open your engine room bilge valve, turn your two-way cock so that it is amidship then open the forward trim tank, your strainers by-pass your H.P.P. suction and sea + stop valve.

(14) What is the klaxon signal used for?  
What is the siren signal used for.

The Klaxon is used when surfacing and submerging, The siren is used when there is a collision.



- note  
all B.L.ges Valves  
are check Type



## THIRD WEEK

I HOW MANY AIR BOTTLES ARE PROVIDED AND INTO HOW MANY BANKS ARE THEY DIVIDED? WHERE ARE THE FLASKS LOCATED?

Q Air Banks. For storage of compressed air, thirty steel flasks are provided. Twenty-one are located in air bottle well in torpedo room and nine in the control room bilges. Standing vertically between frames of after bulkhead. The flasks are grouped to form five banks of six bottles each with a total capacity of 180.81 cubic feet. These flasks before installation are tested to 5,000 lbs. pressure per sq. inch and every seven years thereafter. In service they are charged to 2500 lbs. Each flask is fitted with a drain connection which runs to bottom in order to permit drainage of any accumulated water or to bleed down flasks. The flask in each are connected to a common high pressure copper line which runs along the port side back to high pressure bank manifold for distribution throughout the ship. When ship is rigged for dive, three of these

banks must be out in on the system with at least 2,000 lbs. each

② What is the purpose of the 100 lb. bypass  
The 200 lb. bypass?

⊙ In event of failure of either the 100 or 200 lb. reducers a 100 lb. by-pass valve is located on air distribution manifold to permit high pressure air to be bled directly into 100 lb. line its operation is the same as the 200 lb. by-pass. Because of defects of present type reducers and fact that pressure in excess of 100 lb. is required for some purpose the use of the 100 lb. by-pass is almost universal.

⊙ 200 lb. by-pass

a by-pass is provided on distribution manifold whereby high pressure air can be bled directly into 200 lb. line, by-passing 200 lb. reducer in case reducer fails to function properly or in case more volume is needed than the reducer will furnish.

③ What is the purpose of the volume tank  
In order to increase the volume of line and thus keep a supply of air for operations, a volume tank of 5 cubic ft. is located on the after part of the control room wall, it is equipped with a relief valve and a drain. The volume tank maybe by-passed should it be ruptured.

④ How are air bottles and the volume tank cleared of any accumulated moisture  
Each flask is fitted with a drain connection which runs to bottom in order to permit drainage of any accumulated water or to bleed down flasks

⑤ Make a list of the 100 lb. line air connections in each compartment

The 100 lb. air line

This line is installed to supply the many needs for low pressure air on the submain. It takes off the 200 lb. line in the control room and is at this point reduced to 100 lb. pressure by a reducer. The line then

runs forward to the forward part of torpedo room and aft to after part of motor room as well as supplying air to control room.

- ⑥ What is the purpose of the emergency air outlet in some compartments? In what compartments are they located and from what line do they brack? How distinguished at a quick glance.

In the motor room is an emergency compartment air valve, painted red, which is used to keep water at low level in a ruptured compartment, and to keep water at a desired level while using <sup>the</sup> compartment for escape.

In the engine room there are three leads off the port high pressure line, one through the 750 lbs reducer to engine spray air system for emergency use to engines. There are two emergency connections. On either side of a partial bulkhead for same purpose as stated in motor room. These are known

connections of the port high pressure line in after battery. The port high pressure line in the control room has 3 connections. One leads to high pressure line in the control room has 3 connections. One leads to high pressure distribution manifold through the port compressor charging valve. There is also a lead leading through the pressure hull up to the port side of the conning tower which is for connecting up for charging banks from a compressor on the deck of another boat or tender. There is also an emergency compartment air valve in the compartment from this line. There are no connections from this line in forward battery room. In the torpedo room there is an emergency compartment air valve, also painted red, for the purpose & others in other compartments. To what pressures are the various air lines tested? The two hundred pound air line is tested to three hundred pounds

⑦

it has a relief valve set at 225 lb. The 100 lb. line is tested to 200 lb. the relief valves on the 100 lb. p line is set at 125 lbs. The High pressure line is tested to 3750 lb., this has a relief valve set at ~~500~~ 2500 lb.

⑧ To what pressure are the air bottles tested? The Volume tank?

The flasks are grouped to form five banks of six bottles each with a total capacity of 180.81 cubic feet. These flasks, before installation are tested to 5,000 lb. pressure per sq. inch and every seven years thereafter. In service they are charged to 2500 lbs. The Volume tank is tested to 200 lbs it is equipped with a relief valve and a drain.

⑨ Where are the outside charging line connections located. Into what lines do they connect?

The port high pressure line in the control room has 3 connections

5 lb.  
lb.  
line  
line  
lif.  
tes tested  
five  
total  
flasks  
100 lbs.  
ven gas  
argued  
tested  
relief  
gang  
line  
ins

one leads to high pressure ~~line~~ distribution manifold through the port compressor charging valves. There is also a lead leading through the pressure hull up to the port side of the conning tower which is for connecting up for charging banks from a compressor on the dock or another boat or tender. There is also an emergency compartment air valve in the compartment from this line.

(10)

You are directed to charge No. 1. bank with the port air compressor via the starboard charging line. Describe exactly how to do this naming all valves. A line sketch may be made if directed.

Open the cross connection between two air compressors, open H.P. on starboard side, open starboard charging stop valve and open No. 1 bank valve <sup>port compressor</sup> when you have reached the amount needed secure compressor and valves.

(1) You are stationed at the air manifold. state exactly what you do at the <sup>with</sup> "Rig for Dive". All the banks do not have 2500 lbs. pressure.

When ship is rigged for dive, ~~there~~ three of these banks must out air on the system with at least 2,000 lbs each. The distribution manifold in control room is for purpose of distributing high pressure air.

(2) You believe the ~~bar~~ gauge of No 4 bank is not calibrated properly? What can you do to check it.

If you don't believe the gauge on the no. 4 bank is calibrated right you can check by the master gauge.

(3) What are the purpose of the blow lines to the strainer of the sea of the sea valves.

If anything such as rags gets caught in the strainer, it can be blown free thus clearing strainer.

(14) Describe how the air compressors are driven by the main shaft.

The compressors are driven by a friction type clutch, clutching the compressor ~~to~~ to the main shaft. Which drives a quill shaft with gears on after end of the air compressor shaft. The motive force for the compressor can be furnished by either the main engine or main motor, at not over 300 R.P.M.

When charging air alongside the dock tail clutch must be disengaged so propellers will not turn. friction clutch may be engaged while main shaft is turning, therefore, the compressor may be run when ship is underway. The important thing to remember in above combination is that engine speed must be reduced to 300 R.P.M.

- (15) You are stationed on the air manifold during a dive. The 100 lb. reducer is out of order. State what you would do when ordered to blow No ~~1~~ <sup>main ballast</sup> 1.

If the In event of failure of either 100 lb. or 200 lb. reducers a 100 lb. by-pass valve is located on air distribution manifold to permit high pressure air to be ~~bled~~ bled directly into 100 lb. line its operation is the same as the 200 lb. by-pass because of defects of present type reducers and facts that pressure in excess of 100 lb. is required for some purpose the use of the 100 lb. by-pass is almost universal. Relief Valves on 100 lb. line are set at 125 lbs.

- (16) State exactly how you would blow from forward trim to No 3 torpedo tube, Put 3 to 5 lb. pressure on forward trim tank and vent #3 torpedo tube. Open up the forward trim flood & suction valve and no 3 torpedo tube drain valve. Vent the pressure out of forward trim

(17) Explain why a partially filled tank shall never be blown to sea while submerged.

Because that you must use such a great amount of air ~~which will~~ because there is only a small line of air trying to push a against of several in hole.

(18) While submerged, discuss what deficiencies occur in the air and what is done to remedy them.

### Air Conditioning Apparatus

Instructions for use of Air-Purifying apparatus and of compressed air in submarines, (The instructions given herein are based on the following factors.

Limiting percentage of  $\text{CO}_2$  not to exceed 3 percent. One percent or less is ~~harm~~ harmless and after air purification is started effort should be made to keep the percentage of carbon dioxide from going above this amount, however, if it becomes necessary to conserve ~~the~~  $\text{CO}_2$  absorbent.

which will be described later, the percentage of  $\text{CO}_2$  may be allowed to increase during the last few hours of submergence, barely reaching 3 percent at time of coming to surface. Two percent will not ordinarily be noticed but may cause some discomfort if work requiring strenuous exertion is attempted. Prolonged breathing of over 3 percent causes discomfort in breathing even at rest and becomes progressively dangerous above 4 percent.

The amount of carbon dioxide should never be allowed to exceed 3 percent, if for any reason, it does reach this concentration, it should be reduced as rapidly as possible. Limiting percentage of oxygen not to fall below 17 percent. To maintain air of a submarine with above limits of purity it is necessary to reduce the increasing  $\text{CO}_2$  by chemical absorbants and to replenish the decreasing supply of oxygen by bleeding into boat at regular intervals of time certain specified amounts of pure oxygen or air. After

The original air enclosed in a submarine has become so exhausted that above limiting values of oxygen and  $\text{CO}_2$  have been reached the following procedure is necessary to revitalize the atmosphere. Bleed into the vessel 0.9 of a cubic foot of oxygen at atmospheric pressure per man per hour and at the same time use the Navy standard  $\text{CO}_2$  absorbant in accordance with procedure outlined in the article describing  $\text{CO}_2$  absorbant.

Where it becomes necessary to use air instead of oxygen, bleed into the vessel air from compressed air tanks at the rate of 31 cu. ft. per hour at atmospheric pressure per man. The introduction of additional air or oxygen is solely to replenish the oxygen contents in the compartment which under normal submerged conditions should not be allowed to fall below 12 percent as previously mentioned.

Irrespective of heat, compressed oxygen is used for this purpose. The  $\text{CO}_2$  absorbent should also be used because the bad physiological effects of high concentrations of  $\text{CO}_2$  are not lessened by the introduction of additional oxygen or air.

### Revitalization Process

Before submerging whenever circumstances permit, thoroughly ventilate vessel by closing hatches and ventilators in such a manner that all air for engines is drawn into compartments and throughout vessel. Under these conditions, run engines for about 5 minutes. After cutting off fuel supply. If the dive is not a "Crash Dive", turn engines a few turns under motor or under air to expel all unburnt gases and  $\text{CO}_2$  in cylinders together with foul air in engine room. Since the contained air in the vessel at outset of dive is thus pure it will not reach the limiting value of 17 percent oxygen and 3 percent

carbon dioxide until expiration of a period of hours (X), calculated by following formula ( $X = 00.04 \frac{C}{N}$ ) where C and N for various classes of vessels are given in following table together with corresponding values of (X) for each class

	approximate net air space (C) (cubic feet)	complement (N)	Time in hours (X)
O-class	13,000	33	16
R-class	14,210	33	17
S-2	19,530	43	18
S-3 to S-41	21,700	43	20
S-42 to S-47	23,100	43	22
S-48	26,000	50	20
Barracuda Class	53,200	87	24
Argonaut	61,270	87	30
Norwhal, Nautilus	69,930	87	30
Dolphin	40,175	58	27
Cachalot	27,230	44	24

If submergence under ordinary operating conditions ~~it~~ is less than the periods listed in the last column above, oxygen or compressed air replenishment and  $\text{CO}_2$  purification should not be necessary.

However, if it is predetermined that the time of submergence will be greater in any case than the periods listed in the last column above, air purification with the  $\text{CO}_2$  absorbant should be resorted to immediately, Oxygen replenishment should be resorted to at the end of the periods designated for respective vessels.

Replenishing Oxygen by bleeding from Oxygen flasks.

At the end of the periods listed for each submarine or the classes of submarines in the foregoing table, release from the Oxygen cylinders 0.9 cubic feet of oxygen at atmospheric pressure per man per hour.

approximately this quantity may be obtained by releasing enough oxygen to cause a drop in gauge pressure in the cylinder in percentage per man equal to 13.23 divided by net capacity of the cylinder in cubic feet. Repeat this each hour

Thus, if the volume of the cylinder is 1.53 cu. ft. and initial pressure at 1,800 pounds, for "S" class submarines with a crew of 43 men, release oxygen until the pressure in the cylinder drops

$$\frac{13.23}{1.53} \times 43,372 = \text{pounds}$$

or until gauge reads 1,428 pound

Properties of CO<sub>2</sub> Absorbant has been developed especially for air purification in submarines. It is prepared in crystalline form. One-tenth of a pound will absorb about 0.09 pound (0.175 cubic foot at atmospheric pressure) of carbon dioxide. The amount given out by one man per hour. it is estimated that

7.2 lbs. per man is sufficient for maintaining air in a submarine compartment in a respirable condition so far as concerns  $\text{CO}_2$  concentration for 72 hours. The standard allowance is accordingly 8 lbs.

Low temperatures do not materially affect its rate nor capacity for  $\text{CO}_2$  absorption. Its weight per given volume is considerably less than soda lime, which was previously furnished submarines for this purpose, but its capacity for  $\text{CO}_2$  absorption is so much greater than the total weight of the soda lime previously ~~carried~~ carried consequently the amount of storage space required for this special  $\text{CO}_2$  absorbant is about 50 per cent less than that previously required to store soda lime.

#### $\text{CO}_2$ Absorbant Containers

The  $\text{CO}_2$  absorbant is furnished in corrosion-resisting steel containers of

the same size and double-filler cap type previously used for stowing soda lime.

They are approximately 6 by 12 by 12 inches in size. Each container, when delivered, contains 15 lbs. of  $\text{CO}_2$  absorbant.

This weight and also the gross weight (plus absorbant) is stenciled on the front of each container together with the words "Carbon Dioxide Absorbant". These containers should be distributed throughout the vessel's compartments favoring the end compartments.

Precautions in stowing and  
Periodic Weighing

If containers do not become damaged in stowage and the filler caps are maintained tightly in place, they will protect the  $\text{CO}_2$  absorbant against deterioration indefinitely. If, for any reason the containers do develop leaks, moisture in the air will eventually lessen the rate of efficiency of absorption of the

CO<sub>2</sub> absorbant, This deterioration will be noticed by an increase in the weight of the chemical. Accordingly, containers should be weighed semi-annually and if an increase in the gross weight, stenciled on the containers, of as much as 10% is noted, the container should be replaced with one containing fresh absorbant. Containers should not be painted. They should not be opened until required for use and should be removed from the air compartment when undergoing air tests.

- (9) Describe what you would do to get rid of the CO<sub>2</sub> generated during a long dive.

#### METHOD, OF, USE, OF, CO<sub>2</sub>, ABSORBANT

This chemical absorbs CO<sub>2</sub> upon contact. The larger the area of the exposed surface of the absorbant, the more efficient will be the result. When

the length of submergence is such as to necessitate  $\text{CO}_2$  elimination, the following steps should be taken

(a) Remove the mattress covers from the mattresses of four lower bunks in the most convenient compartment provided with outboard ventilation when surfaced

(b) Remove mattresses, slit mattress covers and spread the covers, single thickness, as smoothly and taut as possible ~~of~~ over the bunk springs. Lash the edges to the springs if ~~necessary~~ necessary to keep it taut

(c) Remove covers from one of the  $\text{CO}_2$  absorbant containers and pour about  $\frac{1}{4}$  of the contents (approximately  $3\frac{1}{2}$  pounds) on each cover. Spread the chemical as evenly as possible over the mattress covers.

In pouring the chemical from the container and in spreading it on the mattress covers, do not agitate

it more than necessary. it is caustic and the dust will cause throat irritation. The irritation, however, is only temporary and while in many instances, coughing and sneezing may be induced, the effects are not harmful and will soon be alleviated. When spreading the absorbent care should be taken to prevent its contact with any cuts about the hands. Do not rub the eyes after handling  $\text{CO}_2$  absorbent before the hands have been thoroughly washed. If it is accidentally gotten into the eyes, painful but not dangerous symptoms will occur. Such may be relieved by ~~washing~~ washing the eyes with a solution of 1 part vinegar or lemon juice and 6 parts of water or by carefully washing with a quantity of fresh or salt water. Do not spread the chemical with the hands. Use a stick or other means. After spreading, stir it gently once.

each hour. Under normal submerged operating conditions the contents of 1 container, when spread on 4 mattress covers, will absorb  $\text{CO}_2$  for 144 man hours or will absorb the  $\text{CO}_2$  produced by a crew of 33 men for approximately  $4\frac{1}{2}$  hours, a crew of 43 men <sup>approximately</sup> ~~approximately~~ <sup>approximately</sup> ~~approximately~~ by  $3\frac{1}{2}$  hours; a crew of 87 men <sup>approximately</sup> ~~approximately~~ <sup>approximately</sup> ~~approximately~~  $1\frac{3}{4}$  hours, a crew of 58 men 2.6 hours. When the chemical absorbs  $\text{CO}_2$  it evolves heat and is warm to the touch. The amount of heat evolved depends upon the amount of  $\text{CO}_2$  present in the air and rate of its absorption. When the chemical no longer evolves heat in the presence of  $\text{CO}_2$ , it has become saturated and should be removed. However, with a small number of men in a compartment the amount of  $\text{CO}_2$  generated will not be as great that produced by a large number of men and the

amount of heat evolved will be slight. Consequently when taking the warmth of the chemical by touch, care should be taken that the material is fully spent before renewing it. If there is any doubt on this point leave the material spread on the mattress cover and spread an additional charge on a split mattress cover on an additional bunk.

### Carbon Dioxide Testing Outfit

The testing outfit consists of a rack of four standard tubes, indicating 1, 2, 3, and 4 per cent of carbon dioxide. Two hardrubber bottles for the solution, an atom atomizer bulb and football bladder with ~~pinhook~~ pinhook for taking samples of air, 2 test tubes and 3 slender glass tubes, all packed in a small nickel plated box; a supply of small glass tubes of concentrated solution is.

furnished with each outfit.

The solution contained in hard rubber bottles consists of sodium bicarbonate, colored with an indicator, the color of which changes with a change in the percentage of carbon dioxide contained in the air which is bubbled through the solution. The color of the indicator does not depend on the volume of air bubbled through the solution after a certain point, called the saturation point, is reached. The time taken to reach the saturation point will usually not exceed 1 minute and may be determined by the fact that no further change in the color takes place.

Directions for Use.

Connect atomizer bulb to the football bladder with the short piece of glass tubing found in the lid of

of the box and pump the bladder full of the air to be tested. Discharge the first sample in order to wash out any remnants of old air in the bladder. Close the bladder neck with the pinchcock and connect in the place of the atomizer bulb one of the slender glass tubes found in the lid of the box.

(a) Pour about  $1\frac{1}{2}$  inches of the solution from the hard rubber bottle into one of the small test tubes; also found in the lid of the box. Then ~~add~~ bubble air from the bladder slowly through the solution in test tube until the indicator ceases to change colors which will usually will not be over 1 minute.

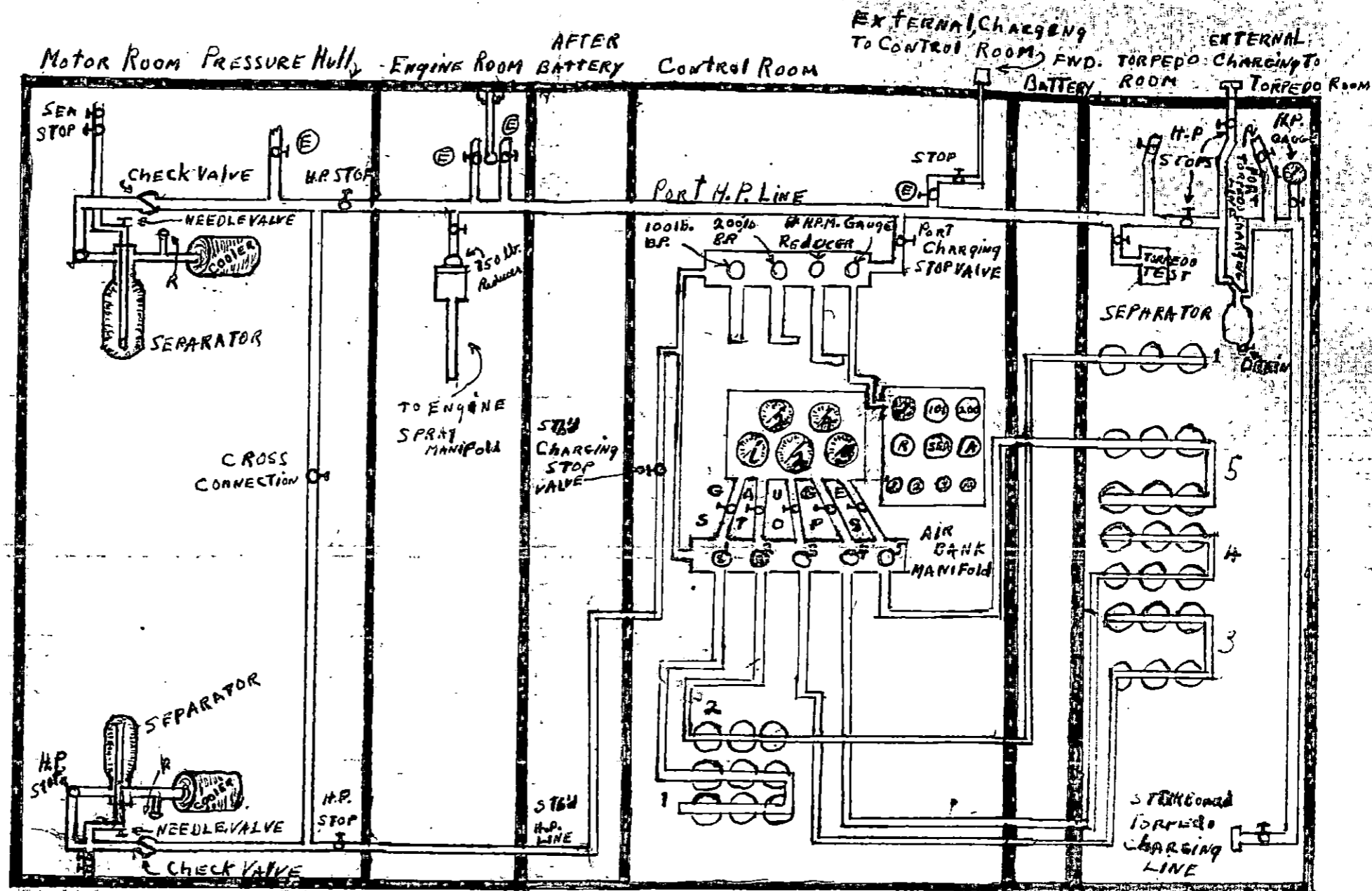
(b) Take the rack of standard color tubes near a good light and set the moveable background plate at about a 45° angle and match up the solution

in the test tubes with the standard tubes to find its place in the rack. Read of the percentage of carbon Dioxide, from the markings on the rack. If the sample does not match a standard tube exactly it should be given a reading by interpolation with the standard tubes. ~~It should be given a reading by~~ as for sample, 1.5 percent or 0.8 per cent.

The same solution may be used for several determinations, not to exceed approximately 20, but should not be kept in the test tube more than 24 hours, The solution will last for months in the hard rubber bottles. The accuracy with which the amount of the carbon dioxide in air may be determined by this method is about two-tenths of 1 percent when using ordinary care in making the determination. The solution

and standard tubes are standardized for a temperature of from  $68^{\circ}$  to  $70^{\circ}$  F. A temperature of  $60^{\circ}$  F. give the reading about 10 percent too high and a temperature of  $80^{\circ}$  F. gives a reading about 10 percent too low

yld  
 - 70°  
 the  
 high  
 20  
 w



THIRD WEEK  
 Notebook SKETCH  
 No 1

MOTOR ROOM  
PRESSURE HULL

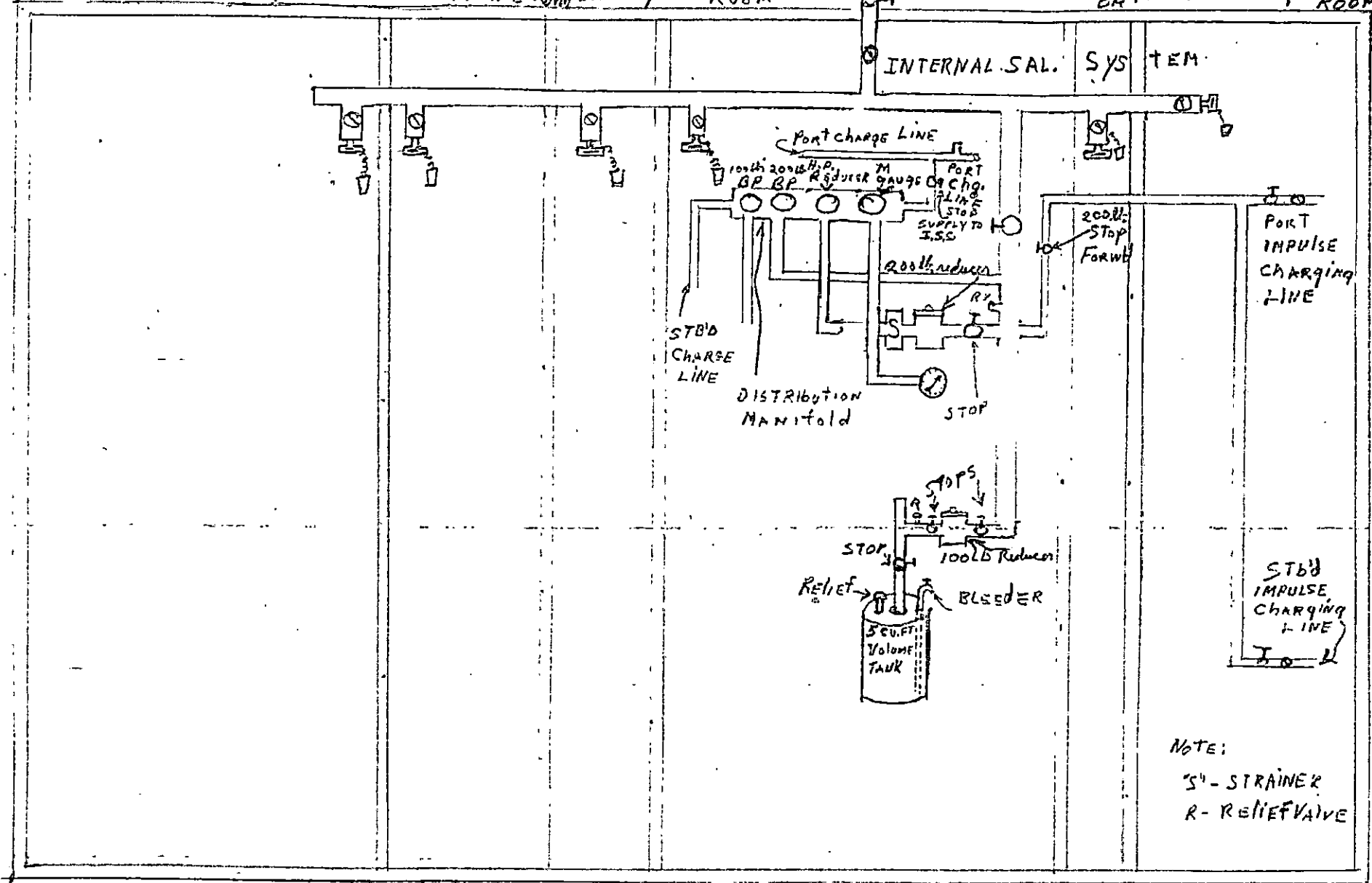
AFT.  
ENGINE ROOM BATTERY

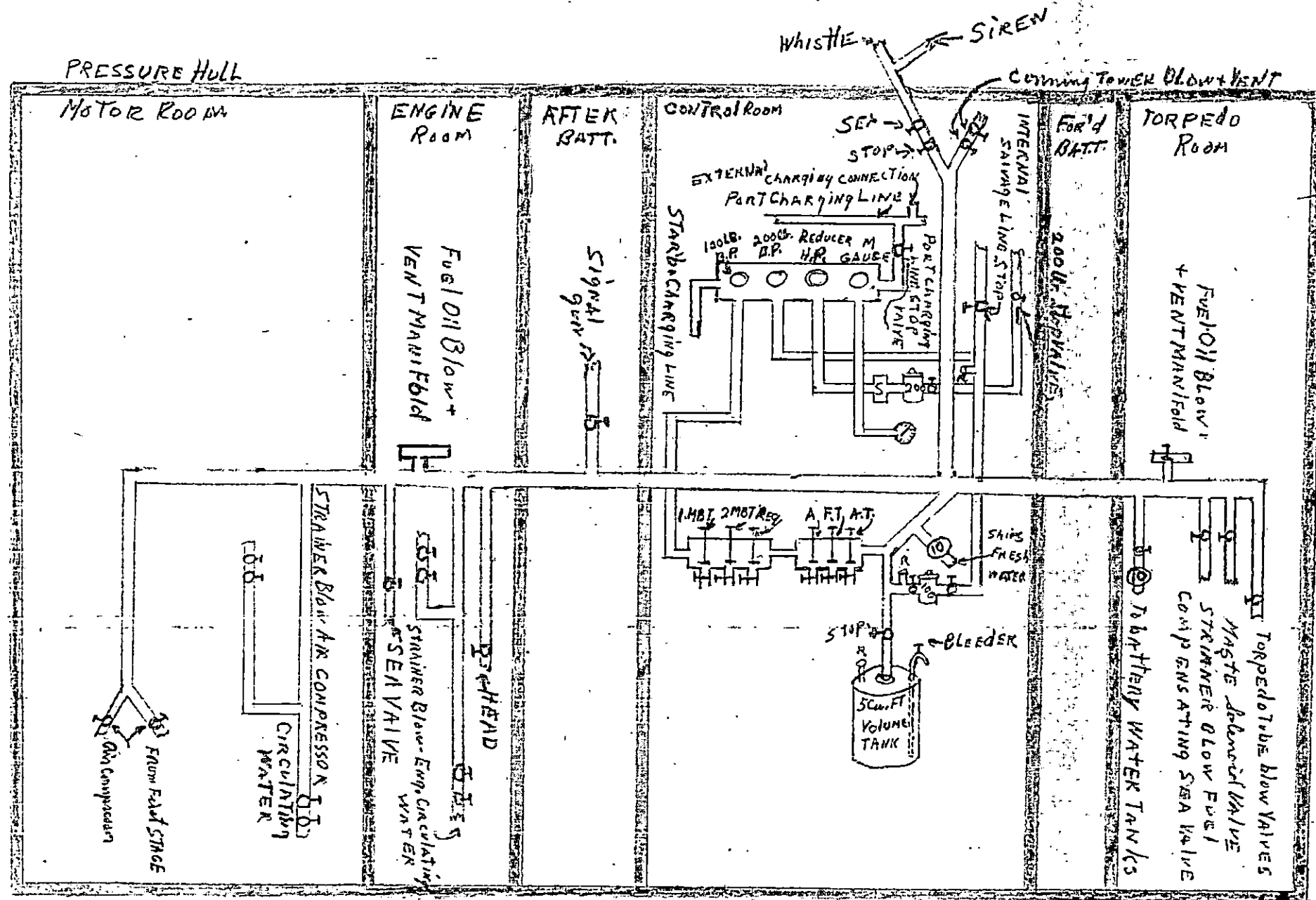
CONTROL ROOM

EXTERNAL SALVAGE  
CONN TO. INTERNAL  
SALVAGE SYSTEM  
FOR'D BATT.

Torpedo ROOM

THIRD WEEK  
NOTE BOOK  
- SKETCH  
NO 2





THIRD WEEK  
 NOTEBOOK SKETCH  
 1403

## FOURTH WEEK NOTEBOOK WORK

I What are the two ventilation ~~systems~~ systems. The two ventilation systems are Battery Ventilation System, and Main Induction system.

II What is the purpose of circulating ~~air~~ air through the main Induction while submerged? While submerged for any length of time, the air can be circulated throughout the boat and also have a tendency to cool the air. It can be circulated from either end but the most common practice is to circulate from the torpedo Room to the motor Room.

III You are ordered to circulate air through the main Induction from torpedo room to motor room; describe exactly what you would do.

- ① Open flappers in torpedo room.
- ② Leave control room flappers closed.
- ③ In motor room open flappers and start main Induction Blower.

You will draw the air from the

torpedo room, through ventilation line above pressure hull which is surrounded by sea water and will have a tendency to cool the air. The blowers will discharge into the motor rooms, thereby circulating the air in the boat.

IV What is the purpose of the battery ventilation system?

The Battery ventilation system is designed for this purpose to circulate air throughout the Battery well and batteries, and to discharge the circulated air outboard.

V Describe the battery well lining, insulation and strengthening of the bottom of the well.

A layer of cement of a thickness of four to six inches is placed in the bottom of the "U". This is used to form a platform for the batteries, also helps to reinforce the tanks.

Located at the after end, a depression of about three inches depth is formed in the cement to form a well for the collection of acid or Water that might get into the well. forming a pumping connection to the outer portion of the well. Laid over the cement and the sides is a layer of building papers. Over this paper at the side to about half way up is an insulation of miconite. Over this is a solid box formed of sheet lead burned at the corners which make the well and water and acid tight at the bottom.

VI Describe just what you would do if ordered to Ventilate Outboard, Ventilate inboard, Ventilate in after Battery room

@ To Ventilate outboard open chlorine flappers intake circulates air over batteries. chlorine flapper is open air goes through blower open dampers close inboard. flapper flapper which at the same time opens outboard flapper, open outboard discharge.

(B) To Ventilate inboard your chlorine flappers  
 are open air comes through intake over battery  
 up through chlorine flapper through blower through  
 damper close inboard flapper which open outboard  
 flapper at the same time close outboard discharge  
 in forward battery; close <sup>outboard discharge in after battery</sup> ~~over to after battery~~ close in-  
 board flappers open outboard flapper, take  
~~cover off damper close damper air comes into~~  
~~after battery; chlorine flappers are open, goes~~  
~~through intake over battery, up~~  
~~through chlorine flappers through blower~~  
 open outboard flapper close inboard flapper,  
 put damper athwartship air hits damper  
 comes in after battery room and is  
 sucked into the Engine room

(C) To Ventilate in after battery, open chlorine  
 flappers air comes through intake ~~over~~  
 through Electrolyte, up through chlorine  
 flappers, through blower open damper, cut damper  
 athwartship air hits damper comes back into  
 after battery - Engine ~~room~~ sucks air  
 into Engine Room.

VII

How to stop battery blowers and seal up battery tank in case of chlorine

Close chlorine flappers, close unboard flappers and shut off blower also take gas out

VIII

By what means may the fuel oil be forced to the gravity tank

Open #4 tank filling stop, be sure fuel filling stop is closed, open filling line stop, be sure #5 & 6 fuel oil tanks stops are closed. open after filling line stop and start the pump. This will bring the oil to the gravity tank.

IX

What is the purpose of two gravity tanks in the fuel system?

There are two gravity tanks in engine room at forward end near overhead. 35 gal. is the cap. of each tank. The reason for gravity tanks is that fuel oil measuring pumps on engine must be fed by gravity flow and also so fuel can be tested for water or sludge and drained off to

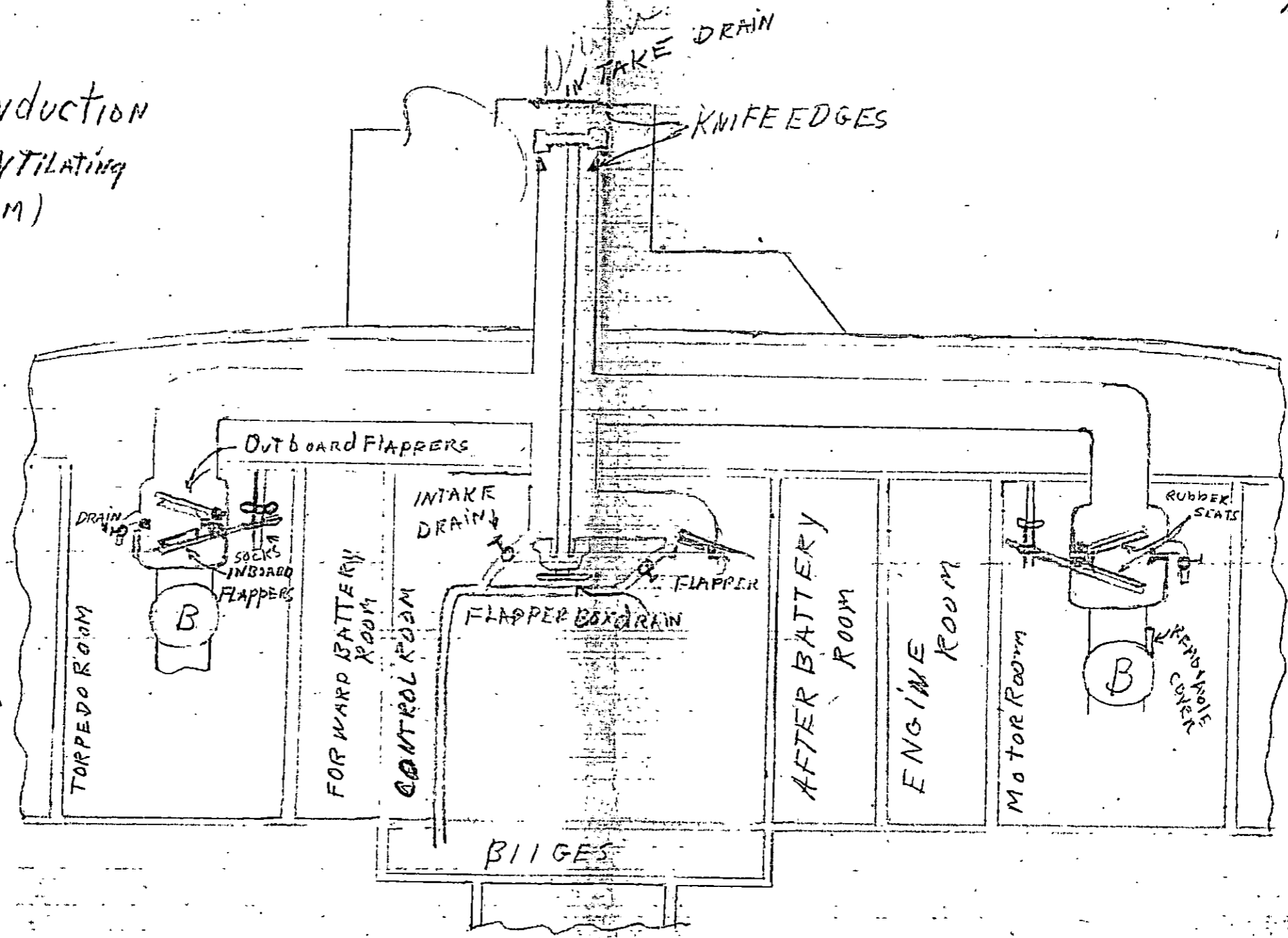
be taken not to allow salt water to get into the lub. oil as it will cause the bearing surface of engine to rust the oil will foam up and destroy the lubricating quality of the oil.

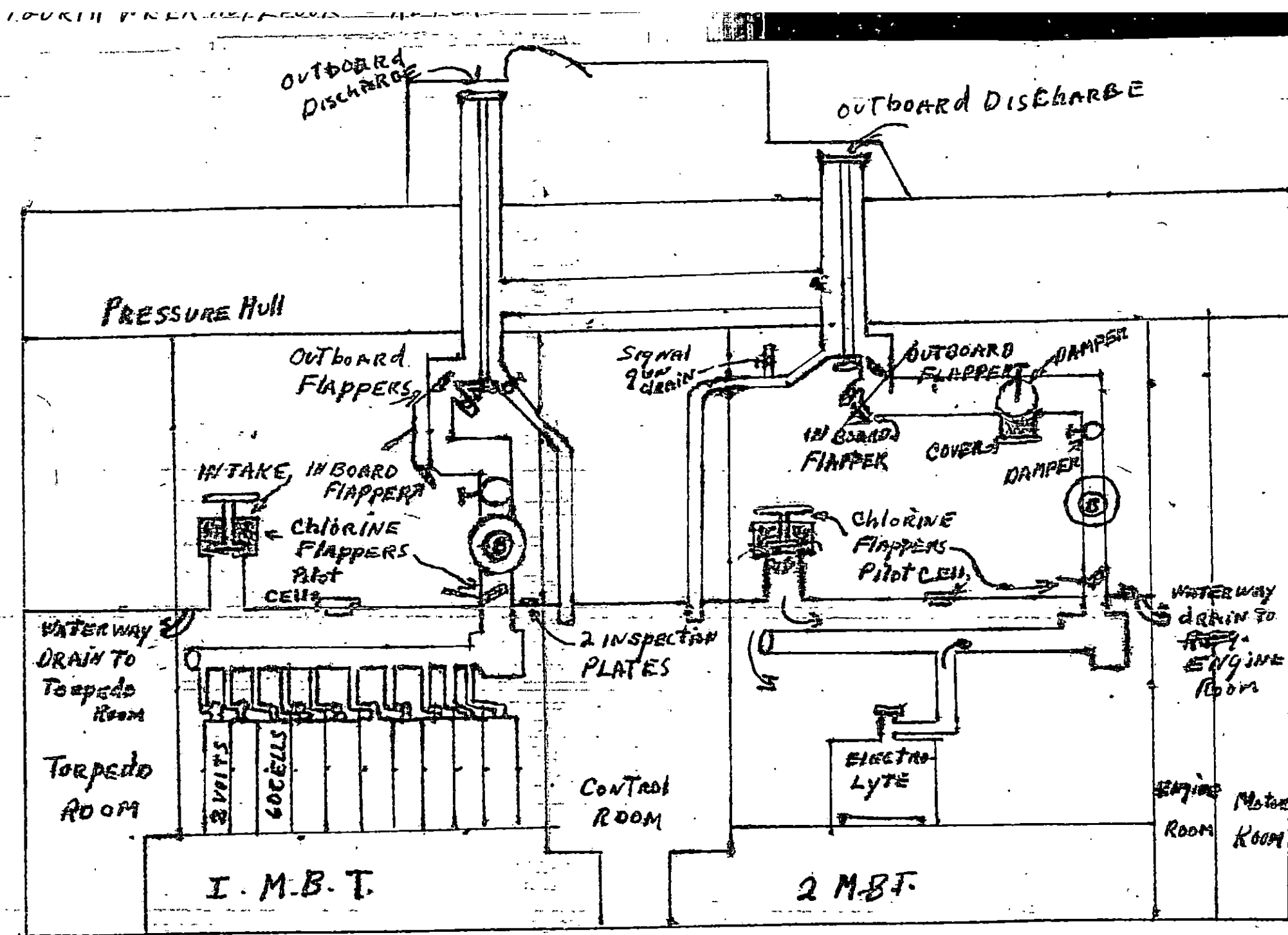
⑭

Describe briefly the main engines, their horse power, What is purpose of Tail clutch? Before starting up, any machinery, What Must Be Done?

Q. The main Engines are 6 Cyl. single action, air injection type with 440 H.P. and 400 rated R.P.M., The tail clutch is to disengage the Engines from the main shaft when it is necessary to charge batteries along side docks. Before starting any machinery make sure that all moveable parts are properly lubricated.

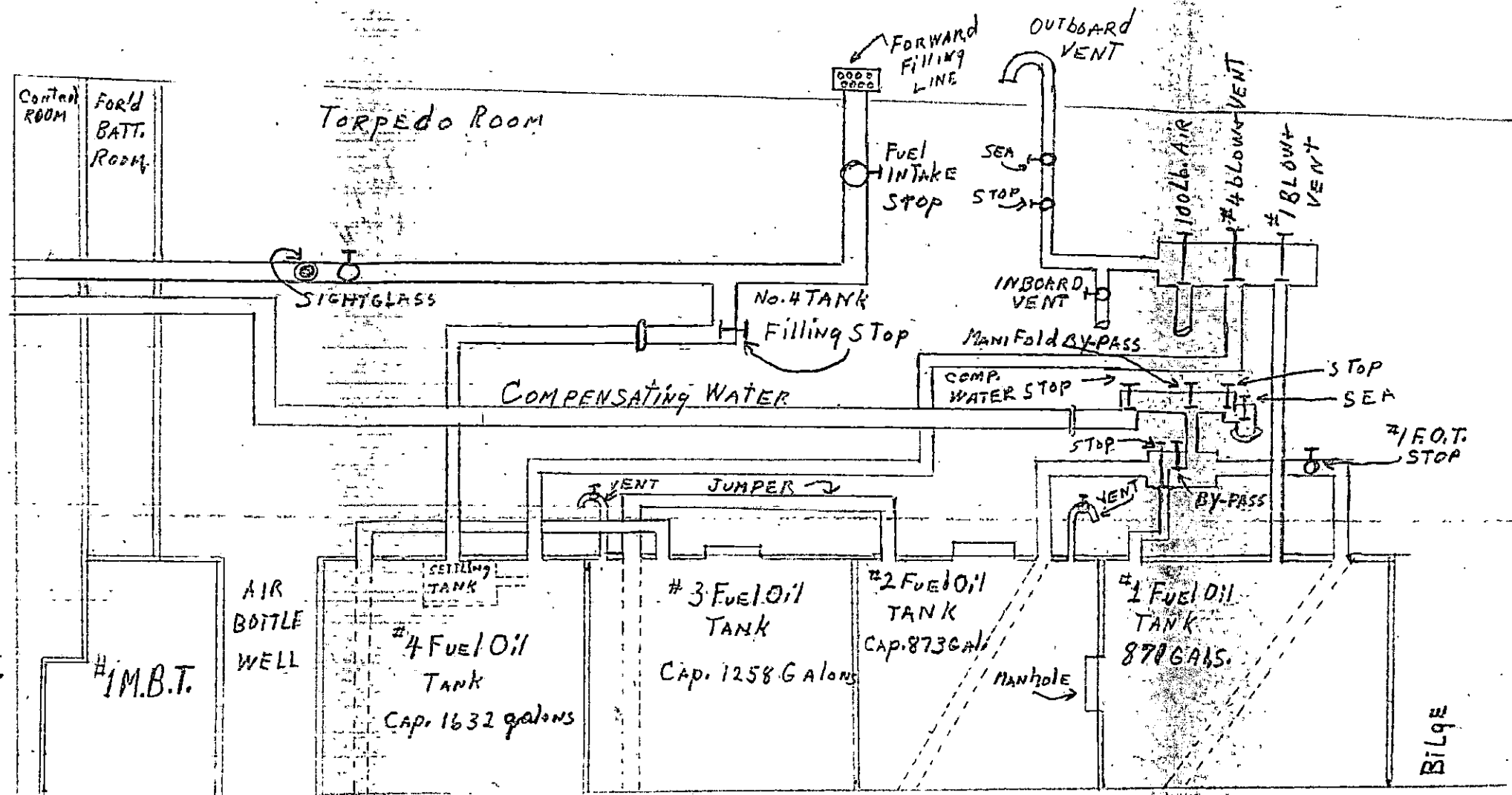
(MAIN INDUCTION  
SHIPS VENTILATING  
SYSTEM)





FOURTH WEEK  
NOTEBOOK SKETCH 2

FOURTH WEEK  
 Note book SKETCH  
 No. 3



## Rig Ship for Dive.

### 1. Close doors

- 1 Close torpedo Room Hatch, inspect same
- 2 Inspect torpedo loading hatch, and be sure that the strongback is in place.
- 3 Inspect <sup>see</sup> that internal salvage gag is out.
- 4 Inspect to see that bulkhead door is free for quick closing.
- 5 Inspect to see that air valve well suction valves, magazines flood and drain valve and battery airway drain valves, are secured.
- 6 Close main induction flappers dog closed and open drain valve
- 7 Check tube drain valves, be sure they are closed.
- 8 Open outer doors & tubes and flood tubes, vent tubes inboard.
- 9 Secure forward trim line stop and bilge valve
- 10 Take readings on forward trim tank column gauge.

11. Open forward trim tank blow and vent  
close local ~~no~~ vent.
12. Check forward fuel oil compensating  
manifold sea chest see that it is secure.  
Note. If using oil from forward  
fuel group, first get permission from  
engine room to close sea chest.

S/P  
McLaren

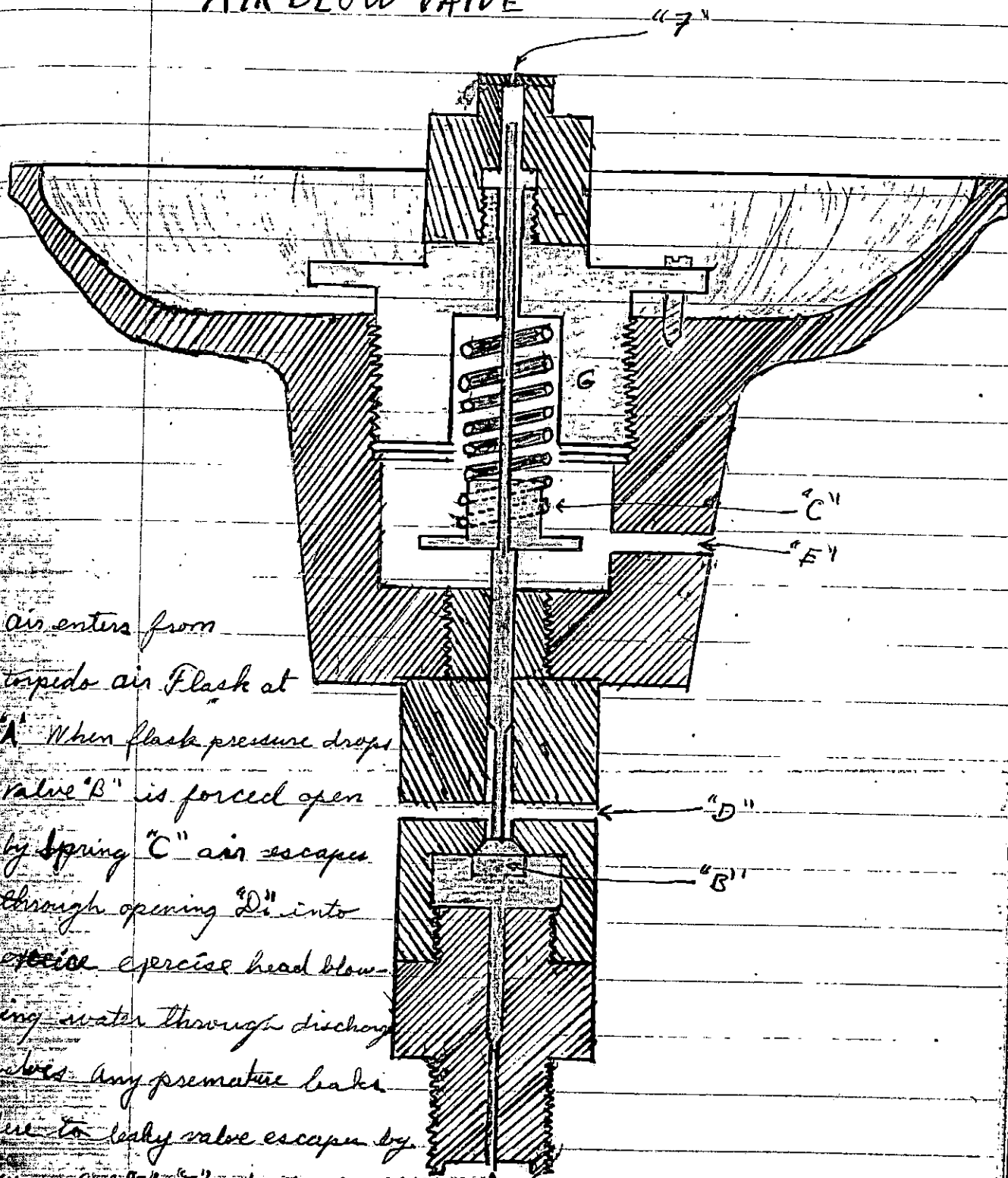
ORDNANCE

SCHOOL



# AIR BLOW VALVE

55



air enters from  
torpedo air flask at  
"A" When flask pressure drops  
valve "B" is forced open  
by spring "C" air escapes  
through opening "D" into  
torpedo. precise head blowing  
water through discharge  
valves. Any premature leaks  
due to leaky valve escapes by  
way of "E" & "F" adjusting Nut "G"  
regulate compression on spring "C" for the pressure valve opens

## General Description

1 The complete torpedo is composed of the following assembled units

War Head (or Exercise Head)

Air flask

After Body

Tail

Gyroscope

Principal Dimensions, Weights and Characteristics.

Torpedo: Mark XIV-1

Mark of Units,

War Head

XV

Exercise head

XXIX, XXIX-1

Gyro.

XII-3

Diameter

21 inches

Length overall with war head 20 ft. 0 in.

Length overall with exercise head 20 ft. 0 in.

Length of War head to joint line 39". 563

Length of exercise head to joint line

(Including towing Eye)

39". 563

Length of air flask section, joint line to joint line

9' 8" 455

Torpedo Marked Unit cost.

MK. XIV-1

Length of afterbody, joint line to joint line 5' 3". 375

Length of tail, end to joint line 1' 7". 188

Length of forward end of guides studs to tail 11' 9". 438

Weights

Explosives charge (cast T.N.T.) 483.25 lbs.

War Head; empty without attachments 262.50 lbs.

War Head, loaded with explosives 831.75 lbs.

Exercise head; ready for run 326.60 lbs.

Air flask section 1057 lbs.

Afterbody, complete with gyro and tail 767 lbs.

Total air charge 62° Fahr., 2800\* gauge 256 lbs.

Air per 100 lbs. pressure at 62° Fahr. 9.14 lbs.

Ballast, lead in War Head 140.00 lbs.

Ballast, lead in exercise head 110.50 lbs.

Ballast, lead in Afterbody 0.0 lbs.

Ballast, Water in exercise head 348.90 lbs.

Torpedo ready for war shot 3048 lbs.

Torpedo, empty with exercise head full 2509 lbs.

Torpedo, ready for exercise shot 2901 lbs.

XIV-1	Torpedo	Mark XIV-1
	<del>Mark of Unit</del> cont.	
375	<u>Bouyancy, Trim &amp; Stability:</u>	
188	Displacement (Water 1.026 sp. gr.)	2430.20 lbs.
1.5	Bouyancy, ready for War shot.	618
438	Bouyancy empty, with exercise head not blown.	79
25 lbs.	Bouyancy, exercise head blown, 350 lbs. air pressure, 5% fuel, 10% water 100% oil	207
2.50 lbs.	Pull around	145 lbs.
1.75 lbs.		
.60 lbs.	<u>Capacities</u>	Mark XIV-1
1 lb.	Air flask (cur. ft.)	18.03
1 tail	Fuel flask, pints	33
67 lbs.	Water compartment pints.	80
56 lbs.	Oil tanks, pints	26
14 lbs.	Fuel spray, seconds to deliver 6 pints	
50 lbs.	water at 35 lbs. pressure	46
50 lbs.	Water spray (same standards as above (two))	38
1 lbs.	<u>Power plant characteristics</u>	
90 lbs.	Sprays, type	Whirl
2 lbs.	Igniter, type	VI-2
50.9 lbs.	Turbine clearance, nozzle and rotor	0". 060
701 lbs.		

Nozzle, conical, ~~nozzle and ratios~~  
number and throat diameter for each  
speed as follows.

Low power 2, throat diameter 2 - " 261

High power 5, throat diameter 2 - " 261  
3 - " 303

Nozzle working temperature, Fahr (Max) 1550° F.

Exhaust temperature at exhaust valve 648 F.

Turbine Speed, R.P.M.

Low power 893.1

High power 12123 ~~12123~~

Gear ratios turbines to propellers Low  
power and High power 8.98-1

Shaft - High powers developed to tank

low power 100-105

High power 320-330

Forward propellers.

Diameter 19"

pitch 35" 5 L.H.

After propellers.

Diameter 17" .05

Pitch 34" 3 R.H.

Propeller R.P.M. at 31 knots 950

propellers R.p.m. at 4.5 knots.

1350

pressure, air flask test, lbs. per sq. in. (Hydr.) 4000

Pressure, air flask working, lbs. per sq. in. "Air" 2800

Pressure reducing valve, low power, lbs. per

sq. in.

530

Pressure reducing valve, high power lbs. per

sq. in.

505

Pressure, nozzle low power lbs. per sq. inch.

487

Pressure, nozzle, high power lbs. per sq. in.

430

Pressure gyro nozzle, continuous size lbs. per sq. in.

125

### Range Characteristics

Low power, Acceptance and service, yards 9000

High power, acceptance and service yards. 4500

Tactical radius yards.

150

Speed, acceptance and service Low power 31-32 knots

Speed, acceptance and service, high power 45-47 knots

### Interchangeability.

(2)

All assembled units and

mechanisms are interchangeable as such; and in general all details parts are also interchangeable except for special assembling operations such as lapping doveling etc.

### Parts carrying numbers.

- ③ The Register Number is the torpedor identification number, all other numbers are serial numbers, which identify some part of the Unit assembly.
- ④ The register number of a torpedo is stamped in three places:— On the flask near the forward joint line. on the afterbody near the forward joint line and on the tail.
- ⑤ Serial numbers are assigned to each of the following Units— Exercise truck, the War head, the air flask, the Afterbody, the Gyro and the tail.
- ⑥ These torpedoes are constructed in four major exterior sections, each detachable as a unit from the adjoining sections.

- (a) The War head or Exercise head.  
 (b) The Air flask, which in turn has the midship section ~~was~~ riveted to it, collectively called the air flask section.  
 (c) The Afterbody  
 (d) The tail

### Stop & Charging Valve

The means provided for charging air into the air flask, and for isolating the air in the air flask at will, after charging until ready for use, thereby making it possible to ~~keep~~ disassemble and overhaul all the parts of the torpedo while the air flask is charged, is known as the stop and charging valve.

High pressure ~~and~~ air preheater  
 From <sup>the</sup> stop & charging valve, the high pressure air is ~~sent~~ led through the turbine Culkhards and through a coil of copper tubing mounted in the exhaust space above the aft. of the

turbine wheels and then returned through the turbine bulkhead to the starting and reducing valve. Suitable nipple connections are provided in the turbine bulkhead. The coil is supported by a bracket fastened to the upper turbine frame. This preheat lowers the temperature of the exhaust gases, and raises the temperature of the air entering the reducing valve which would otherwise be very cold. This coil ~~is~~ while ~~also~~ conserving some of the heat, has its major value in promoting improved reducing valve ~~action~~ as a result of working with warm air instead of with air at or ~~below~~ ~~freezing~~ below freezing temperature.

### The Restriction Valve

In order to control the rate of flow of reduced air, fuel and water to the combustion gas and thereby regulate the volume of the combustion

to the requirements of two or five nozzle jets, two sets of restrictions of the required size are placed

(a) Between the reducing valve and the superheater for air.

(b) Between the fuel check ~~valve~~ valve and the fuel spray for fuel

(c) Between the water check valve and the water sprays for water

The restrictions are arranged in a rotary valve ~~located~~ located in the valve group body adjacent to the reducing valve in such a manner, that by rotating the valve 120 degrees a change in restriction will be effected. The rotary motion required to change restrictions is imparted to the valve through a gear attached to the valve stem, engaging with a driving gear ~~operated~~ operated by the speed change mechanism operating shaft, this shaft in turn is manually operated

operated for speed adjustment prior to a run

### The Premixer

After passing through the restriction, the reduced air enters into the combustion flask through an annular concentric air passage in the combustion flask cover (Premixer top). In this passage is located a bronze ring machined with wide right hand helical guides to give the flowing a whirling motion as it passes through. The fuel spray holder is located in the center of this passage and passing through the helical guide ring, locates the fuel spray in a position most efficient for vaporizing and igniting the fuel for combustion.

The fuel and water Delivery system

Fuel and Water are forced into the combustion flask through their respective atomizing sprays in the form of vapor by the passage of reduced air pressure to the check valves, and through independent leads from the air check valves to the top of the fuel and water compartments thence through Delivery lines from the bottom of the fuel and water compartments, each discharging through its respective delivery check valve, restriction valve and spray to the combustion flask. To prevent sluggish opening of or possible seating of the check valves, due to air cushioning on the outboard ends, these ends are vented by individual pipes connecting, through a common vent fitting, with the interior of the afterbody

## Air Check Valves

The air check valves are interposed between the reducing valves and the fuel and water compartments, their purpose is to close those compartments against each other and into the reducing valve except when the torpedo is in normal operation, and to vent pressure accumulations which may be caused by air leaks into the water compartments.

The air check valves are contained in a naval brass body secured by screws to the midship shell on the on the after side of the stop and charging valve. This body is machined with the necessary inlets, outlets and vent nipples, together with valves and plug seats for the fitting and assembly of the air check valves. In the air inlet nipple is inserted a  $\frac{3}{16}$ " restriction to check a sudden flow of air and permit

the pressure to equalize on both sides of the fuel flask at the instant of opening and thus prevent a possible rupture.

Note: Venting of the air check valves is necessary to prevent pressure accumulation above the valve from cushioning the valve or preventing its opening.

### Combustion Flask

The function of the combustion flask is to provide a pressure tight chamber of such proportion and arrangement, that the flowing air and fuel may be thoroughly mixed and ignited, and the resulting mixture of gases and steam raised to a temperature for delivery to the nozzles.

### Sprays.

The function of the sprays is to regulate the rate of flow and

vaporize the fuel and water entering the combustion flask and thus, supported by air from the reducing valves, introduce the elements of combustion in their proper ratios.

### Igniters

The combustible mixture of air and alcohol entering the flask at the instant of firing is ignited by a combined pistol and double fuse, called the igniter. The igniter is fired by air from the reduced pressure side of the reducing valve almost as soon as the torpico is fired. It consists of a body containing a piston assembly (composed of piston, spring and plunger as one unit) which is held by a diaphragm on its upper or pressure side and which normally rests on two firing pins. The firing pins rest on the igniter tube. This member is screwed in the body from the top against a copper

washer, its lower section is flat and divides the inside of the body into two half sections, each side of which is sealed against each other by packing and into which the double charge is pressed, the lower end being sealed by a lead disc. The ignition tube is drilled from its upper end to the primer caps, with holes extending nearly to the bottom, and so perforated that the flames from each cap is directed to its own ignition charge. The piston assembly, which rest upon the two firing pins, is held in the firing position by shear ribs on the firing pins, which take up on the shear plate and the sides of the holes in which the caps are seated. The shear ribs hold the piston and firing pins away from the caps until air pressure of about 250 lbs per sq. inch is built up above

the diaphragm, when by suddenly yielding, the piston assembly and firing pins are forced down on the caps by the firing air pressure plus the energy stored in the plunger spring during the time the pressure was building up to the firing pressure.

The firing pin will rest on a small steel shear plate with holes of lesser diameter than the holes in the igniter tube, this is to ensure that the sheared areas are not dragged along on their way down to the firing caps. The ~~single~~ igniter is installed in the combustion flask against a gasket.

The burning igniter projects its flame into and across the combustion flask and burns for about 10 seconds. The two primer caps and the double loading reduce failures far below the misfire record of a single cap or c.

single loading.

If used simply as stored, the compressed air in the air flask of a torpedo contains only a definite and limited amount of available energy which, with the most economical conversion into motive power, will propel a torpedo for a limited maximum distance at certain speed. This energy, however, is materially increased during its conversion into motive power by a simple application of the law of expansion of gases or increase of temperature and such increase is accomplished in the present torpedo design in the superheater system.

In order to clearly grasp the functions of the superheater system two features incident to torpedo design should be considered: First, that increase of range involves

decrease of speed and therefore decrease of engine working pressure and vice versa; and second, that for any given speed with the accompanying maximum range at such speed there is a definite economical engine working pressure.

It is therefore apparent that the maintenance of constant and economical working pressure during the run is mandatory to torpedo efficiency. With the reduces and superheater as at present developed the variation in pressure during a run is negligible.

The speed of a torpedo may be altered within certain limits by varying the rate of energy expenditure which in the case of mark XIV and modifications torpedoes is accomplished by regulating the flow of reduced pressure air, fuel and water before

decrease  
and vice  
very  
expanding  
economical

combustion takes place, and then  
regulating the volume of the product  
of this combustion by opening or  
closing nozzle jets, in which the  
gases are given velocity and  
directed into the turbine buckets.

### Main Engine

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XIV  
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The main engine is of the  
turbine driven, gear reduction type.  
It is frequently spoken of as a  
balanced turbine engine, due to the  
fact that the turbine and gearing  
are in pairs revolving in opposite  
directions, thus balancing the gyro-  
scopic effect of on the torpedo. It  
consists essentially of two turbines  
rotors, each attached to a suitable  
spindle, one within the other,  
mounted in ball bearing and a  
system of gearing for ~~reducing~~  
reducing the speed of the turbines  
and transmitting the power developed

241  
by them to the propeller shafts.  
The reducing ratio is 8.98 to 1

### Oiling System

It should be borne in mind that no piece of machinery will continue to operate properly unless the moving parts are well lubricated. This is especially true in the case of a torpedo, which delivers such tremendous power at high speed and high temperature; it is therefore imperative that an ample continuous supply of oil be furnished to all bearings on a run. This oil is supplied to the bearings of the main engine by an oil pump attached to the lower "A" frame and operated through gearing from a worm on the lower end of the second turbine spindle.

### Starting Gear

The starting gear lever, in the operation of the starting gear, is

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normally held in its forward by the trip cam spring, and in this position the valve lift is at its lowest point, the starting valve is closed and the escape of air from above the main starting valve in the valve group is prevented. ~~When~~ When the starting lever is thrown to the rear, the action of the cam raises the valve lift, thus raising the starting piston off its seat, and exhausting the air over the main starting valve, permitting the same to open and start the torpedo at the same time the catch on the valve lever will disengage from the catch on the unlocking lever and the latter is pulled forward by the tension on ~~spring~~ springs locking the position of the ~~to~~ valve lever and thus holding the valve open.

## Depth Control Mechanisms

The depth control (immersion) mechanisms has for its sole function the maintaining of the torpedo at the desired depth below the surface of the water, while running.

The ~~for~~ its function is accomplished by two saddles mounted in bearings on the after end of the horizontal tail blades just forward of the propellers. These saddles are interconnected by a yoke ~~of the~~ on their inner ends to afford clearance for the passage of the propeller sleeves, an arm projecting downward from the left side of the yoke forming the tiller to which its connection attaching to the yoke is made in three sections to facilitate assembly and adjustment, its forward end being attached to the piston rod of an air engine (Depth engine) The piston of

This engine is air actuated and is controlled by a sensitive valve in its central axis. This valve is connected to a pendulum and the pendulum is connected to a diaphragm through independent levers and links, in such a manner that motion in one will produce motion in the other two. Motion in the valve may be produced by the pendulum when the torpedo inclines from the horizontal, or by the diaphragm when the torpedo is off its set depth, or by both in combination, but in any case the pendulum and diaphragm move together, each producing a modifying effect upon the other.

The diaphragm, diaphragm lever, and lower depth spring socket are acted upon by pressure of the sea water while the torpedo

is running. The diaphragm is held against this sea water pressure by the depth spring connected to the lower depth spring socket plus atmospheric pressure in a pressure tight air chamber. Since the pressure in the air chamber is maintained constant at atmospheric pressure, the depth spring loading controls the running depth of the torpedo. The pendulum is acted upon by gravity and serves to limit the angle of inclination at which the torpedo may seek set depth and at the same time tends to steady the torpedo when at set depth.

### The Immersion gear casing

This unit is a bronze casting secured to the forward end of the gyro and immersion mechanism base by suitable

studs and nuts and with a gasket  
 between its lower section is hollow,  
 it is opened to sea water and  
 contains the hydrocontrol elements.  
 The upper section branches in  
 two arms the ends of which are  
 fitted with knife edge bearings for  
 the pendulum. The starboard arm is  
 directly under the depth setting  
 side gear spindle and carries the  
 connections for transferring the  
 turns, in setting for depth, to the  
 spring adjusting screw and spring.  
 Two connections are made from the  
 interior of the immersion casing to  
 the interior of the afterbody, one  
 where the spring adjustment screw  
 comes through at the top of the casing  
 and one where the diaphragm lever  
 shaft passes through near the  
 bottom of the casing. Both of  
 these openings are lapped with

the parts which pass through. there is no packing at these points, but ~~one~~ due to the lap fits the joints are practically watertight -

### The Pendulum

The pendulum is a heavy bronze casting suspended on knife edge bearings from the arms of the immersion casing. The base of the pendulum is ballasted with cast lead and encircles the immersion casing. The pendulum being made in two parts keyed and screwed together for assembling and disassembling. In the upper ends of the pendulum arms are bushings also called knife edge bearings. These bushings, or knife edge bearings are locked in place by set screws and have triangular openings which fit over the knife edge bearings which project from the immersion casing arms. The maximum

swing of the pendulum from its vertical position is only  $\frac{1}{4}$  inch as controlled by stops on the immersion casing; this is all the swing which is necessary to effect proper depth control. a retainer plate ~~the~~ set in each pendulum arm makes near contact with the underside of the immersion casing knife edge bearing and prevents the pendulum from jumping or pounding excessively on its support. This clearance is  $\frac{1}{1000}$ .

119  
Torpedo Tubes - 21-inch submerged  
Mark XX to Mark XXV, Mod. 1, Ind.

General

- (1) The 21" submerged torpedo tubes, Mark. XX to Mark XXV type, were designed for installations in submarines. They are arranged in groups or nests of four in the bow and two in the stern. In general the tubes are identical in both design and operation. The structural features for securing and mounting the tubes to the ship's structure make up the chief difference between upper and lower or right and left-hand and also between bow and stern tube installations. The after torpedo tubes Mark. XX I are shown on plates 1, 2 and 3. On page 1 is a table or data sheet giving characteristics for the several marks and mods and on page 2 is a table of weights.

② These torpedo tubes are designed to fire torpedoes at sufficient velocity to clear the submarine, ~~when the~~ ~~vessel~~ when the vessel is running at full speed on the surface or submerged to a depth of seventy feet and running at a speed of nine knots.

③ The torpedo tube is composed of various mechanisms, which, in general, are distinct units. These units are listed as follows.

- ① The barrel
- ② The breech door mechanism
- ③ The muzzle door mechanism
- ④ The firing ~~mechanism~~ mechanism
- ⑤ The tripping latch
- ⑥ The depth setting mechanism
- ⑦ The gyro setting mechanism
- ⑧ The speed setting mechanism
- ⑨ The torpedo stop
- ⑩ The interlocking system
- ⑪ The ~~to~~ electric firing and indication system

② The barrel contains the torpedo, and during ejections confines it to a fixed direction. Its relation to the torpedo is similar to that between the barrel of a gun or rifle and the projectile except that the propelling agent is compressed air instead of an explosive. A guide slot extending throughout the entire length of the barrel prevents rotation of the torpedo, which is loaded into the rear end of the barrel.

③ The breech door mechanism corresponds to the breech of a gun, allowing the loading of the torpedo into the barrel, when open. When closed, it prevents the escape of the propellant into the vessel as well as preventing the flooding of the ship when the muzzle door is open.

④ The muzzle door mechanism seals the muzzle end of the tube against entry of sea water, thus permitting loading the torpedo into the barrel.

This mechanism and the breech door mechanism are mechanically interlocked so that it is impossible to have both doors open at the same time through fault of or carelessness.

### Operating Instructions

1 The criteria upon which the correct functioning of the torpedo tube may be based are as follows.

① The torpedo must be ejected from the barrel with sufficient velocity to clear the ship vessel without interference with the muzzle or any part of the ship's structure. And ejection velocity of 40 feet per second is considered sufficient to accomplish this under the most severe conditions for which the tube is designed.

③ ~~Satisf~~ Satisfactorie ejection as in (a) must be obtained without exceeding the ~~maximum~~ maximum allowable external pressure on the torpedo afterbody; although this is 150 pounds per square inch for certain torpedos the pressure should be kept below the 100 pounds per square inch to provide a margin of safety.

④ All parts of the torpedo tube ~~must~~ must function in a satisfactory and positive manner, and must fulfill the requirements for which they were designed ~~mechan~~ mechanically, electrically or both as the case may be.

### Procedure for Firing a torpedo

② Inspect torpedo tube and see that it is in operating condition. See that stop valve on impulse line is closed. See that stop bolt is in place and projection within guide slot.

Before the torpedo is loaded look into the barrel to see that

the tripping latch, gyro, depth and speed setting spindles have been drawn clear and do not project into the barrel.

④ See that hydraulic chamber of firing valve or firing mechanism is filled, if not, proceed to fill as follows.

① See that stop valve is closed.

② Open filling valve on firing valve head

③ Open overflow valve on firing valve body

④ fill with clean fresh water until it ~~overflows~~ flows from overflow valve.

⑤ Close both valves when water ceases to overflow

⑥ Drain impulse tank of any accumulated water

Routine for upkeep of tubes

Daily.

① prepare tubes for firing.

25  
② Fire water slug from each tube. (torpedoes must not be in tube) proceed as follows:

- ① Fill hydraulic check in firing valve.
- ② Open muzzle door.
- ③ Raise pressure on stop cylinder valve to 200 pounds.
- ④ Withdraw gyro, depth, and speed setting spindles.
- ⑤ Open stop valve about one turn.
- ⑥ Charge impulse tanks to about 40 pound pressure and see that hydraulic check is seated and holding impulse pressure.
- ⑦ Charge impulse tanks to pressure desired (not over 400 pounds) and fully open stop valve.
- ⑧ Throw firing interlock lever to "tube Ready to fire" position.
- ⑨ Press firing key or hand firing lever on this test, to bring the entire firing mechanism into action, the tube

should be fired from the regular fire control station.

Note the operation of the mechanism when the tube is fired, ~~from the~~ ~~regular~~ paying particular attention to the following points

① The firing intervals. The response should be quick. any delay in expulsion indicates that the apparatus is not in good condition. The defects should be found and remedied at once.

② The action of the stop bolt rods and bell-crank levers where visible. If there is any tendency toward slow or jerky motion, examine working surface. See that they are clean and that the parts are lightly lubricated. Examine stuffing boxes through bow bulkheads and see that the packing is lubricated and that stuffing boxes ~~from~~ ~~glare~~ glands are not set up too tight

(c) The action of the tube ready lights. These lights <sup>indicate</sup> ~~indicate~~ that the tube is ready to fire and they should only log light when ~~or~~ certain conditions are ~~positively~~ positively fulfilled. VIZ. shutters and ~~unwound~~ magazine doors fully ~~open~~ <sup>interlocking</sup> gear in gear speed and depth - setting spindle cut; and topside - stop valve open.

At conclusion of the above

- ⑦
- ① Drain tube
  - ② Open tube door and examine position of stop bolt. See that it extends down flush with the bore of the tube.
  - ③ Work tripping latch by hand. See that it works freely.
  - ④ Operate all vent and drain valves on tubes.
  - ⑤ Operate gyro, speed, and depth-setting mechanism.
- ⑧ Weekly (In addition to daily)
- ① Open tube doors: Fire each tube inboard using low impulse. Note carefully

the action of the stop bolt.

- ③ See that stop bolt is in proper position across guide slot.
- ④ Build up full impulse.
- ⑤ Open stop valve to firing valve.
- ⑥ Put pressure on line, to stop cylinder.
- ⑦ Allow air to remain on system for 15 mins.
- ⑧ Note any drop in pressure and listen for sound of air escaping through firing valves. Stop bolt should remain in position and stop bolt piston should not move during test. If stop bolt does move, it indicates a leak in the stop cylinder valve, locate leak and remedy at once. This is very important, for a leaking stop cylinder valve permits pressure to back up ~~the~~ behind being stop bolt piston, displacing it, and so withdrawing the stop bolt. The stop valve to the main firing

02.24  
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valve should remain closed until the tube is ready for firing. Although this prevents full impulse from going into the tube if the stop bott. piston is displaced, it does not prevent the torpedo from working forward in the tube, tripping the starting lever, thereby causing the torpedo to run in the tube. an accident of this kind will not only seriously damage the torpedo but it may also injure the crew and damage the vessel.

Quarterly. (In addition to daily and weekly.)

- ① Remove firing valve head and examine valve and seats.
- ② Examine chuck valves
- ③ Examine torpedo stop cylinder spring
- ④ Examine all rubber gaskets. it is important that the gasket be renewed, when they show signs of hardening or rotting
- ⑤ Examine gyro, speed, and depth setting. *Make*

When submarine is docked

- (A) Examine muzzle-door gaskets
- (B) Examine relay valve and ~~spring~~ springs
- (C) Check for alignment with line of guide slot in tube.
- (D) Examine, repack, and lubricate all stuffing boxes.
- (E) Bore sight tubes and check alignments with line of sight ~~of~~ of periscope
- (F) Gauge inside of tube when considered necessary under special circumstances.
- (G) Examine muzzle doors and bow shutters. see that the operation is positive and correct. and that there is no lost motion that would permit the door shutter to interfere with the passage of torpedoes from the tube!

Tripping latch.

The latch must operate freely in the latch housing. failure to do so may be due to:

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- (A) Dirty or gummy working surfaces
- (B) A bent latch.
- (C) A bent or otherwise deformed operating shaft.

The movement of the latch is essential, as otherwise the operating cam, located at the end of the tube, may exert sufficient force to deform the operating shaft and render it inoperative. It is therefore advisable to observe the position of the latch in the tube when the breech door is fully open - at such time it must be entirely within its housing, no part projecting into the tube. The curvature of the operating cam is such that the tripping latch is in the extreme down position when the breech door is partially open, thus permitting verification of the latch position by sighting into the barrel.

① A clearance of  $\frac{3}{4}$ -inch should exist between the operating face of the tripping latch and the forward face of the torpedo starting lever when the torpedo guide stud is bearing against the torpedo stop.

② See that the stuffing box in the housing is tight. Renew the packing as necessary, using "Garlock", plastic metallic or equal.

③ Inspect the cam and roller at the breech end for freedom of action and conditions.

### Depth Setting Mechanism

④ The housing of this mechanism contains two stuffing boxes, the packing of which should be renewed when necessary, using ~~garlock~~ "Garlock", plastic metallic or equal packing.

⑤ In assembling the depth

~~the~~ setting mechanism, it is necessary to secure the following relations: When the depth index dial is set at 10 feet, a side of the square setting socket is to be parallel with the center line of the barrel, and the detent plunger is to be in the center of a notch in the detent wheel.

### Torpedo Stop

- (26) The chief ~~trouble~~ trouble with this mechanism is due to the bending of the stop bolt, and ~~consequently~~ consequent binding of the parts careless loading of the torpedo into the barrel is the usual cause. and ~~particular~~ particular care should be taken to bring the torpedo gently ~~up~~ against the stop a bent or otherwise mutilated stop bolt should be promptly replaced.

(2) The stop rod spring and the stop bolt spring mounted in the recess in the top of the stop bolt ~~stop~~ should exert the design pressure on the stop rod and stop bolt respectively, and the stop bolt should slide freely in its housing. The freedom of the movement of the stop bolt and the downward pressure exerted by the stop bolt spring can be determined, without disassembling the mechanism, by manipulating the stop bolt from within the tube barrel while the stop rod is jacked as otherwise held toward the breech approximately one-half of its total travel.

### The submarine signal gun

(1) The gun is designed to throw the submarine emergency

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Identification signal clear of the vessel either submerged or on the surface. It is usually located in the control room and extends through the shell and superstructure deck with its muzzle flush with the latter. The propellant is air pressure from the 200 lb. line on the later types of submarines and 100 lb. line on the older types. There is also an air connection to the outboard section of the gun. This connection permits the blowing down of the water in the barrel after a signal has been fired, through a one inch drain line to the control room bilges. The operating gear is located at the breech. A muzzle door and a breech door are provided somewhat similar to a miniature torpedo tube arrangement. The muzzle door is a swinging gate type with

circular valve disks. The breech door and its mechanism is of the swinging gate type, but the valve is a screw down disk type with rubber inserted gaskets. These two doors are opened or closed by a horizontal operating lever which through a cam arrangement that forms a mechanical interlock permits the opening of only one door at a time. The firing valve is a quick opening type and so interlocked with the muzzle door that it is not possible to fire the gun with that door closed.

(B)

The submarine emergency identification signal is fired by a lever at its base which projects beyond the side and is inserted in a groove in the ejector tube. When the signal is ejected the <sup>lever</sup> ~~groove~~

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~~in the~~  
reaches the end of the groove just before passing the muzzle door and the tripping ~~bar~~ lever is drawn back and the signal fired. The signal is held in the tube by a spring stop until the breech door is closed.

### Safety Precautions

- ③ Safety precautions are as follows
- Ⓐ Submarine emergency identification signals shall be fired only from the submarine signal ejector - unless an alternate method is specifically authorized by the bureau of ordnance or by the submarine force command for a particular purpose and occasion.
- Ⓑ The submarine emergency identification signal is designed for discharge from a submerged submarine through the submarine signal ejector. Ships Emergency Identification signals, and Very signals are provided for the

surface signalling. If it is found necessary for any reason to fire a signal from the signal ejector while the submarine is on the surface, all necessary precautions shall be taken to see that personnel on deck remain well clear of the gun, and of the area on deck on which the ejected signal might fall. The fact ~~should~~ <sup>should</sup> be ~~impressed~~ <sup>impressed</sup> on all personnel that when a signal functions to eject the grenade from the cartridge, the recoil of the aluminium case shall must necessarily be not violent if a signal is fired accidentally, or functions on deck, personnel should keep well clear of the rear of the case as well as the front, until ejection of the grenade has occurred.

© The normal delay between firing of primer and ejection of grenade

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brown  
The  
by a  
ch  
follow  
inflation  
on the  
inleas  
fically  
release  
onward  
easion  
ident  
discharge  
through  
ships  
and  
the

6-443a

varies between 24 and 30 seconds. But the possibility of a premature functioning should never be lost sight of. Signals which are fired accidentally shall, where possible, be thrown overboard immediately.

- ⑥ Care shall be taken to avoid pointing the signal directly toward or directly away from a person.

#### Instruction for firing

- ⑦ Instruction for firing follows.

① Safety pins which pull out to the side (as in the signal Mark I, Mod. I) shall be left in place until just before inserting the signal into the ejector. Safety pins which pull out to the rear (as in Mark II and Mod. I) shall be left in place until after the signal is loaded in the ejector.

- ② During removal of the signal from storage and during handling and use, care shall be exercised that

the signal is not dropped nor the firing pin or tripping levers forced, struck or pulled.

③ Make visual inspection of signal to determine that firing mechanism is in serviceable order, case not dented, case sealed, etc.

④ The tripping lever extension shall be carefully inserted into the tripping groove of the ejector.

⑤ Do not flood signal ejector until immediately before firing.

⑥ Use an air pressure of 100 lbs. per square inch for firing in the older type of ~~ejector~~<sup>ejectors</sup>, and 200 lbs. per sq. inch in the latest type.

⑦ If the signal is removed from the ejector without being fired

⑧ Replace safety cotter pin immediately after inspecting carefully to see that firing mechanism is

is undamaged and that primers has not been fired.

② See that case is dry and that nose seal has prevented water from entering signal before returning to stowage.

③ Turn in at first opportunity to a naval ammunition depot, properly tagged for identification, any signal found unserviceable.

### Submarine Emergency Identification Signal Types.

① A grenade type of pyrotechnic signal has been made standard for issue to submarine for use when submerged.

The following types of signals are used:

(a) Parachute smoke signals

(b) Float smoke signals

(c) Caterpillar star signals

### General Description

② The submarine emergency identification signals described herein are the Mark III.

Mod. 2 signals, which are the type under current manufacture.

(A) The signal is an ogival headed tube which is expelled in its entirety from the submarine signal ejector by a charge of compressed air under a pressure of 100 lbs. per square inch. The signal has sufficient buoyancy to float on the surface of the water.

(B) As the signal is leaving the ejector, a tripping lever is raised by contact with a lug in the ejector, ~~not~~ cocking and releasing a firing pin lever which strikes and fires a primer, thus igniting the time fuse.

(C) After burning for approximately 27 seconds, the time fuse ignites an ejection charge which ignites the delay train in the grenade and projects the grenade into the

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air ~~th~~ to a height of 300 to 400 feet. During the 27 seconds burning time the signal if the submarine is submerged rises to the surface, the expelled signal will fall back in the water, from its initial trajectory in the air, and float on the surface in position to eject the grenade.

② At the summit of the grenade trajectory the delay train flashes into the signal ejection charge and causes the parachute sustained smoke (day) or star chain (night) to be ejected from the grenade.

### Safety Features

③ The design safety features incorporated in the mark II Mod. 2 signal are

- ① Prevention of accidental firing during handling or in storage
- ② Prevention of accidental firing while being placed in the submarine signal ejector

© Prevention of firing if after being placed in the submarine signal ejector and before safety lock pin and ring have been removed, the signal is removed from the ejector

Browning Machine Gun Caliber .50 M2 (and M2A1), Water Cooled, Fixed (Naval)

The Machine gun is ~~port~~ belt fed, recoil operated, and water cooled.

### General Data

Weight of gun with water	110 lbs.
Weight of gun without water	93 lbs.
Weight of barrel assembly	14.5 lbs.
Water in Water jacket	8 qts.
Overall length, fixed	55"
Overall length, flexible	57"
Overall length of barrel assembly	36"
Caliber of bore	.50"
Rate of automatic fire: shots per min.	500 to 650
Weight of one metallic belt link	284 grains
Weight of one complete round of M2 Ball	

0-41485

ammunition, approximately - - - - - 1816 grains  
 Weight of powder charge, approx. - - - - - 224 grain  
 Weight of bullet, approx. - - - - - 734 ~~801~~ grains  
 Weight of case, approx. - - - - - 867 grains  
 Weight of 100 rounds in metallic belt - - - 30.25 lbs.  
 Maximum chamber pressure per sq. in. - - - - - 52,000 lbs.  
 Muzzle velocity - - - - - 2500 ft. per sec.  
 Range at which tracers burn out, approx. - - - 2,000 yds.  
 Maximum range horizontal - - - - - 7,500 yds.  
 Maximum range, vertical - - - - - 5,000 yds.

### Operation

The automatic operation of the gun mechanism is effected by the recoil caused by the explosion of the powder charge in the chamber. The barrel and breech mechanism are so arranged in the receiver that they are free to slide a short distance (about  $1\frac{1}{8}$ " ) to the rear except for the opposition of the driving spring, and the action of the oil buffer, and oil ~~for~~ buffer spring.

4/19/46

116 grains  
224 grain  
~~337~~ grains  
67 grains  
30.25 lbs.  
2,000 lbs.  
0 ft per sec  
000 yds  
500 yds  
000 yds  
gun  
oil  
water  
band  
in  
slide  
the  
position  
in of  
a

During the initial recoil of the barrel and the breech mechanism, the breech is unlocked, the bolt given and added impetus to the rear by the action of the accelerator, the recoil of the barrel and barrel extension is absorbed by the oil buffer and these are latched in their rearward position by the accelerator. The bolt continues to recoil and during its rearward travel carries out the functions of extracting a cartridge from the belt and an empty case from the chamber, cocking the firing mechanism and retracting the belt feed pawl; the remainder of the bolt's recoil is absorbed by the driving spring and the fiber buffer disks in the backplate. The counterrecoil movement of the bolt is accomplished by the driving

driving spring. It carries out the following functions on the forward movement: loads a live cartridge into the chamber, positions the next cartridge against the cartridge stops, closes and locks the breech, releases the safety device (cocking lever) of the breech, releases the safety device (cocking lever) of the firing mechanism and carries the sear slide against the side plate trigger cam so that the sear slide is forced inward depressing the sear which allows the firing pin to be forced <sup>forward</sup> by its spring.

### Feeding

The machine gun is fed from a belt arranged in horizontal layers in an ammunition chest which can be attached to the mount. Feeding is from the left-hand side. Either the disintegrating metallic link belt or the fabric belt may be used.

but the link belt is standard for the Navy. The ejection of empty cartridges cases is from the bottom of the receiver and the empty links from the right side of the feed magazine.

### Cooling

The barrel of the gun is surrounded by a waterjacket which holds about eight quarts of water. When additional cooling is required a water circulating system is provided. The water absorbs the heat generated in firing the gun and this prevents the barrel from becoming overheated. A steam escape tube is located in the top of the waterjacket and is comprised of a steam tube and two steam tube supports. The steam tube supports have holes near their bases which allow the steam or water to escape. The steam tube slides freely on

the steam tube supports and in elevating or depressing the gun the force of gravity causes this tube to mask the lower hole, thus preventing the escape of water from the jacket. The upper hole, which is uncovered by this movement, allows the steam generated through prolonged firing to escape. If a circulating system is used, water passes out of the water jacket instead of steam and in the same manner.

### Prepare the Gun for firing Headspace

Probably the most important part of preparing the gun for firing is the proper adjustment of headspace. By headspace adjustment is meant the adjustment of the space between the rear end of the barrel and the front of the bolt so that the bolt will press closely against the barb

of the cartridge when the gun is loaded to fire. This adjustment is made when screwing the barrel ~~in~~ into the barrel extension. If the headspace adjustment is not tight enough, the explosion of the powder in the cartridge will cause the rear part of the cartridge case to blow backward and pull the case into pieces, leaving the front part in the chamber and preventing the entrance of the next cartridge. If the adjustment is made too tight, the recoiling parts will not go home and the gun cannot be fired. This adjustment should be carefully made in accordance with the following instructions.

To adjust Headspace By the Bolt Method  
Lock Bolt in barrel extension by holding breech lock up in its recess

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in the bottom of bolt. With the bolt thus locked, screw barrel into barrel extension until it is hand tight and back off one, or one and one half notches. This adjustment should be carefully ~~me~~ tested after the gun is assembled. This test is as follows with gun assembled, draw bolt slightly to the rear and release. If it does ~~not~~ go into ~~the~~ battery smoothly. The headspace adjustment is too tight and must be loosened one notch at a time until the adjustment is correct. With gun assembled, raise cover and extractor and draw bolt to the rear slowly. There should be no movement of the bolt, There should be no movement of the bolt to the rear when independent.

## Care + Cleaning

The importance of a thorough knowledge of how to care for + clean the machine gun can't be over emphasized. The kind of attention given to a weapon of this type determines largely whether or not it will shoot accurately + function properly when needed. Bore + Chamber must be kept clean for accurate shooting. Also it is important that the receivers + moving parts be kept clean, lubricated, + in perfect condition for efficient functioning. Care + cleaning should not be confined to the gun alone but should include all accessories, links + ammunition as well.

Proper oiling is ~~a~~ <sup>not</sup> in importance to intelligent cleaning. Oil is vitally necessary for the working parts but should be ~~as~~ used sparingly. Oil ~~on~~ all bearings before firing.

2-1-53

Points to be Observed Before,  
During & After firing

When a Machine Gun is to be fired, it must be cleaned properly assembled & lubricated. While in use it must be kept as nearly as possible in the same condition.

After firing it must be put in readiness for later use. If the points as outlined below are carefully & intelligently followed by the gun with work with ~~minimum~~ ~~minimum~~ of stoppages. All stoppages except those caused by breakage of parts can be traced to neglect on the part of the gunner.

Method of filling oil Buffer

Remove the oil buffer tube filling screws. Use the oil & buffer tube filling oiler, filled with oil buffer oil, start the flow of oil by pressing the base of the oiler. While oil continues to pour from oiler, insert

the nozzle into filling hole +  
 with continued pressure of on the  
 hose of the oiler allow the ~~oil~~ cited  
 oil to flow into buffer tube. Don't  
release pressure on the hose of the  
oiler until nozzle has been  
removed <sup>from the</sup> filling hole thus avoiding  
 getting air bubbles into buffer tube  
 Repeat this operation until flow  
 of oil is out of other hole, & replace  
 screens

### Malfunction

Explanation - Is an improper action  
 of some part of the gun resulting  
 in a stoppage; for example a failure  
 to extract empty cartridge case.

③ Any accidental cessation of fire  
 is a stoppage. Maybe faulty cartridge  
 or a malfunction of some part of  
 the gun. The fact that all amm  
 unition in the belt being fed  
 into the gun has ~~for~~ been

exhausted should not be called malfunction since it is accessation of fire from natural results.

© Immediate action is the team applied to that operation requires to clear a temporary stop.

~~Pre~~ Prevention of stoppages  
Proper care of gun & attention to the points before during & after firing as outlined in this pamphlet greatly reduced liability of stoppages particularly if the gunner has an intelligent understanding of the reasons why stoppage generally occurs. Prevention is the best remedy for all stoppages. Nevertheless stoppages will ~~oc~~ occur in spite of all that can be done to prevent them.

## Classes of Stoppages

Stoppages may be classed under 2 main headings

(1) Temporary, which are due to -

(a) Failure of some part of gun of which a duplicate is carried.

(b) Faulty ammunition

(c) Neglect of points before or during firing.

(d) Lack of knowledge of the operation + functioning of the gun.

(2) Prolonged, which are due to a failure of some part that cannot, as a rule, be remedied by the gun squad under fire or without skilled assistance

The End

Next Stop Tokyo



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p. 157-229 blank

Describe the use of the Main Induction  
In own ~~words~~ words describe the use  
of the double jaw flappers in Torpedo  
room & Motor Room.

The Main induction is used on  
the surface to bring air into the  
boat where it is circulated through  
the boat this is done in the following  
manner

- ① High in the periscope there is located  
the intake valve which permits air  
to be drawn into the boat forward line  
which branches fore & aft. to the Torpedo  
Room & Motor Room, where there is a  
suction blower located which takes the  
suction from the forward line & discharges  
into the boat
- ② The main induction is used  
while submerged to circulate air and  
cool it through the above induction  
line in the following manner, the  
intake valve is closed, the double

jaw flappers are open at T.R. + M.R. and either blower or both may be used in any manner desired

- ③ This suction line and blowers may be used as an emergency means of ventilating either battery compartment.

The double jawed flappers in M.R. + Torpedo Room are used in connection with the ~~the~~ watertight integrity of the boat while submerged, while on the surface the ~~the~~ flappers are used as a quick means of sealing up the compartment concerned in

There operation is so designed that pressure on either side flapper will seat the flapper tighter on its seat to assist this operation there is secured on the overhead what is known as a lock bolt which when engaged and tightened assures a positive seat of both flappers. These flappers have live rubber gaskets which fit into a metallic knife edge.

Rig forward Battery for Chlorine gas giving all steps. Torpedo Room

(A) "Pass the Word"

(B) Close ~~battery~~ door bulkhead door and water way drains

(C) Put I.S.S. gag in

(D) Man phones and report for chlorine and forward battery.

Forward Battery compartment

(A) Pass the Word

(B) Close Chlorine flappers stop blowers

(C) Leave I.S.S. gag out

(D) Close Bulkhead doors

- (E) Man phones <sup>report</sup> (if chlorine mask is on) standby to receive orders over phone.
- (F) If main vent is open secure vent.

### Control Room

- (A) Pass the word
- (B) upon orders of senior officer controller man, stops both, shift to parallel & removes load from effective battery. bow and stern planes men standby for surfacing. The air manifold man blows ballast tank under ~~unaffected~~ unaffected battery & stands by to vent the ballast tank. The Kingston man closes Kingston of ballast tank under effected compartment and opens drain to tank. Without orders water manifold man closes bulkhead door (Fwd) Man on telephone receives and reports to S.O.P. the condition of all compartments. Surviving officer as chief puts I.S.S. tag in <sup>pass the word</sup> After Battery Upon orders shift load from series breakers to parallel breakers.

n) leave forward parallel breakers set  
without orders close bulkhead door leading  
to control room, check "B" Vent closed man  
put I.S.S. gag in  
Close after bulkhead door.  
Man phones report aft. battery rigged  
for chlorine

### Engine Room

Pass the Word. Put I.S.S. gag in  
man phones report Engine room rigged  
for chlorine (Motor Room)

Pass the Word Upon orders put H.P.P.  
on main drain and start pumping

Without orders puts I.S.S. gag in, closes  
bulkhead door leading to engine room  
man the phones and report aft. battery  
rigged for chlorine

- ④ Pump from auxiliary to forward trim.
- ① On the manifold in the control room open, aux. valve, open sea valve on after part of manifold, open aft. F. L. valve, open fuel trim pump suction valve, open crossconnection, open trim line stop, open trim lifter and suction valve, open fwd. trim tank vent, open aux. tank vent, note contents of tanks before and after pumping, start pump, after desired amount of water has been shifted, secure pump all valves concerned and vents.
- ② Flow from auxiliary to Regulator.
- 3.5 lbs. pressure in aux., open regulator tank vent, open aux. valve on main, open by pass on main, open regulator valve on main, when proper amount of water has been shifted secure all valves conn. Vent pressure from aux.
- ③ Explain in your own words the following.
- ① Positive buoyancy ② negative buoyancy, ③ Reserve buoyancy

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Second week Water up

I Positive Buoyancy

The condition of a body immersed in a liquid which is capable of displacing a weight of liquid greater than its own weight hence it floats.

Negative Buoyancy

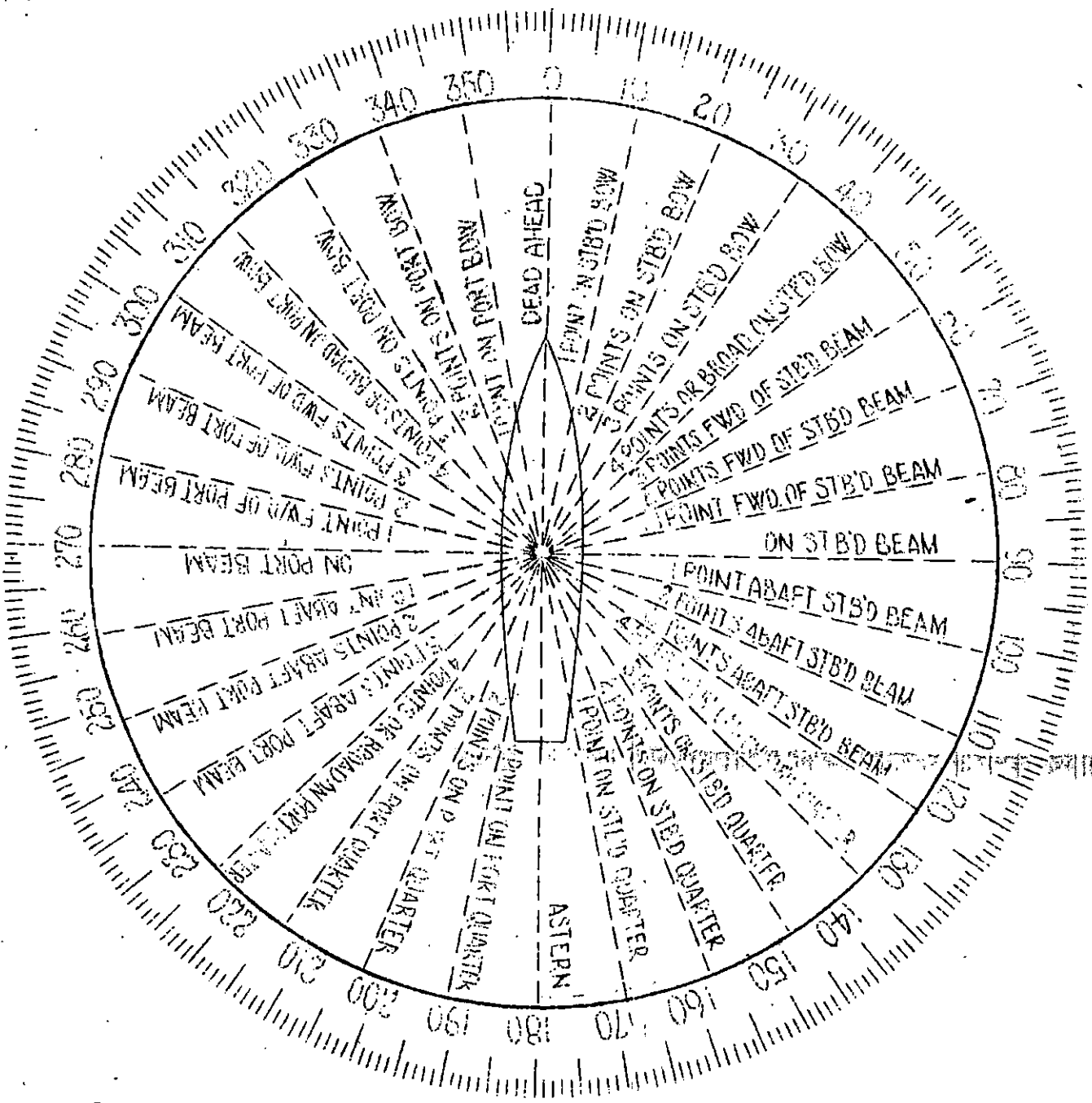
The condition of a body immersed in a liquid in which the body is incapable of displacing a weight of liquid equal to or greater than its own weight hence it sinks.

Reserve Buoyancy

The difference between the weight of surface displacement of a submarine in diving trim and her displacement when submerged in neutral buoyancy with all M.B.F. completely filled in or in other words the amount of ballast that must be taken on board to change her from the surface condition to <sup>the</sup> submerged condition condition in Neutral buoyancy.

LOOKOUT REPORTS AND BATTLE ORDERS

The following instructions are those issued by Commander Submarines, Atlantic Fleet, in SUHLANT X-4 (Revision 1) dated April 8, 1943.



1. Lookouts shall be instructed and drilled to make reports brief, clear and complete. This applies to navigation lookouts as well as battle lookouts. The old procedure of "Sail Ho," "Where Away?", etc., shall be abolished, and men shall be trained to tell all they know in one sentence, in the fewest possible words. No rigid form of reporting should be prescribed, but examples, such as the following, should be given by way of illustration:

- (a) "Green light dead ahead." (f) "Two ships broad on port bow;  
(b) "Plane diving on us, port bow." can not make them out."  
(c) "Red buoy one three five." (g) "Bombing planes on port  
(d) "Masts of ship on horizon zero quarter; think they are  
nine zero true." friendly."  
(e) "Dim light ahead, close to us". (h) "More bombers on port beam;  
look like enemy."  
(i) "Flashing white light far away bearing one six zero true."

2. Commander Submarines, Atlantic Fleet desires that look-out reports continue the use of the "point" sytem where applicable since submarines lookouts are not equipped with dummy peloruses or bearing circles at the present time. However, this should not prelude the use of the more general type of report where appropriate, such as "Airplane diving on us, port bow."

Examination on this will be given on sixth week.