SAILORS NOTES ON NUCLEAR SUBMARINES

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Basic Method of Submarine Hull Construction

Primary requirement of the pressure hull to withstand pressure at depth. Basic shape of a pressure hull, cylindrical with domed ends

Basic method of construction of a pressure hull - still segments which are welded together.

How the pressure hull is strenthened - by fitting T shaped frames. How the pressure hull is divided up - by bulkheads and decks.

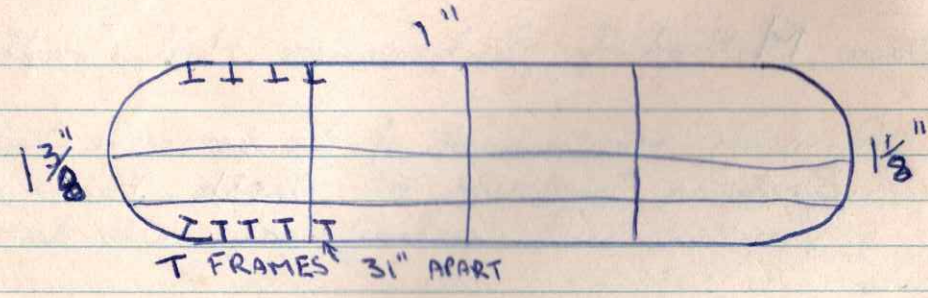
Define a watertight bulkhead - a bulkhead which when shut down will withstand the pressure of a flooded compartment

Define the deep diving pressure - the depth at which the submarine would normally operate to.

Deep diving test pressure (FULL DIVING DEPTH) - the maximum depth to which a submarine would be taken. All systems tested to this depth. Pressure hull as a further 70% added to the deep diving test pressure for safety margin.

Purpose of putting all heavy machinery and tanks in the lower part of the pressure hull - to give added stability to the submarine.

Purpose of the keel - to give added stability by filling with ballast weights



Major Hull openings in any class of submarine

Axcess.

Axcess into a submarine for material and personell is via hatches.

Hatches

Torpedo loading hatch
Escape hatches
Main axcess hatch
Conning tower hatch

Towers

Two hatches, an upper and lower are fitted as a safety measure

Hull Valves

A mechanical valve fitted to any system that passes through the pressure hull. The valve when shut acts as the pressure hull.

Rotating Equipment

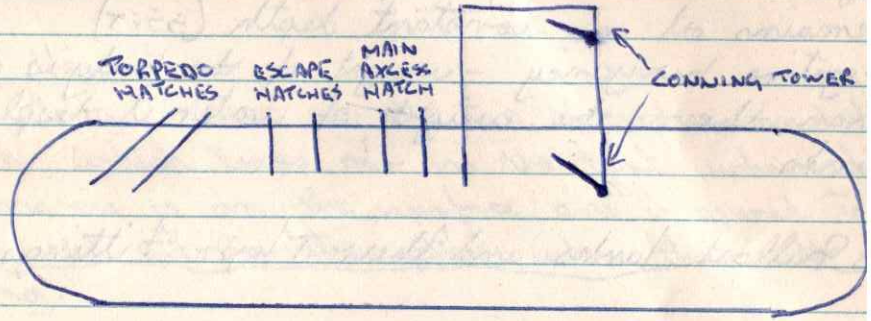
Masts, periscopes and main propulsion shafts are fitted with a gland allowing rotation without allowing ingress of water.

Strong Backs

Fitted in place of broken T frames

Hull Pads

Hull pads fitted to hatches shafts or mas
give added strenth



Buoyancy

There are 3 states of buoyancy.

1. Positive buoyancy - weight of the body is less than the weight of water it displaces. It floats.
2. Nutral buoyancy - weight of the body is equal to the weight of water it displaces. It remains at a constant depth (55ft)
3. Negative buoyancy - weight of the body is greater than thern the weight of water it displaces. It sinks

Main Ballast Tanks and Their Major Fittings

PURPOSE

To dive and surface the submarine by altering its displacement. They also provide a reserve of buoyancy when the submarine is on the surface.

LOCATION

External to the pressure hull, the forad and after ends of the submarine or saddled around the pressure hull.

PRINCIPAL OF DIVING

By allowing the air trapped in the main ballast tanks to vent to atmosphere so that water will flood in. When the submarine is dived the main ballast tanks are full of water.

PRINCIPAL OF SURFACING

By admitting high pressure air into the of the main ballast tanks the water is fo out of the bottom. When the sub is on surface the main ballast tanks are empty water with a small air pressure.

MAIN VENT

A large valve at the top of each main bal tank which traps air in the tank when th submarine is on the surface and is opened to vent the air to atmosphere when the sub diving.

OPERATION

1. By hydraulic pressure - primary
2. By hydraulic pressure - LOCAL HYDEL VALVE
3. By hand using a ratchet handle

Main vents are prevented from being opened accidentley by cotters

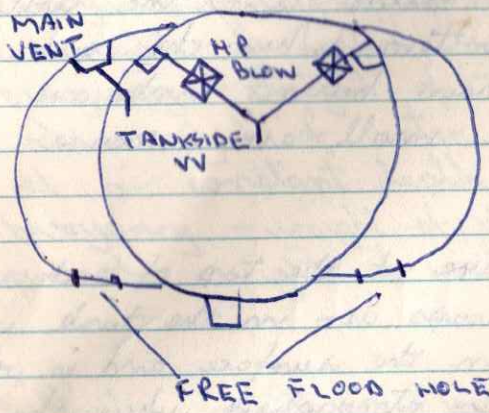
Free Flood Holes

The means by which water can be allowed to flood into or blown out of the main ballast tanks.

HIGH PRESSURE BLOW

Air is supplied from the HPA system via

pipework and tankside valves.



The Casing

Function

1. To cover all external fittings.
2. To reduce water noise
3. To provide a flat working surface for the casing parts.

Streamlining

The fin and casing are streamlined to increase speed and to reduce water noise.

Free Flood

The term free flood means the casing can flood when the submarine dives and drains it when on the surface

Fairing Plates and Shutters

1. To continue streamlining effect
2. To provide access to equipment within the casing.
3. Reduce water noise
4. Protects delicate equipment such as periscope

Equipment

Equipment housed within the casing includes

1. Anchor and anchor windlass
2. Cable locker
3. Steaming lights
4. Indicator buoys
5. Sonar transducers
6. Wireless floats
7. Capstan
8. Fair leads, cleats, bullrings etc.

Indicator Buoys

To indicate the subs position in an escape situation by visual flashing light and W.T. signal. They can be released from either side of escape compartment bulkheads.

Ballast System

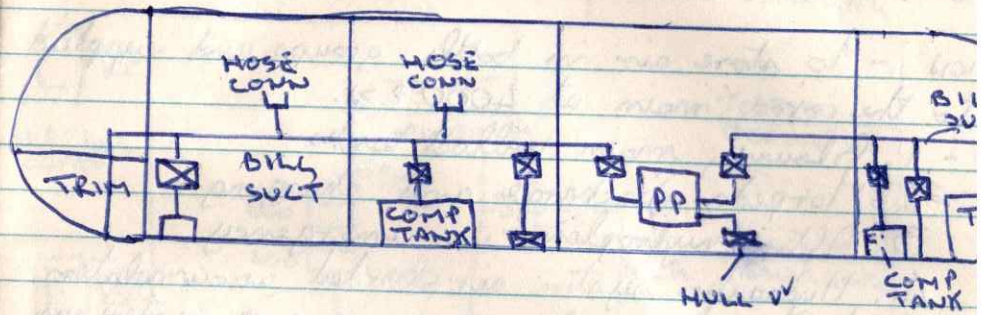
Function
To adjust the bodily weight of the submarine by flooding into or pumping out of internal tanks.

Secondary Functions
1. Fire fighting
2. Salvage

Depth
The system is tested to deep diving depth and can pump out at this depth.

Ballast Pump
A dc variable speed pump capable of discharging water against more than deep diving pressure.

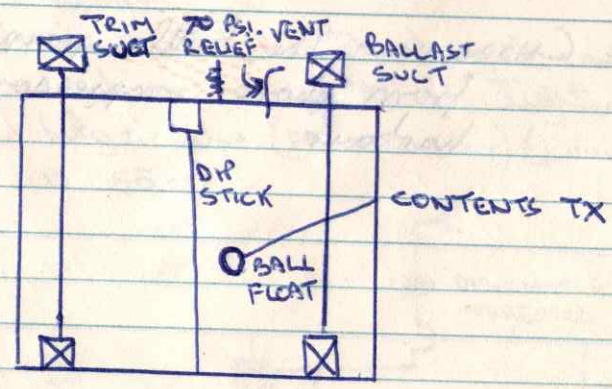
Valve Chest
A chest incorporating flood and suction valves which enables the ballast system to be controlled from a central position by one man.



Ballast System For Bodily Weight

Trim System

Function :- To achieve horizontal balance.
Trim Tanks :- Two in number, one forad one
Method :- By a reversible trim pump which pump from forad to aft or vise thus altering the subs trim.



H.P.A. System

FUNCTION - To store air in bottle groups and supplied to the ring main at 4000 P.S.I.

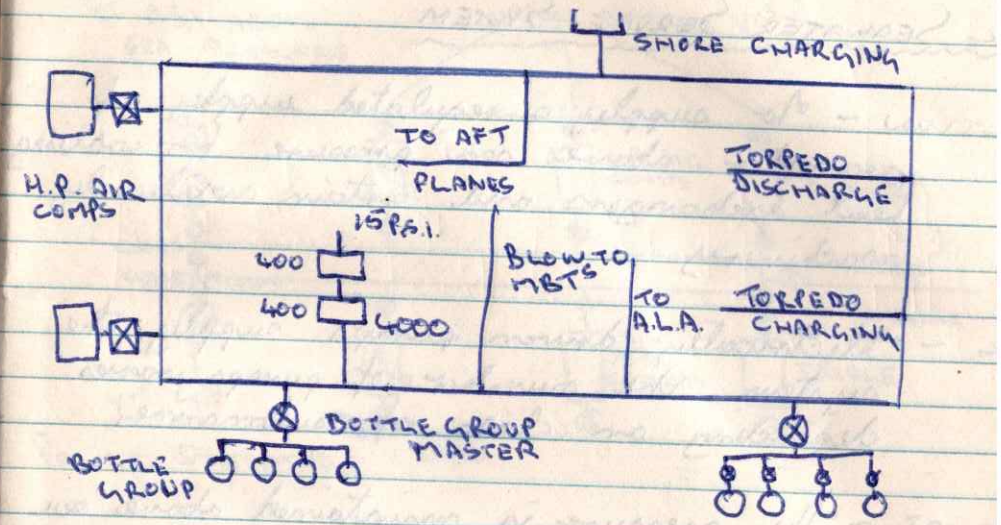
USES - 1. Blowing main ballast tanks
2. Torpedo discharge and charging
3. After hydroplanes in emergency
4. Hydraulic system air loaded accumulators
5. To supply a low pressure air system via reducers

CHARGING - By two in number H.P.A. compressors

GROUP MASTER VALVE - To isolate a bottle group from the H.P.A. system

ISOLATION - bulkhead stop valves are fitted to isolate the H.P.A. system to minimise the effect of a burst or for maintenance.

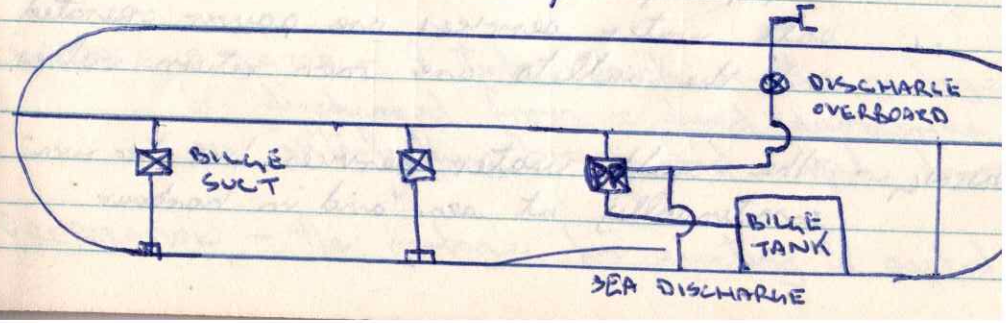
SHORE CHARGING - The bottle groups can be charged from shore compressors whilst in harbour



Basic Bilge System

FUNCTION - To collect the contents from various bilges and hold it until convenient to discharge it overboard

RESTRICTIONS - 1. Depth
2. Must not be discharged in harbour except to a lighter bilge line (FASLANE ONLY) (LIMIT IS 55 FT)



Basic Seawater Service System

Function – To supply a regulated supply of seawater above sea pressure for cooling heat exchangers and certain auxiliarily machinery

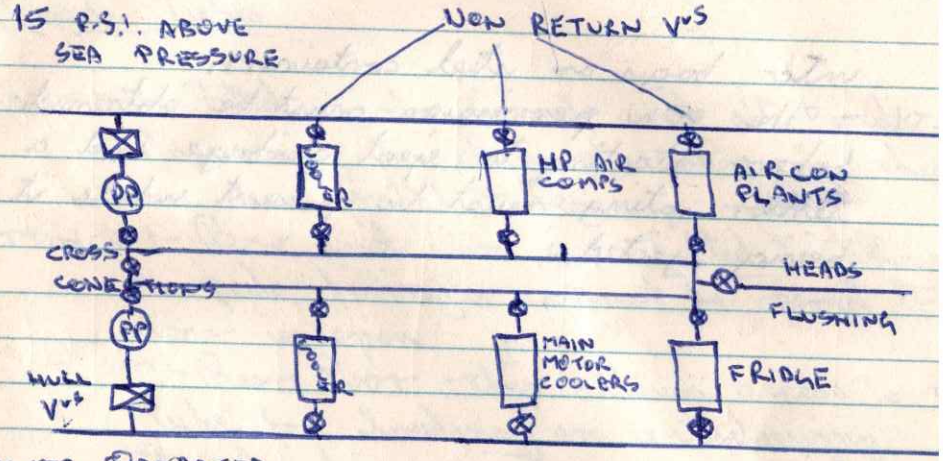
Pumps – electrically driven pumps supply the system. the number of pumps varies depending on class of submarine.

Pressure – The pressure is maintained above sea pressure by either increasing pump speed or starting more pumps.

Equipment supply – 1. Lubricating oil coolers
2. Main Motor coolers
3. Heads flushing
4. H.P. air compressors
5. Refrigeration plant
6. Air conditioning equipment

Safety – To minimise flooding in the event of a pipe fracture. The inlets on the salt water services are power operated and the outlets are non return valves.

Running – The salt water services has to run continually at sea and in harbour



Power Operated

Slop Drain, Sewage and Garbage

Function of slop drain and sewage system – To collect waste water from the galley and bathrooms and sewage from the heads in a tank where it can be held until convenient to discharge.

Method of discharge – Either by pumping overboard or by blowing, depending on class of submarine.

Garbage ejector – A tube which enables garbage to be discharged from a dived submarine via interlocking breech and muzzle doors

Preperation – The garbage for ejecting is packed

into bags or steel containers.

SAFETY - O/e OOW permission must be obtained before starting to eject garbage and a senior rating must be present while it is being ejected.

Torpedo Tubes

FUNCTION - Fitted in the forends and after ends depending on class of submarine thes are horizontal tubes.

FITTINGS 1 - Bow and stern caps fitted to allow torpedo firings cannot be opened if door is open.

2 - Rear Door - this allows access to t tube for loading or withdrawing torpedo for maintenance, or replacem

3 - Interlocks fitted to prevent re door or bow stern caps being opene together.

4 - Equalising pipe - an open ended direct from sea to tube to equalise tube with sea pressure before open bow or stern caps.

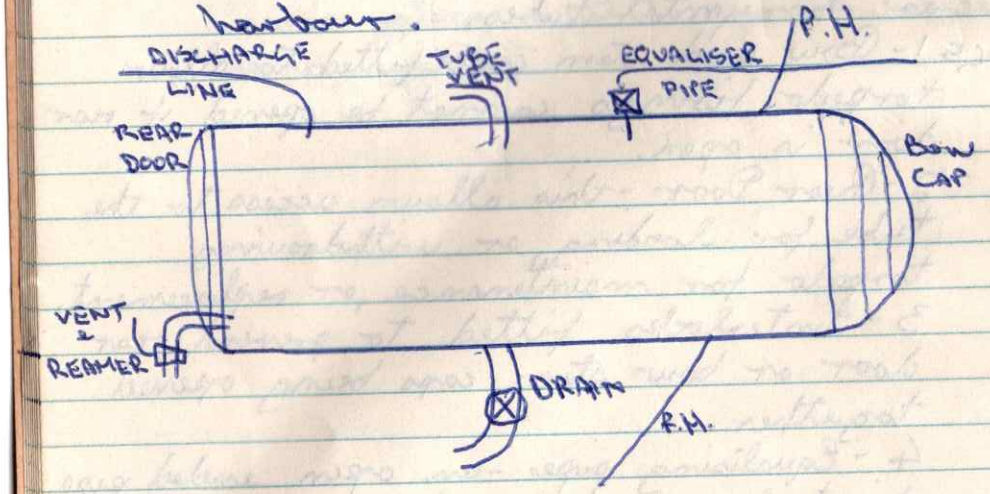
5 - Tube vent - to check tube is fu flooded and to assist in draining

6 - Discharge line - to fire the torp from the forard tubes only. After tub torpedo swims out.

7 - Torpedo Tube Drain - to drain tube back into the submarine for trim purposes.

8 - Vent & Reamer - fitted as a safet and checking device, so that tube be checked clear of water before opening rear door. Vent handle ab

acts as a locking device on rear door. A jet of water would indicate tube flooded. Checked by safety rounds watchkeeper in harbour.

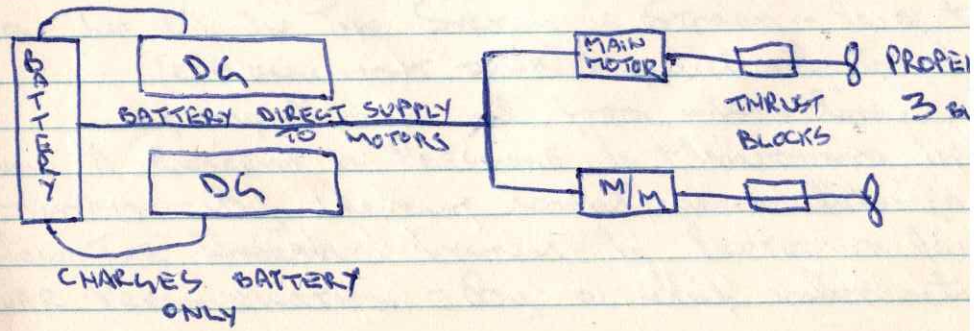


Methods of Propulsion Used In Submarines

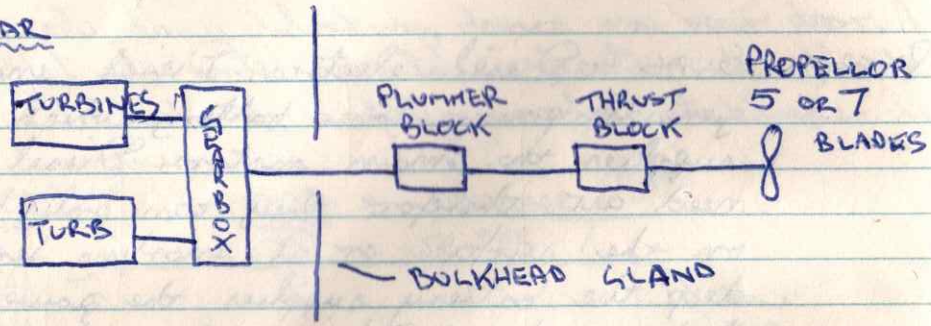
PATROL SUBS - Diesel electric. Diesel engines generate power to a battery which in t supplies the main motors. Diesel en need air therefore they can only be u on the surface or at snorting depth. deep the battery supplies the power w it has stored, it is recharged as operational conditions permit.

NUCLEAR SUBS - Are driven by two steam turbines driving through a reduction gearbox to a single multibladed s steam is supplied by a nuclear reac A back up is provided by a main motor supplied from a battery, simi to a patrol submarine.

PATROL



NUCLEAR



Basic Submarine Hydraulic System

Function of the hydraulic system - To supply oi
under pressure within a set pressure ra
to operate fittings inside and outside
submarine, quietly, efficiently with lit
effort and by one man.

BASIC PRINCIPLE OF HYDRAULICS - A liquid ca
be compressed. Therefore by exerting pr
on a liquid a pressure transmission
effected.

BASIC PIPEWORK REQUIRED - Pressure line - oil
high pressure to components. Return lin
returns displaced oil back to pressure
(LOW PRESSURE)

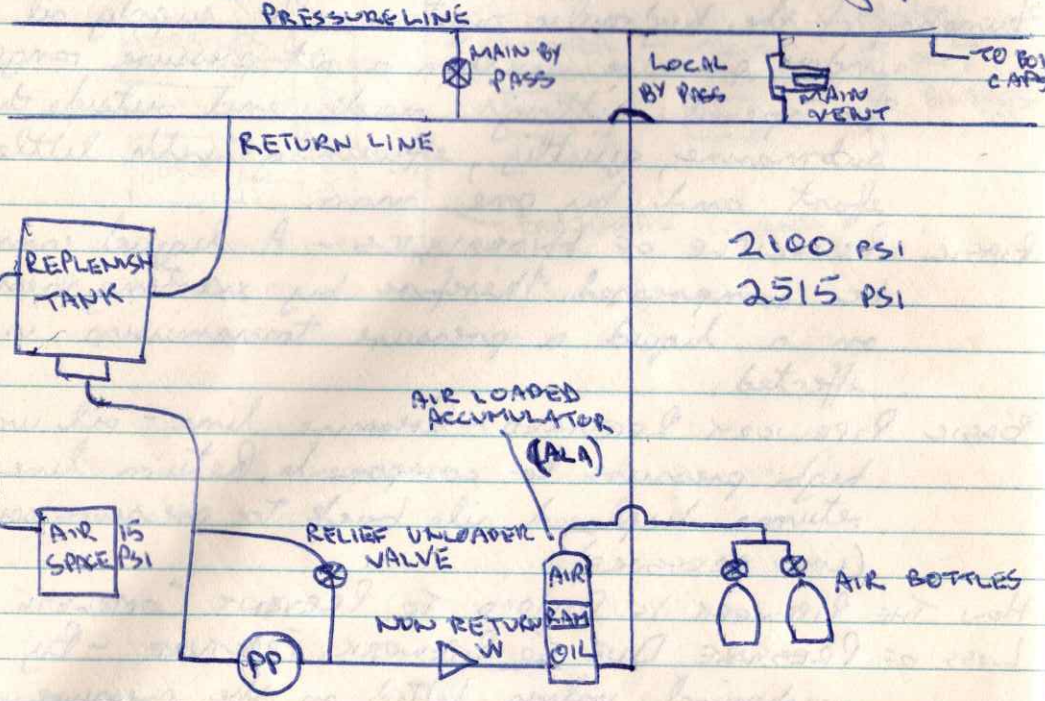
HOW THE PIPEWORK IS DIVIDED TO PREVENT COMPLET
LOSS OF PRESSURE DUE TO PIPEWORK FRACTURE - Bu
mechanical valves fitted on the pressure
return lines normally at the bulkheads (
(BULKHEAD STOP VALVES).

HOW THE PRESSURE IS MAINTAINED IN THE SYSTE
By electric motor driven pump (KNOWN
HYDRAULIC PUMP).

HOW THE OIL IN THE SYSTEM IS STORED - In a t
(REPLENISHMENT TANK) supplies oil to the
pump. Receives oil from return line.

HOW A RESERVE OF PRESSURE IS MAINTAINED IN
SYSTEM - By the air loaded accumulator (A
HOW THE HYDRAULIC SYSTEM IS PROTECTED AGA
OVER PRESSURISATION - By a relief valve sets

slightly above nominal working pressure.



CONTROL SURFACES

FUNCTION OF THE O.M.C. AND LOCATION – do pro
directional control of the submarine
use of foreplanes, afterplanes and rudde
O.M.C. located in the control room.

METHOD OF OPERATION – The control surfaces are
operated by hydraulic pressure, position req
via a jointed there are other methods of
operation which will be explained in th
type course.

FOREPLANES – to control the depth of the sub

AFTERPLANES – to control the angle of the sub.

RUDDER – to enable the sub to be steered on
desired course.

EFFECTS OF SPEED TO CONTROL SURFACES – Results
fast speed, a faster control of submarin
Results of slow speed, a slower contro
of submarine

Noise Reduction

OBJECT OF NOISE REDUCTION – Avoid detection by enemy sonar, avoid interference of own sonar in the event of detection, avoid being hit by acoustic underwater weapons.

COMMON SOURCES OF NOISE – Water flow, sea water passing over projections and casing holes. Propellor noise. Machinery vibration. Rattles in casing due to loose fittings. Loose gear and pipes inboard. Crew noise. Movement, dropping tools, and hammering.

METHOD OF ELIMINATING THE FOLLOWING SOURCES OF NOISE :-

1. Water flow – streamlined fin and casing fit fairing plates and bow shutters.
2. Propellor noise – fit noise reduced propellors
3. Machinery vibrations – design gearless machinery. Mount machinery on resilient mounts or on floating raft. Fit flexible pipes and couplings.
4. Casing rattles – ensure casing is searched prior to sailing for loose piping, and gear lying around.
5. Loose gear and piping inboard – all loose gear to be stowed in proper stowages, strap pipework and ensure rubber inserts.

Need for Air Purification

NORMAL ATMOSPHERE – Nitrogen – 78%
Oxygen – 21%
Other gases – 1%

METHODS USED TO REPLENISH OXYGEN – Snorting or ventilating. Air completely changed in the case of snorting
2. Oxygen generators – ninety minute self burning candles. Ignition by cartridge.
3. Electroliser – electrolis of water produces O^2 and H^2. H^2 pushed overboard.

METHODS USED TO REDUCE CARBON DIOXIDE
1. Snorting or ventilating
2. Absorbtion
3. Soda lime Canisters
4. Two hour rotation circles. Power, electric Air, and salt water battery

THREE MAJOR AIR CONTAMINATORS
1. Hydrogen – battery gasing, or electroliser l
2. Carbon monoxide – fried cooking, sm
3. Freon – refrigerant leakage

DANGER OF HYDROGEN
Explosive build up of hydrogen gases

M.

METHODS USED TO REDUCE HYDROGEN

1. Hydrogen eliminators
   OR CO H^2 burners - hydrogen burnt producing CO^2
2. Snorting and ventilating

METHODS USED TO REDUCE CARBON MONOXIDE

1. Reduce smoking and fried cooking.
2. CO H^2 burners
3. Snorting and ventilation

EQUIPMENT USED FOR AIR PURIFICATION IN AN ESCAPE COMPARTMENT

1. CO^2 absorbtion unit. Oxygen generators using cartridge to start

Snort System and Major Components

FUNCTION OF THE SNORT SYSTEM - To enable diesel generators to be run while the sub dived at periscope depth, to charge the batteries, also to change ships atmosphere

INDUCTION MAST & FITTINGS - external to hull to enable air to be inducted into the submarine whilst dived via a mast raised by hydraulic pressure. fitted with a float valve to prevent ingress of water when under.

2. (INTERNAL TO THE HULL) Induction hull valve hydraulicly operated to shut off hole to the pressure hull backed up by an emergency flap valve shuts automatically a big ingress of water. Flood and drain valves to enable mast to be flooded and drained as required.

EXHAUST MAST & FITTINGS

1. To enable diesel generator exhaust gases to be discharged whilst snorting at periscope depth.
2. Exhaust mast is kept just below the surface
3. The exhaust gases are cooled and bubbled up by sea water.

SNORT MUFFLER VALVE

To allow gases from diesel generators to pass to the snort exhaust system.

BLOW VALVE

1. Fitted to blow water clear of the snort exhaust mast before starting diesel generators.
2. Snort exhaust mast is hydraulicly operated

WEAPONS USED IN SUBMARINES

WEAPONS USED IN SUBS AND METHOD OF DISCHARGE

1. A3 missile system - polaris
2. Electrically driven torpedos and diesel driven torpedoes - polaris, fleet and patro
3. Mines - fleet and patrol

ELECTRICALLY DRIVEN TORPEDOES CARRIED FOR SM VERSUS SM ATTACK can be discharged by water ram, air or self swim.

MAIN ARNAMENT OF FLEET AND PATROL - SECONDAR TO POLARIS CLASS

DIESEL DRIVEN TORPEDOES - carried for SM versu skimmer attack

MINES

Can be carried and laid by all classes subs normally not carried on polaris - discharged by air

Sensors In A Submarine

FUNCTION OF SENSORS - A means of gathering information about the enemy to enable a successfull attack to be carried out and also for own navigational aids.

PERISCOPES TWO TYPES SEARCH & ATTACK

1. Gives a visual indication, and are located in the fin. Raised by hydraulic pressure via two piston hoists. Two types are fitted attack periscope - this is smaller in dimension and only has one eyepiece, also harder to detect visual and by radar.
2. Search periscope has two eyepieces mainly used at night.

RADAR VISUAL DISPLAY

Gives a Visual display of surface shipping and a land mass outline. Hazards can be detected by visual and other radar - also TX's a signal which can be detected.

ELECTRONIC SUPPORT MEASURE

Gives a visual display and audible of, aircraft, ships, and SM's radar TX's. Can detect enemy by information gained

SONAR SERVICE - UNDERWATER VISUAL DISPLAY

Gives two types of information range - o when we TX bearing rate passive - whe listen only for objects both on and under sea i.e. submarines - shimmers - the sea bed sea density

NAV AIDS & INSTRUMENTATION

DECCA - A radio beam picked up by W.T. mast and fed into a box containing three dials, reading off which are then transferred to charts

W.T. - Radio to shore

ECHO SOUNDER - Soundings for when entering harbour run continuos. For snap soundings while surfaced or dived which then can be checked with ships charts.

LORAN - A similar system to decca but reads off in miles and ranges in yards.

SHIPS INTERNAL NAV SYSTEM (SINS) - Used in nuclears for underwater navigation while dived

LOG TX - a small prop which spins with the flow speed of water and TX's to speed recorder in control room. Also records miles run.

GYRO COMPASS - Gives the actual heading of a submarines and also has repeaters in control room and bridge.

RADAR - Visual display of shore lines

SUN SIGHTS - Taken from bridge while on surface for forad periscope whilst

PLOTTING TABLE - Fixing charts and book st Books containing tide tables sunset sunrise.

DEPTH GUAGE - Records the depth we are at Keel level ie. if submarine has a d of 17 ft depth guage reads 17 ft on surface.

CLINOMETER - Records the subs vertical and h levels

FLOW METERS - to check amount of water tra forad to aft or vice versa, pumps flooded in or out of the submarine fitted ballast system and Trim line

CONTENTS GUAGES - fitted to certain tanks for quick visual check on tank content

Types of Submerged Signal Ejector and Pyro-technics

When An SSE Would Be Used - Exercising with ships, aircraft, escape, and identification.

Types of SSE used - Mark 4 water ram discharge uses VK and VS candles. Polaris, fleet and patrol. Mark 5 air firing. Polaris and fleet. Mark 2 air firing - air ram for bubble decoy. Patrol only

Pyrotechnics Used - Deep and shallow candles, FSS red, green, yellow message carriers, dye markers, bubble decoys.

Safety Precautions for Pyrotechnics - accidental firing of strikers whilst loading fire fighting equipment required locker flood facilities fitted.

Pressure Hull

Function :- To withstand pressure depth

Diameter - 33 FT
Length :- 360 FT

The pressure hull is thicker around the area of the missile hatches. Certain parts of the hull have 'soft patches' which can be cut out to allow for removal and replacement for large pieces of equipment and then w back into place

Construction :- A cylinder with chronicle sections at either end on which are domed ends giving 360' overall.

Divisions :- Bulkheads at frames 35 55 72 99 109 118 134 147

Bulkheads. 35 & 147 to withstand deep diving pressure

Watertight Bulkheads :- 35 - 72 - 109 - 118 - 147
109 and 118 withstand pressure to 266 P.S.I. (FOR CONTAINMENT)

Watertight Doors - 35 - 72 - 109 - 118 - 147

Hydraulicly Operated Doors - 35 - 109 - 118 - 147

N.B. hull strengthened by T frames internal along cylender external around domed ends. T frame are numbered from for'd to aft thus giving a means of whereabouts of equipment in different co

Hatches :-

1. Torpedo loading - torpedo compt
2. Torad escape (2) - torpedo compt
3. Main access - accomodation comp
4. Conning tower (2) - control room
5. Capsule loading - AMS 2
6. Access - AMS 3
7. After escape (2) - motor room

Hull Openings Which Affect Watertight Integrity

Hatches
Torpedo Tubes
Missile Hatches
Cash Ejector
Systems Pipeworks
Prop Shaft - Periscope - Shaft Seal
Sect Prop Motor
Mech Shafting
Cable Glands

Compartments

Nine Major Compartments - divided by bulkheads - not all watertight - lettered fwd to aft A to J (See notes chapter 1)

Main Ballast Tanks

Function - To dive and surface SM and to give full positive buoyancy on surface.

Location - Six M.B.T.'s external to pressure hull. 1, 2, 3 fwd - 6, 7 & 8 aft. All tanks are partitioned to form port & stb but are treated as 1 tank. 4 & 5 auxiliary tanks (INTERNAL) have nothing to do with the function of M.B.T.'s.

Notes - Read chapter 1 and complete questions except for question 12

Main Ballast Tanks

Function - to dive & surface sub - provide full positive buoyancy on surface - last sub for missile jettison

Major Fittings -
1. Main Vents
2. Main Vent Actuators
3. Hydel Valves
4. Free Flud Holes
5. Blow Line
6. Tankside Hull Valves
7. Non Return Valves
8. Blow Selector Valves
9. Tank Empty TX
10. Tank Access Doors

No 1 MBT - ~~Bow Planes~~ has larger main vents to provide a bow down on diving and more free flood holes to give bow up on surfacing.

No 3 & No 6 M.B.T.'s have a "split blow" facility to enable us to correct any list on surfacing

MAIN VENTS WILL FAIL SHUT ON LOSS OF 24 VOLTS D.C.

MAIN VENTS FAIL AS IS ON LOSS OF HYDRAULIC PRESSURE. Main Vent cutters (SEA & HARBOUR) prevent main vents from opening accidentally when shut off from diving

Blow Selectors
Operated hydraulicly can be operated locally i.e. local hydel and hand. Blow selector valves fail open on loss of 24 volts

MAIN VENTS
Control and Indication at systems consol

CONTROL
open/shut switches
blow selectors open/shut switches

INDICATION
illuminated indicators
dowty indicators
empty illuminated indi
for tank empty TX for
ballast tank contents

CASING FIN & FITTINGS

Function - covers fittings external press hull. ass
ship speed through water Reduces water n
Overall length of SM including casing is 4
The casing is made streamlined and all
openings have shutters or fairings to ma
this.

EQUIPMENT FOUND UNDER CASING

Blow low - In bow above sonar flat - a
from J.R. rec space, see 3.7.
Anchor - housed in recess in bottom of 1
starboard cable in locker inside 1 MBT st
operated from T.E.S.
Steaming lights - raised and lowered by rod
Indicator buoys (FOR'D & AFT) sighted under ca
at 35 BH and aft of after escape tower. Can
released from either side 35 & 147.
W.T. floats - 2 abreast aft of missile casing.
by hydraulicly operated doors. Winch and hand
gear also sighted under casing.
Secondary propulsion motor - housed in
of 6 M.B.T. Used in event of major breakdo
Hydraulic. Faired off.
Sonar Array 2001 - part of streamlined f
around upper part of bow. Capstains 2 (F
AFT) normally stored flush with casing. Ra
& lowered mechanically on screw thread. H

Nos 4 & 5 AUX TKS

FUNCTION - Compensate missile firing - to give additional buoyancy on surface

OPERATION - internal - not tested to M.O.P. - kingston valves are fitted. These are ball type hull valves which have a quick action and are safe.

Kingston valves - inboard & outboard vent valves are all hydel operated and all fail shut on loss of 24v D.C.. They may be opened by local hydel valve push button. Kingston valves can be operated by local hand pump on loss of main hydraulic pressure in which case inboard and outboard vents are operated by hand lever. The L.P. blow valve also will fail shut on loss of 24v D.C.

Control & Indication

CONTROL	INDICATION
2 five position switches Control switches for inboard vents.	contents guages clarity indicators for inboard vents
L.P. blow valves	Illuminated indicator for kingston valves & outboard vents Tank pressure guag

FITTINGS IN AUX TKS

KINGSTON VALVES
INBOARD & OUTBOARD VENTS
Blow Valve - air operated
Contents c/x
Suction & Flood line - valves - ballast line
Hydel valves for Kingstons
175 P.S.I. relief valve

HOVERING SYSTEM

FUNCTION - automatically maintains the sub on required depth for missile firing.

LOCATION - tanks inside M compensating

OPERATION - comprised of hover tk and acc tk & a hover pp & and dist valve. The tk is auto pressurised to 35 PSI below press. This assists in flooding the tk. The tk is pressurised to 35 P.S.I. above sea press and assists in discharge of cargo to sea

The hover PP weighted in AMS 1 runs continuously through the hover. The dist valve also weighted AMS 1 diverts flow of oggen into or out of the SM as directed by the comparitor. The comparitor compares the required flow of water with the actual to maintain the SM at the ordered depth. The hover system can also be maintained manualy

Trim & Ballast System

CODE - W.S.
Colour of pipes & flanges - green
Two different systems

Trim System
Pump below 3 desk level in A.M.S 1.

BILGE System

code - BS colour - green pipes - orange flanges

To dispose clean & dirty water collected from bilges & drain tanks. Also disposes brine from distilation. Bilge mains runs stb 3 deck connecting fwd LP bilge system, MC BS, HP bilge pump aft LP. BS. A non-return valve in AMS 2 e the following lines up :-

1. fwd LP BP can take a suction fwd & aft
2. Aft LP. BP can take suction fwd an and discharge aft.
3. H.P. BP can take suc fwd & aft discharge overboard.

N.B. LP BP's can only discharge overboard to

After Bilge System

Discharges bilges etc. to sea a 120 ft or clean bilge tank if greater than 120 ft Discharge clean & dirty bilge tanks to sea dow 120 ft and dirty bilge to a lighter in harbou A.C. priming pump controlled locally in machinery space but can be connect to central priming system if required M.P. bilge can be cross connected to do its duty

H.P. B.S.

Discharges brine tank clean & dirty bilge tan bilge & drain tank down to maximum draug can take a suction on any tank or bilge in hull bilge system and direct to sea to during depth. A 440v A.C. 2 speed pp co

locally AMS 3 (T.G. room) must be primed by C.P.S. Can carry out duties of ballast pump

M.C. BS

Besides servicing M.C. bilges the system can supply a suction on each missile tube. Two small capacity auxiliary pp stb and port M.C. lower level which are normally run in conjuction with the after L.P. bilge pp to discharge to sea or the C.B.T.

bilge alarms - high level alarms are fitted to the following tanks & bilges

1. R.C. drain tank
2. R.C. bilge
3. Torpedo compartment bilge
4. ballast space
5. A.M.S. 1 bilge
6. M.C. bilge
7. A.M.S. 2 bilge
8. A.M.S. 3 bilge
9. M.M.S bilge
10. M.R. bilge

These alarms indicate at the auxiliary mach panel in the manouvering room.

read chapters 4 - 5 & 6 & 8 upto 89

H.P. AIR SYSTEM

function - to store air at 4000 P.S.I. and supply it to the following services

Blowing M.B.T.'s - 4000 PSI
Reactor air services - 3000 PSI
Torpedo discharging - 2000 PSI
" charging - 2000 PSI
A/t planes air energy - 2000 PSI
A.L.A. - 3000 PSI
A.V. system - 4000/400 PSI

operation - six H.P.A. bottle groups plus a missile gp charged to 4000 PSI by two compressors port & stb side of motor room. H.P. air distribution is by ring main & branch lines

ring main - port & stb sides are seperate. Each is further seperated into three sections by non-return V's.

Group master stop valves which isolate the bottle groups can be shut hydraulically from but must be opened by hand locally using a two position lever to allow pressure differences across the valve to equalise slowly

Numbers 1,2,5 & 6 groups located externally in ballast tanks and have hull V/v's which act as back-up V/v's. The missile group is isolated from sth side by M.G.4 and M.G.2. (pneumatically operated) Normally all group master stop V/v's and back up V/v's and M.G.2 are left open. Non-return valves ensure the following line up:-

	Groups	Supply
A.	1 & 2	Port section of associated lines after section associated lines
B.	5 & 6	
C.	4	all of port line
D.	3	all of sth line
E.	Missile	besides its own section can supply all of sth side by opening M.G.4

By this line up 1,2,5 & 6 groups can be maintained at max pressure for emergency blowing while 3 & 4 cater for normal requirements.

Group master stop V/v's fail "as is" on loss of either 24 volts D.C. or hydraulics. They may be shut manually with a lever.

Control & Indication

Controls	Indicators
systems consol manual/shut for each G.M.S.V. (6)	OPEN/SHUT for G.M.S.V. (6)
open/shut switch for M.G.2 & M.G.4 (M.G.2 normally open M.G.4 norm shut)	open/shut in for each valv
	pressure guag each H.P. air m missile gp, mid sth ring main port ring ma

At the auxiliary machinery panel in manoeuvering ro pressure guages for mids port main- mids sth ma

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Reduced Pressure Services

Pressure reduction is achieved by auto reducing Vv's or hand operated fine adjustment needle Vv's. Auto Vv's are employed for services that require a constant supply of air.

SERVICE	PRESSURE
1. Hydraulic System A.L.A.	3000 PSI
2. Torpedo discharge	2000 PSI
3. After hydroplanes (air emerg)	2000 PSI, 100 PSI
4. Reactor air [redacted] system	3000 PSI
5. Mark 4 SSE	1000 PSI

Aux Vent & Blow (AV SYSTEM)

A.V. reduces H.P. air to 400 PSI or less. Five branch lines from the HP ring main supply the 5 main reducing stations. Sited :—

1. Torpedo compt – port fwd ring main } fwd section
2. Control room – stbd mids ring main } fwd section
3. AMS 2 – port mids " " } aft section
4. AMS 3 (manoeuvring room) – stbd mids " " } aft section
5. Motor room – port aft " " } aft section

Divided into two sections by an isolating Vv at the reactor compt (in tunnel).

Service | Pressure

H/P & L/P Blowing of MBT's

System code – HLB

Normal Blow – HP air used initially to surface SM has pos buoancy H.P. air and MBT's are subsequently blo LP air.

The master blow chest situ sup con is supplied with air HPA 57 from 3 & 4 bottle gro LP air via HPA 56 from the 1 2, 7 & 8 MBT's have one selector Vv each 3 & 6 MBT's blow selector valves (1 per). T a split blow facility to com

on surface. When dived blow selector Vv's and tankside hull Vv's are normally open. The non-return Vv's prevent water from MBT's entering the sys.

Blow selector valves fail open on loss of 24 volts D.C. and can be operated manually on failure of hydraulics.

To blow in "normal" the two normal/emerg switches at the sys con will be switched to normal & H.P. air from 3 & 4 groups enters the MBT's ~~bottom~~ ~~lighter the HPA sys on the AK sys~~ via the master blow Vv's & the HPA 57C. an gaining pos buoy and on way to suit HPA 57C is shut. LP air ~~from 57C~~ via 54C from the AV sys now takes over.

Emergency Blow

If any flooding occurs it is essential the SM be brought to the surface as quickly as poss.

Battle groups 125 & 6 are kept at full press at all times to achieve this. When emerg blow is selected at sys con the control valve is deenergised. No action takes place until the master blow valves are open at the sys con. Immediatly the pressure rises to 100 psi in the blow lines the emerg blow Vv's open and full press of 125 & 6 groups is supplied to MBT's.

When press of 125 & 6 groups fall to pre of 3 & 4, 3 & 4 join in the blow.

Emerg blowing continues until normal selected at the sys con.

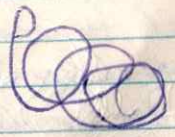
In event of 24 volt D.C. failure sys fails emerg.

2 press gauges above sys con indicate press rise in blow lines which may h leaked past master blow valves and can initiate emerg blowing.

Emerg blowing can be controlled locall hand in T.C. and M.R.

Air Conditioning & Purification

Purp	Cons
removal of unwanted gases	maintain habitability
replace wanted gases	drying - heating - cooling.
	filtering



PURIFICATION

4 functions - to prevent intoxications of SM's atmosphere

1. oxygen	- decreases - breathing
2. CO^2	- increases - breathing
3. CO	- increases - smoking, burning
4. Hydrogen	- increases - battery - sewage
5. Nitrogen	- increases - used in MC
6. Freon 12	- increases - fridge leaks.
7. Hydro carbons	- increases - cooking fats, painting
8. Dust	- increases

Oxygen - level indicated at atmosphere analyser. Two electrolisers - ems 2/1 - replace lost oxygen. Work on the principle of electrolysis of water. Demineralised water is broken down into O and H by passing high direct current through it. O released to SM's atmosphere. Hydrogen discharg overboard.

A highly costic chemical LYE is used in this process. Great care must be used when handling LYE as it can cause damag to eyes & skin.

CO^2 - 3 CO^2 scrubbers port side AMS 2/1 (em purification room) ships atmosphere is passed through a cemical AMINE which has the ability to absorb CO^2 when cold and relea it when hot. Co^2 extracted in this manne is discharged overboard and SM's atmosph released to

CO & H - two COH^2 burners sighted port & stb side of AMS 2/1. Air containing CO and H is heated and passed over a catalyst whi combines the gases & converts them to CO^2 & water vapour. Water vapour is condensed & drained & CO^2 is released to atmosphere to be dealt with by scrubb

dust - to remove dust particles air is passed through precipitators two plants sited at air conditioning space. Air passed through a magnetic field dust partic given a pos charge subsequently coll at neg charged plate.

Freon - removed by going to ventilation state y

Nitrogen - only used as fire in M.C. (drenchin removed by ventilation state yellow.

Hydro carbons (smells) air from air conditionin space passed through large carbon filters which filter out smells & certain elements. filters changed bet each patrol. small filters fitted to servo tank motors.

Oxygen Generators – 8 units fitted for S.R.'s rec space for motor room. Reserved for escape purposes they produce oxygen by burning a chemical candle candles stowed in sealed containers until required, A rotary disc indicates green when O is being generated.

CO^2 absorption units – four fitted two in SR's rec space / motor room / engineers stores flat (MMS upper level) draw air through canisters containing soda lime which absorbs the CO^2 the air is discharged back into compt. A vacuum guage is fitted which will indicate correct air flow through the canisters. Unit is powered by 1. D.C. [redacted] from SM's battery 2. sea water batteries 3. L.P. air at 70 psi. During escape air flow is to be avoided as it increases compt press.

PRECAUTIONS

O. candles

1. Candle maint active date and Lot No recorded.
2. Candles should not be used if A. spongy discoloured or damp. B. damage. C. handled by dirty hands

CO_2 Absorb unit

1. do not use a dented canister
2. Stow canisters right way up
3. Check seals top & bottom are removed before use
4. check seals are into top & bottom before

Atmosphere analyser sited M.C. middle level stbd aft monitors oxygen, CO^2, CO, H, freon and all hydro carbons in the SM's atmosphere. Connected compt's via small bore sampling lines

Air Particle detectors – three fitted 2 in AMS 3/1 in washroom passage. These APD's detect radioactive particles in SM's atmosphere and trigger alarm above certain level

Air Conditioning

Function – maintain ships atmos at desired levels of temp & humidity

operation – the for'd section of SM and M.C have identical recirculating sys. all aft of 99 bh is conditioned by individual A.C.U.s

for'd recirculating sys – by combination of thermostat and humidistate air is passed either cooling coils if too hot and or too humid or over a heating coil if too cold.

After conditioning system – air treatment units aft, air is drawn through unit by fan pa

over a cooling coil through a water eliminator and finally over a heater heater temp and chilled water flow through cooler controlled by thermostat.

Chilled Water (ref chpt 13)

Function - provide chilled water 45°F to various equipment for cooling.

Method - 2 steam vac fridges MMS #4 (recon fridges in AMS 2/2 (refrig mach rm) sup a chilled water line throughout the sh services are fed from this water pressur supplied by pumps which return wat to fridge plants.

1. Air treatment units
2. Sonar
3. refrig mach condensors
4. WT & radar
5. drinking water coolers
6. MCC electronics
7. Air conditioning coolers
8. Nav centre electronics

CONTROL

1. AMP (manoeuvring room)

pump STOP/START BUTTONS

INDICITION

pump running in

chilled water inle
outlet temp

Freon plant running indicators

Hydraulics

Function - supply oil under pressure to various equip & valves

Description - 2 plants - AMS 1 and AMS 3/2 (SWITCHBOARD RM) Supply system with oil approx 3,000 PSI. Isolating VV's port side MC upper level enable port & aft plants to supply own sections. System comprises supply line, return line, external return & vent line. Should either plant fail isolating VV's may be opened for 1 plant to supply all system. In event of a burst on either system by-pass VV's between supply & return lines may be opened to collapse the press. Branch lines either side of isolating VV's in MC ensure that plant with highest press supply steering & hydroplanes when in rate control

Power Plants - each plant consists of:-
1. a replen tank
2. Three motor driven hydraulic PP's
3. Two A.L.A.'s
4. Three unloader VV's - one on discharge line of each PP

Description of -
replenishment tank:- 250 gals - 2 sections - main section recieves return oil - split into 3 bays - one for each pump. Other section recieves external return oil & seperates oil & seawater contamin warning lights on system consol indicate low level in the tan A guage glass is fitted on the tanks to sight contents. The tank is topped up from reserve tanks using 20 PSI blow via the vent line. 10 to 12 PSI air boost to replen tanks to insure positive suction to PP's.

Pumps - PP's McTaggart Scott 440 volts A.C. 1 & 3 ~~PP's~~ 4 & 6 essential supplies. 2 & 5 non essential supplies.

A.L.A.'s - maintain a reserve of pressure in system.

Unloader VV's - allow the duty pump in normal load to run continously by opening at system pressure discharging to replenishment tk & shutting at low pressure to charge up the sys.

Normal mode - 1 PP selected (duty PP) running continuous

PUMP	IN	OUT
duty P/VV	2600 PSI	3100 PSI
1ST S/BY	2500 PSI	2900 PSI
2ND S/BY	2450 PSI	2900 PSI

all figures above are for illustration only

Read page E-21 Book 140

Harbour mode – 1 ea selected as harbour pp. pump starts 2500 stops 3000.

Control guages – 8 control guages auto controlled running of the plants. 3 guages sense accumulator air pressure 5 sense oil press

Hand pumps – 4 hand pumps coupled into sys for emgy & maintenance purposes.

1. T.E.S. used for torp loading gear, torp tube sys and anchor windlass can also be used to centralise f'd hydroplanes
2. Ballast space :– operation of 4 aux tanks kingstons in emgy
3. AMS 2/3 operation 5 aux tanks kingstons in emgy
4. M.R. small capacity suitable only for centralising after planes and rudder in emgy & maintenance purposes

Control & Indication at sys con

Control	Indication
mode selector for each plant harbour/emgy off/normal/emgy off	duty indicator for each pump
On/off buttons for each pump	→ lamp
	f'd & aft press guages
	replen tank low level warning
	A.L.A. contents full/available/warning

Steering & Hydroplanes & OMC

Function – to control depth course & angle.

Method 115 v A.C – position control electric normal – of op electrical Tx's & Rx's control the flow to the control surface rams to follow precise the movement at the joysticks. To achieve this position control hunting gear is fitted to the to centralise the control V.V. Position con hydr On loss 115 volts A.C. position control hydraulics auto selected. A hydraulic closed loop sys is to Tx the position of the joystick. The Rx positions control V/V the same way as in the electric sys This method of control can also be selected for quite operation.

Rate control – In the event of failure of positio control equipment – loss of one hydraulic plan loss of 24 volts D.C. rate control is selected by of rate control levers at S & HC. Ships hydraulic press is routed directly to the required control which will move one direction or the other depending on the position of rate control lever. must be centralised to stop this movement.

Air emgy – used in event of loss of all othe methods of control including total hydraulic fail selected from S & HC by operation of a switch controlling 100 PSI LP air. This control air in tu controls 2000 PSI HP air on a separate air on the after planes. Movement of rate control positions the after planes.

CHAPTER 10

Snorting & Ventilation

Snort induction - SN
Ventilation exhaust - VEX
Diesel exhaust - DE
Ventilation - VSB

SN system

Function - to allow fresh air to enter SM for ventilation or running diesels.
Components - induction mast - a telescopic hydraulics mast. Not tested to DDP ∴ is flooded below 80 FT. fitted with flood-drain-vent VV's
Head float VV - open when above surf. - shut down to 80 FT opens mast to sea press after 80 FT.
Induction hull VV - hydraulicly op from sys con, hand op in emergy & on loss of hydraulics - gear-motor accumulator maintains press for 3 operations.
Emergency flap VV - hull VV backup normally operated by hand wheel full flood of water past VV will shut it.

DE system

Function - discharge diesel engine exhaust + plus hydrogen gases overboard
Components - exhaust mast, telescopic hydraulics upper end open hood
Muffler - acts as silencer
Muffler VV - external normally open & shut fm D.C. may also be shut fm sys con. Hydraul operated, manual in emergy
Group exhaust VV - hydraulicly operated fm D.C. hand operated in emergy

VEX system

Function - expell stale air fm SM via LP blow
Components - vent exhaust mast, atised mast te DDSTB. mast head flap valve opened by d pressure of LP blower. Vents drain VV allow to be drawned into SM stb in event of flo
Hull VV & flap VV operate the same as in sn induction mast.

VSB system

Function:-
1. To circulate air through air cond. & air pu sys at all times
2. To adequately ventilate battery tank under conditions
3. To exhaust stale air & replace with fresh
4. To supply air to D.C.'s and exhaust D.C. a overboard
5. To purge RC or MC of contaminated air
Components - read chapter Term pages 7 & 8

Ventilation States

Vent state green – submerged state

Vent blue – diesels running

Vent state yellow – LP blower – ventilate

Vent red – RC purge

Hand operated flap W – position for each ventilation state is marked with appropriate colour. ventilation fans control switches sited control room stbd aft above ladde to 2 deck. LP blower control in fan room

Electrics

function – to provide power for lighting, mach, el
e propulsion

D.C. system – 276 V D.C. with power available at
times. Consists of battery recharged as required
motor generator sets or 2 ~~[illegible]~~ D.G.'s
supplies – items such as main propulsion motor, cent
L.P. AC circuits via small M.G.'s 24 volts for cont
e indication, ballast pump, ESSENTIAL SERVICES V
LARGE MOTOR GENERATORS

A.C. system – 440 volts 60 HZ supplied supplied by
T.G.'s (steam driven) The AC system is divided into esse
e non-essential services – ESSENTIAL MUST BE
MAINTAINED AT ALL TIMES. Essential services inc
1. primary cooling PP's (FULL SPEED) 2, 13, 4 & 6 hydraulic pumps
3, 1 & 2 sea water inc pp 4. 24v sys (via transformer rectifiers) 5. sec
propulsion motors 6. lighting 7. control & mining sys

Non essential services – 1. primary cooling PP's port 2. 2 5 hydrauli
3. 3, 4, 5 & 6 sea water inc PP's 4. A.C.P.'s 5. bower trim & LP bilge

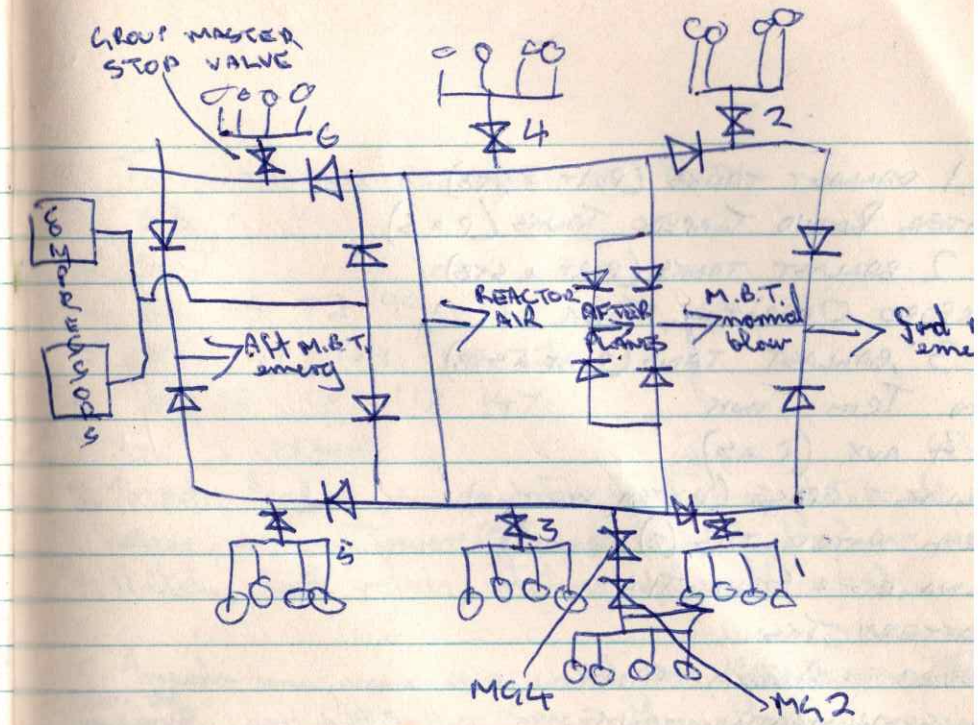
Main components – 2 T.G.'s AMS 3/3 – 2,000 KW each / 2 or 3 M.G.'s / Am
switchboard AMS 3/2 / batteries under accom 3 deck / 2 D.G.'s / D.G. room /
emerg M.G. AMS 1 / 24 V D.C. control & distribution from main centre

read chapters 15–16 & 18 & 17

18. State the equipment fitted to remove following from SM's atmos and its whereabouts
    CO_2
    CO
    HYDROGEN
19. State function of electrolysers
20. How does a suit change depth
21. How does compressibility affect the suit whe
    1. going deep
    2. coming shallow
22. give the six main uses of the ballast syst
23. give 4 items of control & indication for the ballast system at sys conn
24. give 3 line ups appertaining to the bilge sy made possible by cross connecting pumps in the sys

1.

2. assuming main vent is open how does it fail on loss of A. 24 volts
   B. hydraulics
3. list four fittings associated with MBT's
4. primary function 4 & 5 and the
5. list 4 fittings associated with and the
6. Give the function of the HPA system and list six primary services
7. State normal sea line up of group master stop V's incl M.C.
8. Which bottle groups supply normal HPA at sea.
9. assuming group master valve shut give correct procedure for opening
10. give primary function of 125 & 6 air groups
11. list all methods of blowing MBT's
12. When dived how do you 1. initiate emerg blowing
    2. stop emergency blowing
13. State function of H.P. system, operating pressure, and air source
14. how does a blow selector V fail on loss of 24 and hydraulics
15. list all hatches from for'd to aft on centre line
16. from what compts can indicator buoys be released
    list six fittings housed under casing



1 - Nº 1 BALLAST TANKS (PORT & STB)
2 - WATER ROUND TORPEDO TANKS (P & S)
3 - Nº 2 BALLAST TANKS (PORT & STB)
4 - TORPEDO OPERATING TANK
5 - Nº 3 BALLAST TANS (PORT & STB)
6 - FWD TRIM TANK
7 - Nº 4 AUX (P & S)
8 - BALLAST SPACE (EXTRA WEIGHT)
9 - FRESH WATER TKS (2)
10 - SEWAGE & SLOP TKS
11 - BATTERY TKS
12 - HOVER & ACCUM TANK
13 - M COMPENSATING TANK
14 - Nº 5 AUX TANK
15 - DIESEL FUEL OIL TK
16 - O COMPENSATING TK
17 - BRINE TK
18 - [redacted] FEED TKS
19 - Nº 6 BALLAST TK (P & S)
20 - Nº 7 BALLAST TK (P & S)
21 - AFTER TRIM TK
22 - Nº 8 BALLAST TK (P & S)

See Chapter 2

1. TO WITNSTAND PRESSURE AT DEPTH
2. 33'
3. 360'
4. 35 55 72 99 109 118 134 147
5. 35 147 109 118 72
6. 35 72 109 118 147
7. BY T FRAMES
8. Torpedo loading (2), escape hatch forad, escape hatch aft, ma
access, conning tower (2), capsule hatch, No 3 AUX MACH
9. Hatches, hull valves, rotating equipment (MASTS)
10. Torpedo room, accom space, control room, MISSILE ROOM NO 2
~~Missile room~~, REACTOR ~~MISSILE~~ ROOM, Nº3 AUX SPACE, Main Machinery space
Motor room.
11. 9
13. To give positive or neutral buoyancy in order
dive or surface
14 123,678

0825

1 0915 2 1005-20 3 1110 4 1110-1300 5 1400 - 1500 - 15 - 1610 6 7

ON ← REC ACT →

TUE ← SCHOOL →

NED ← SCHOOL → ← FISHER KINEMA → ← CLASSROOM →

THU 0800 ← TANK →

FRI ← DIV → ← SCHOOL →