



EXERCISE BOOK

Narrow Ruling.

Code No. 28—31

School CLASS AT Standard X

Name BERRY S 9/11/70289 LDG/CK

Subject BOOK

Commenced 6th 12th Finished

RULES FOR MENSURATION

a = Area. l = Length. b = Breadth. h = Height.
 t = Thickness. v = volume. R and r = radius.
 D = diameter. c = Circumference.

Area of rectangle = $l \times b$. (N.B.— $l \times b$ must be in the same units, i.e., when l is in ft. b must be brought to ft.)

Area of parallelogram = $b \times a$.

Area of triangle = $\frac{b \times h}{2}$.

Area of four walls of a room = $2b(l + h)$.

Cubic contents of rectangular solid = $l \times b \times h$.

" " cylinder or pipe = Base $\times h$.

Sum of the three angles of a triangle = 180° .

Circle { circumference = $2\pi r$ or πD (π = the constant 3.14)

area = πr^2

area of hollow ring = $\pi(R + r)(R - r)$

surface area of

cylinder (exclud-

ing area of two

ends)

= $2\pi r h$

volume of cylinder = $\pi r^2 h$

volume of cone = $\frac{\pi r^2 h}{3}$

truncated cone = $\frac{\pi h}{3}(R^2 + Rr + r^2)$

(R, r are radii of 2 ends).

MISCELLANEOUS

1 dozen = 12

1 score = 20

1 gross = 144

A cubic foot of fresh water weighs 62½ lbs.

" " clay " 125 lbs.

" " loose earth " 95 lbs.

" " pine " 41 lbs.

" " oak " 59 lbs.

A gallon of water weighs approx. 10 lbs.

A cubic yard of compressed hay weighs about 225 lbs.

" " straw " 145 lbs.

" " coal (solid) weighs about 2,160 lbs.

" " sand weighs about 1 ton (approx.)

A truss of straw should be 35 lbs.

" " old hay should be 55 lbs.

" " new hay should be 60 lbs.

36 trusses = a load.

5% Interest or Profit = $\frac{1}{20}$ = 1/20 in the £.

Sound travels in air at approximately 1,100 ft. per second.

A halfpenny is 1 inch in diameter.

A noggin = 2 gillies. (4 noggins = 1 pint.)

Supplied for use in NAVAL & MILITARY SCHOOLS, etc., by
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Awaitt.
Masihua.
Bedoon.
Kikimo
Pomali
Macabell
Lizk
Zuku
Afridi
Cossack
Heubinn
Maori
Tartar
Tartar
Cossack
y hanka

Kev

YD

Maori

PRESSURE HULL

is built circular in shape, to withstand pressure. and is strengthened throughout with **Z** frames, spaced about 15" apart. the hull is built of thick plating to withstand sea pressure when down, with only atmospheric pressure to counter balance it. the hull is tested 225 lbs per sq inch.

BUOYANCY

A body in water will either float, hover, or sink, there are three principle states of buoyancy of a submarine, that is positive, neutral and negative.

An S class submarine, has a surface displacement of 700 tons, when submerged 900 tons, therefore a submarine has 200 tons positive buoyancy. to dive the submarine 200 tons of water must be taken into tanks. this is known as main ballast. to bring the submarine to the surface, this water is blown with H.P. air, which is stored in air bottles, and also by using propellers and hydroplanes.

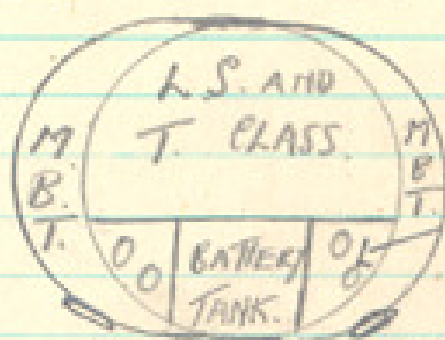
PROPELSCION

On the surface mainly by diesel engines. with the engine clutch in, and the tail clutch in. when submerged, main motors are used, which get their power from

electrical storage batteries.

The maximum speed when diving is 9 knots for 1 hour, the minimum speed is 2 knots for 30 hours.

TYPES OF SUBS.



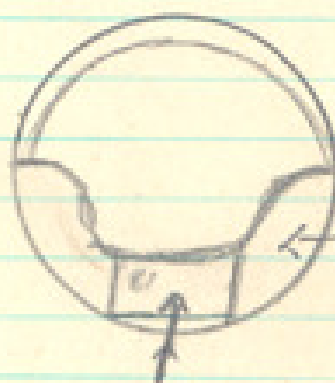
Z. I. TYPE.

MAIN BALLAST TANKS.

AIR STORAGE BOTTLES.

Have main ballast tanks outside pressure hull, the main ballast tanks are tested to 15 lbs per sq inch, this class of boat as a large cruising radius, good accommodation, good storage, but poor streamlining.

Z. 2. TYPE U BOATS



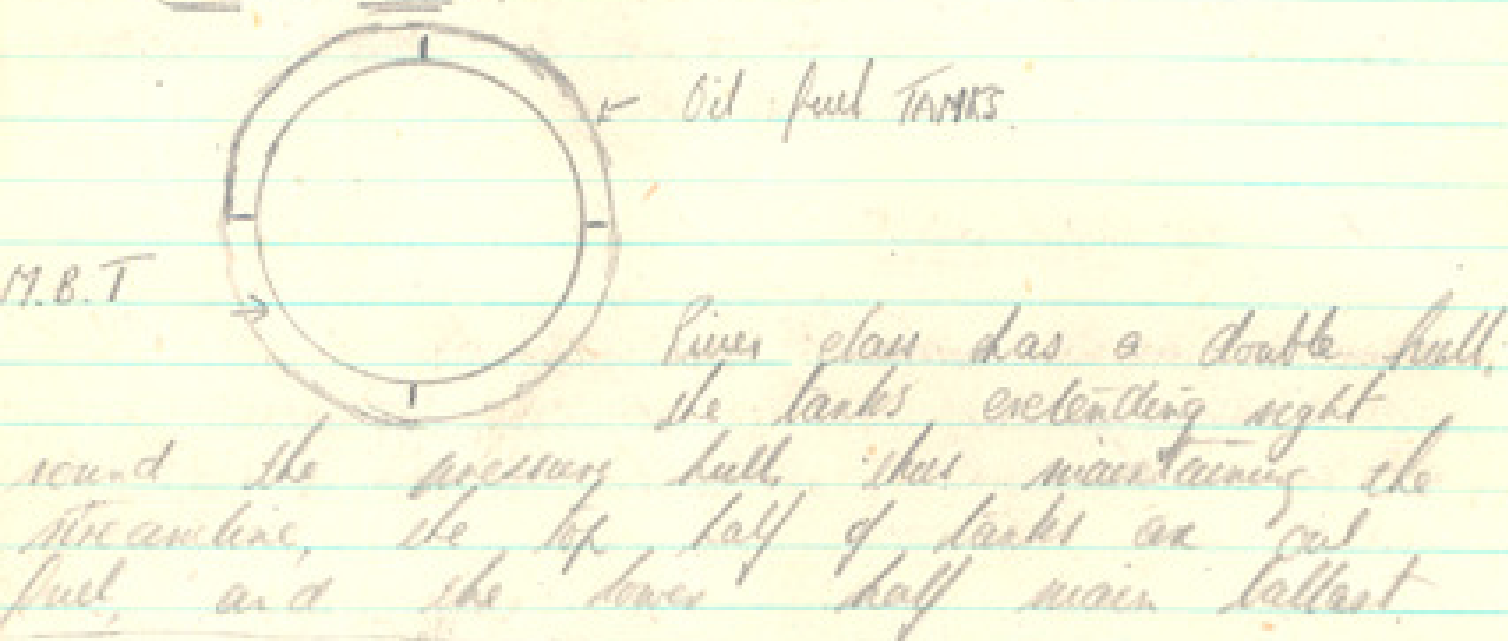
MAIN BALLAST.

BATT. TANK.

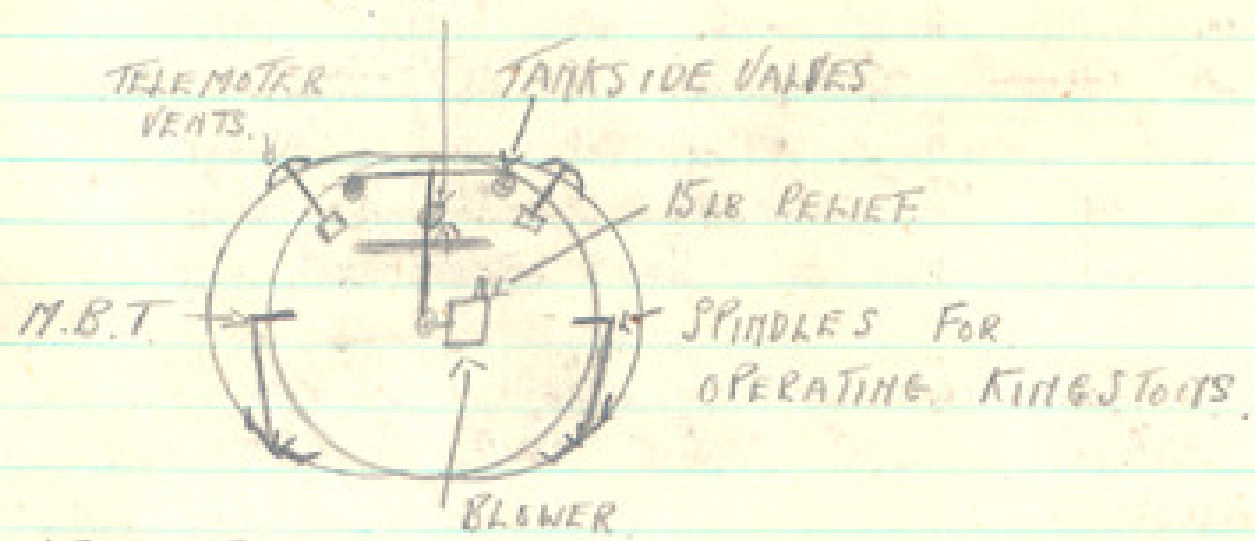
This type as the main ballast tanks inside pressure hull, and are U shaped to take the

batteries, the main ballast tanks being inside the pressure hull, reduces its fuel capacity, and it is essentially a short range boat. it has very good streamline and maneuverability. when submerged it has small accommodation, and less storage room.

RIVER CLASS



L.P. BLOWER.



KINGSTON
TANK. 2 + 4 P.S.

NO 1 KINGSTON TANKS 1.3.5

LEVELLING COCKS

TANK SIDE VALVE.

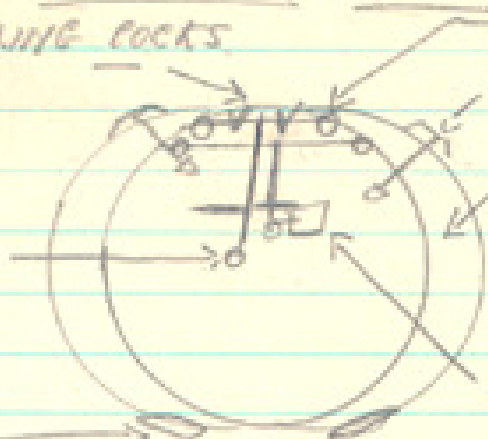
TELEMOTOR VENT

MAIN B.T.

H.P.

DIRECT
BLOW.

FREE FLOOD



L.P. Blower only used on surface,
can be used to reduce pressure
inside boat.

FITTINGS AND THEIR USES.

1/ Telemotor vent, situated in the top of the tank, and when opened allows the air to escape when flooding, when shut, it seals the top of the deck when blowing.

2/ Kingstons on No 2 AND 4 main ballast only are hand operated, and when open they allow water to enter the main ballast tanks and through which water is expelled when blowing. when shut, they help a buoyancy in the main ballast tanks, they are never shut at sea.

FREE FLOODS

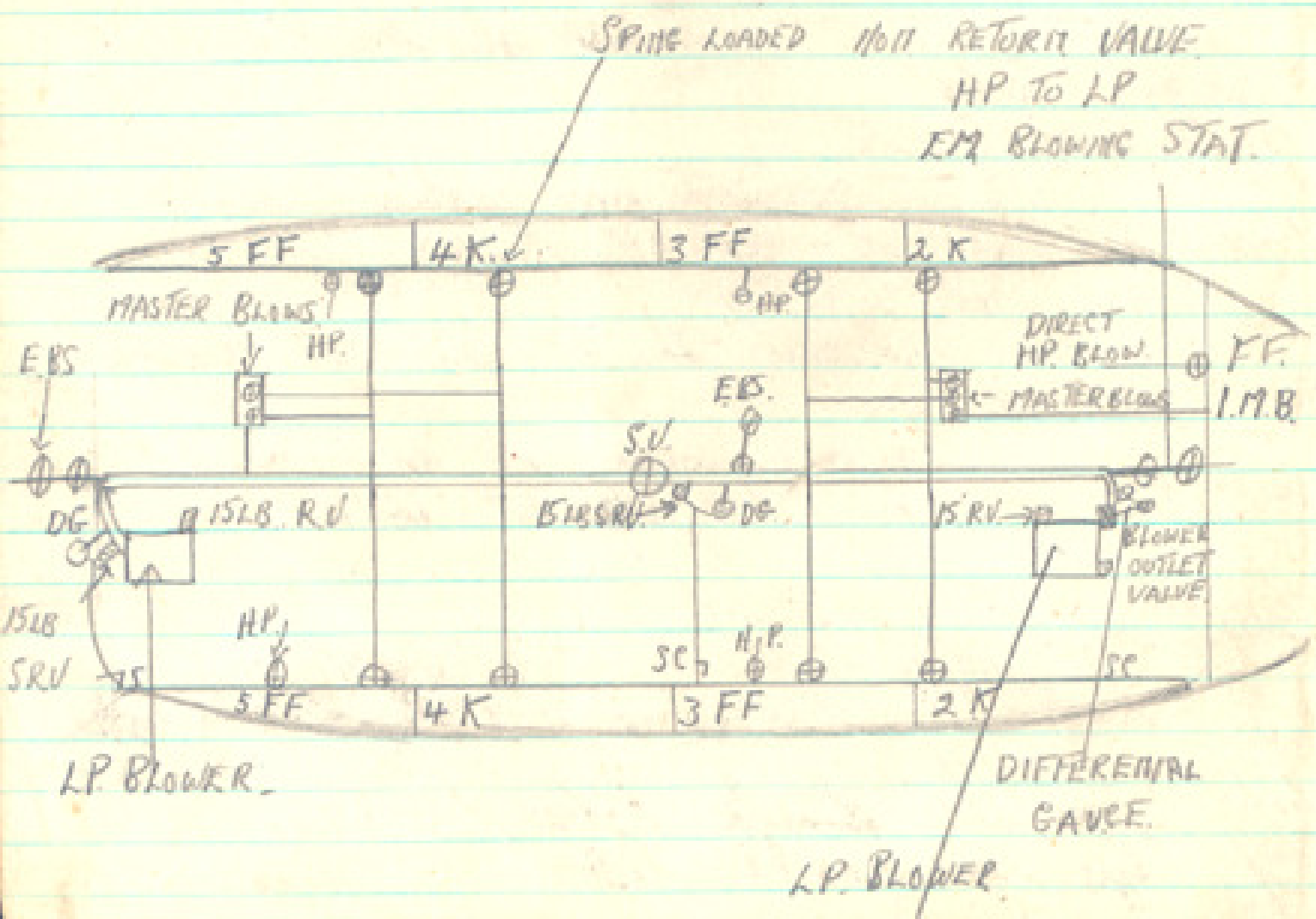
are large holes in the bottoms of No 1, 3 & 5 main ballast through which water is admitted and expelled.

Leveling cocks are fitted on the H.P. flow to enable to No 3 main ballast tanks.

SEPARATELY OPERATED VENTS

TANKSIDE VALVES

LOW POWER BLOWING SYSTEM:



L.P. System (PAINTED RED)

The blowers are electrically driven L.P. air compressors, which supply a large volume of air at low pressure and are used to complete the blowing of the main ballast tanks when the submarine is on the surface and the venting lower hatch is open.

BLOWER OUTLET VALVE

connects the blower to the L.P. line.

15 LB SPRING RELIEF VALVE

Protects the blowers and the

Kingston Tanks

MASTER BLOWS

connects the external main ballast tanks to the L.P. line.

L.P. STOP VALVE

Divides the L.P. line into 2 sections.

EM. B. STATION

There in number, is a means of admitting H.P. air to the L.P. line.

TO USE AN. E. B. STATION

- 1/ Check the Kingstons and Tanksides open.
- 2/ Open the Master Blows.
- 3/ Open the outlet valve.

4/ Crack the regulating valve and watch the DIFF gauge and see that it registers air pressure over 1000 pressure.

There are three ways of blowing a new Kingston Tank.

1/ By H.P. air direct blowers.

2/ By the L.P. Blowers.

3/ H.P. through the L.P. line on F.B. Station.

There are two ways of blowing a Kingston tank.

1/ By means of the L.P. Blowers.

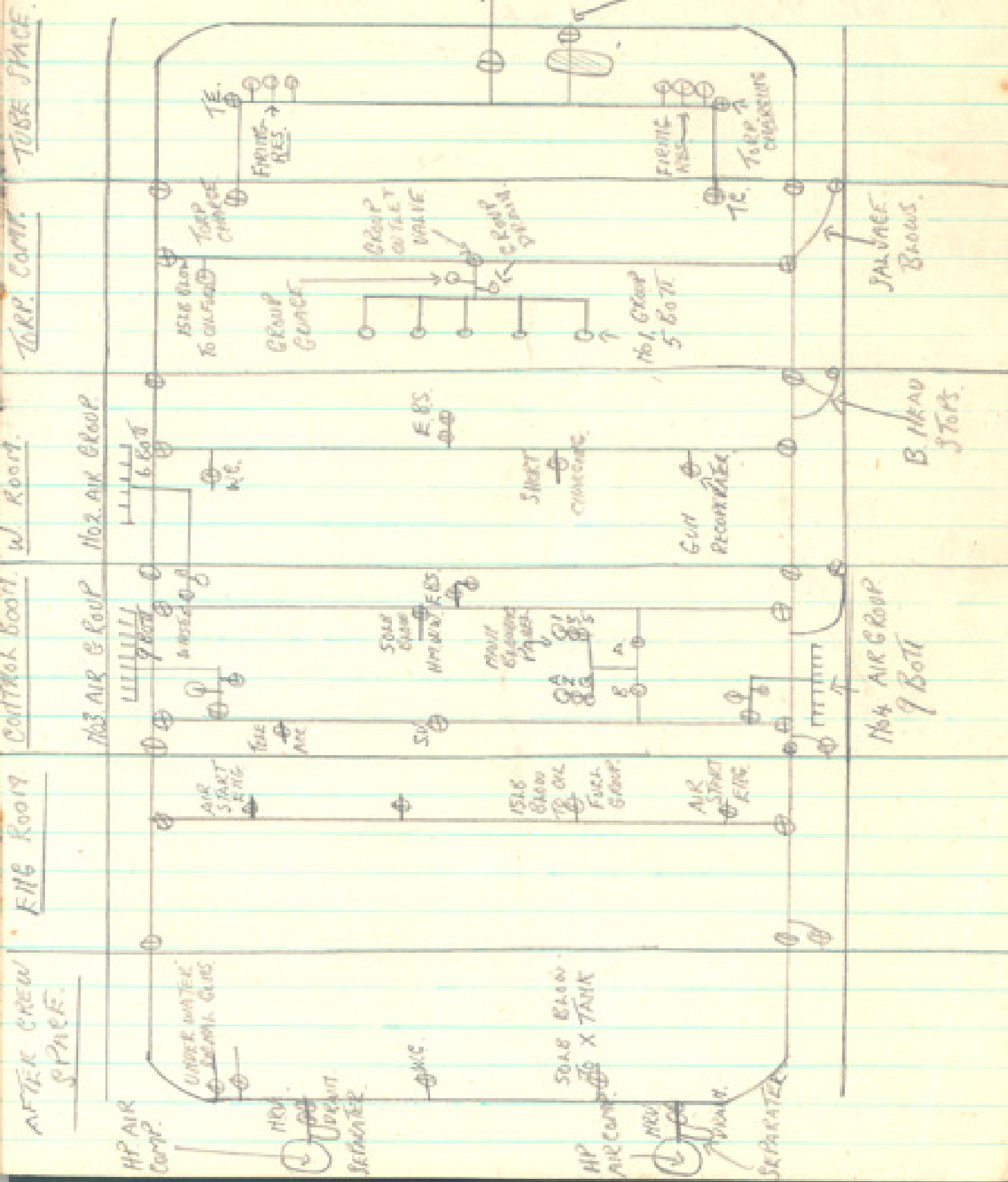
2/ H.P. through the L.P. line

all H.P. PIPES PAINTED GREEN

HIGH PRESSURE AIR RING MAIN

Sold Grain to Tubes
W.R.T. To T.

CHARENTIS COA



H.P. AIR SYSTEM. (PAINTED GREEN)

The H.P. air line runs right round the submarine, and through every compartment.

The working pressure of 3500 lbs per sq inch is supplied through groups of air bottles. There are 29 bottles made up in 4 groups of 5, 6, 9, 9 bottles, at every point where the pipe pierces the bulkhead stop valves are fitted, and these valves are always on the control room side of the bulk head.

On the control room side of the bulk head stop, a tapping is led from the ring main through a stop valve into the scot compartment, these are called salvage blows and form a means whereby H.P. air could be blown at pressure into a flooded compartment, thus assisting salvage, every compartment has a cross connection.

The control room having two, and all tapings except salvage blows are taken from these cross connections. There are stop valves on either side of the cross connections, which enable them to be isolated if so desired each bottle supplies air through its own bottle outlet, these through the group outlet and into the cross connection. The bottles are recharged by means of motor driven compressors.

When air is compressed, a certain amount of water is formed, this water must be removed, before the air

is fed into the bottles, this is done by passing the air from the compressor through a separate column, the air then passes through a screw downed non return valve into the cross connection and so into the bottles, each cross connection is fitted with a pressure gauge, in the control room there is a shore charging connection which goes right through the pressure hull, it enables the bottles to be charged from an outside source.

AUX AND COMPENSATING TANKS

How THEY ARE CONNECTED TO MAIN LINE

MAIN LINE is a 6" pipe running throughout the submarine at deck level on the "Port" side. Near the centre of the line is a 6 valve box to which is connected a drossale pump. In larger submarines there are two 6 valve boxes and two drossale pumps, tapped off the main line there are pipes with a valve known as suction valves which lead into each of the auxiliary and compensating tanks. Therefore the use of the main line in conjunction with the drossale pump and 6 valve box is for pumping out the internal tanks or by means of a sea flood for flooding the internal tanks. water can also be blown or pumped from one internal tank to another through the main line. the main line can be split into three sections by means of stop valves known as No 1, 2, 3. main line stops. The 6 valve box and pump is situated between No 2 and 3 main line stops. In the latter class submarines, a tank can also be pumped out through the main line and over board. the object of this is to ensure that a tank is completely empty and at the same time obviate the danger of giving a bubble to the surface. if completely emptying a by blowing. The tanks which can be pumped out

through the main line. A and Z auxiliaries,
H, M, W, W star and X compensating tanks, ammo
magazine, battery tanks, gun tower, cleaning tower,
fog tank, bilges, and the engines.

ammo magazine and battery tank suction are
always kept locked when not in use.

There are four types of valves on the main line

1/ Main line stops are of the sluice type.

2/ Screwed down type to all internal salt
water tanks and hose connections.

3/ Non return valves to all bilges and
battery tanks.

4/ Hood type to the magazines.

TELE
VENT

Z
AUX.
TANK

714

CONTINUED
VIB TO X
SOL P 000

3 MS
2 SEC

CLAP

HP
3 SEC
SOL
SOL
SOL

HP
2 MS

COMBINED
VENT AND BLOW

1000 PSI
PRESSURE
1000 PSI

MR

MEAS
VENT

TANK

TELE
VENT

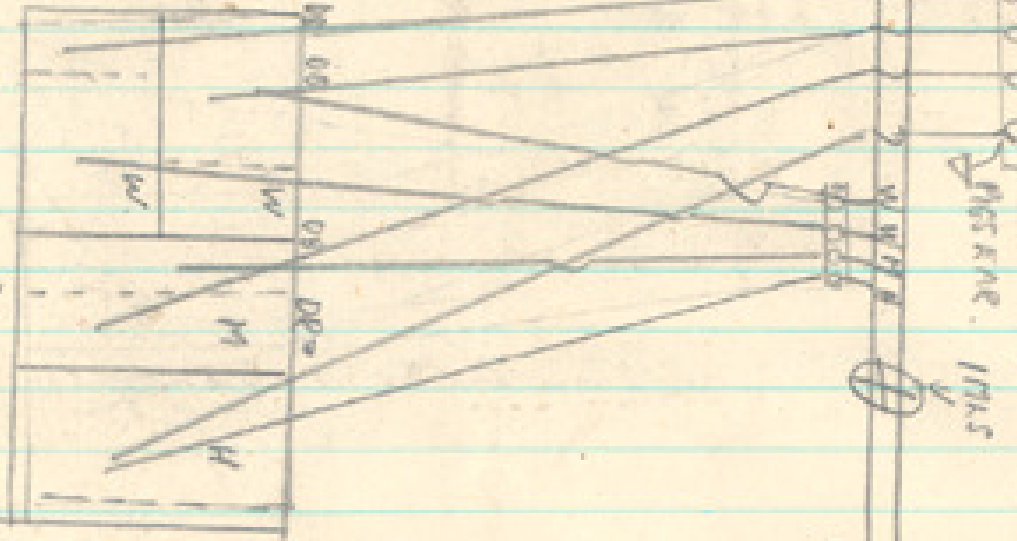
3 POS
CATER
CAPS

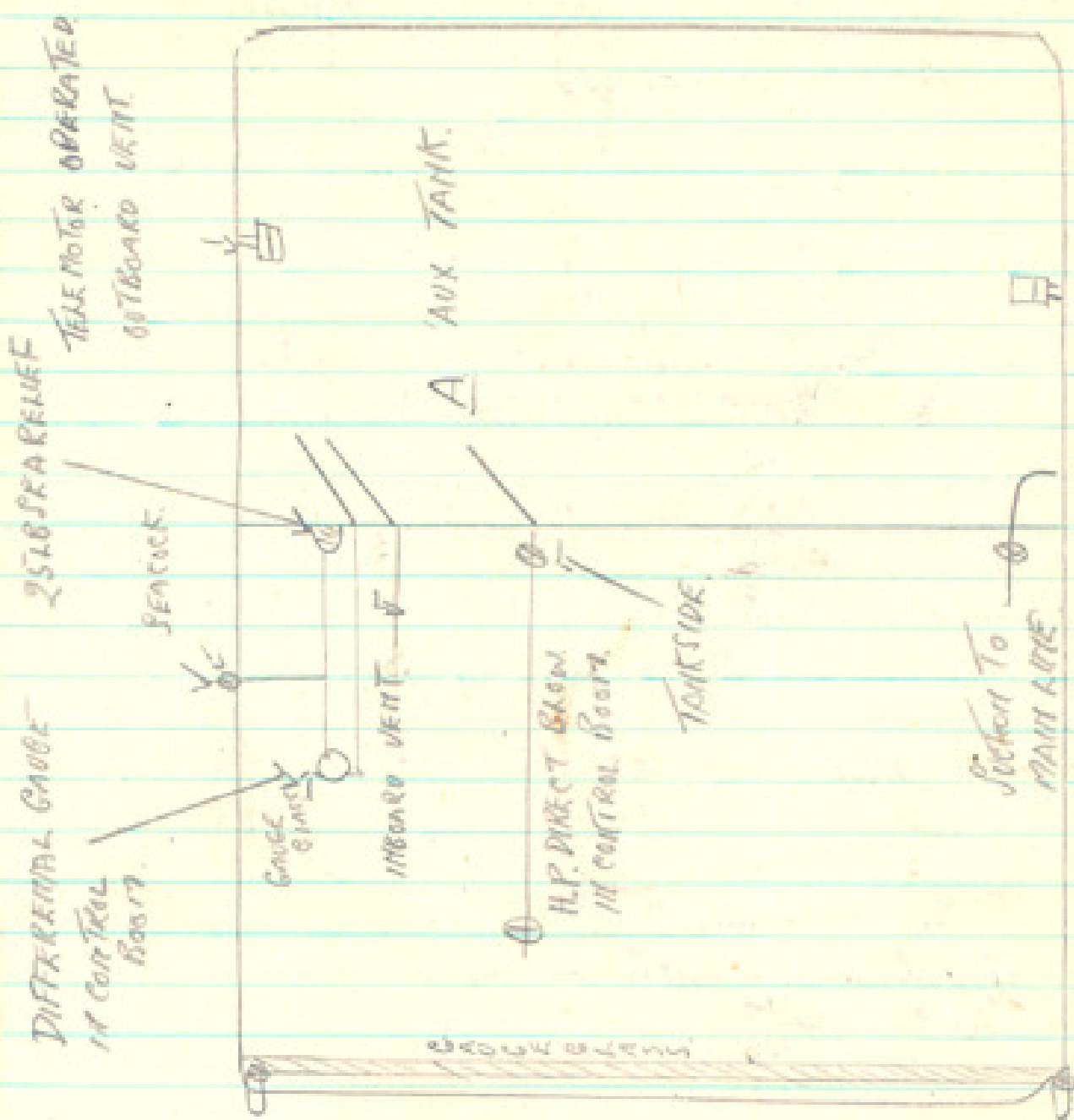
PUMP

FOR
SOL
AFT
SOL
SEA
SOL

SEA DISCHARGE

COMPENSATING
TANKS





AUXILIARY TANK A. and Z.

Are used to balance the submarine on a
central line fore and aft, for final trim
adjustments, that is, putting the floating
equipment to the neutral buoyancy.

Fittings in the tank are eight in number.

1/ Helicopter operated outboard vent which is

2/ operated from the control room on auxiliary panel.

A three position lever, Helicopter operated
from control room on the auxiliary panel.

3/ Section to the main line.

4/ outboard vent.

5/ gauge glass.

6/ H.P. direct blow, with Tankside, operated
7/ from Control room on Auxiliary Blowing panel.

8/ 25 lb sea relief valve.

Differential gauge, situated in control room
above H.P. direct blow.

Three position lever used for quick

blowing and flooding when blowing with
the D lever at its blow position, it
will bring the submarine to a state of

neutral buoyancy in the shortest possible time.

To take water into an auxiliary tank.

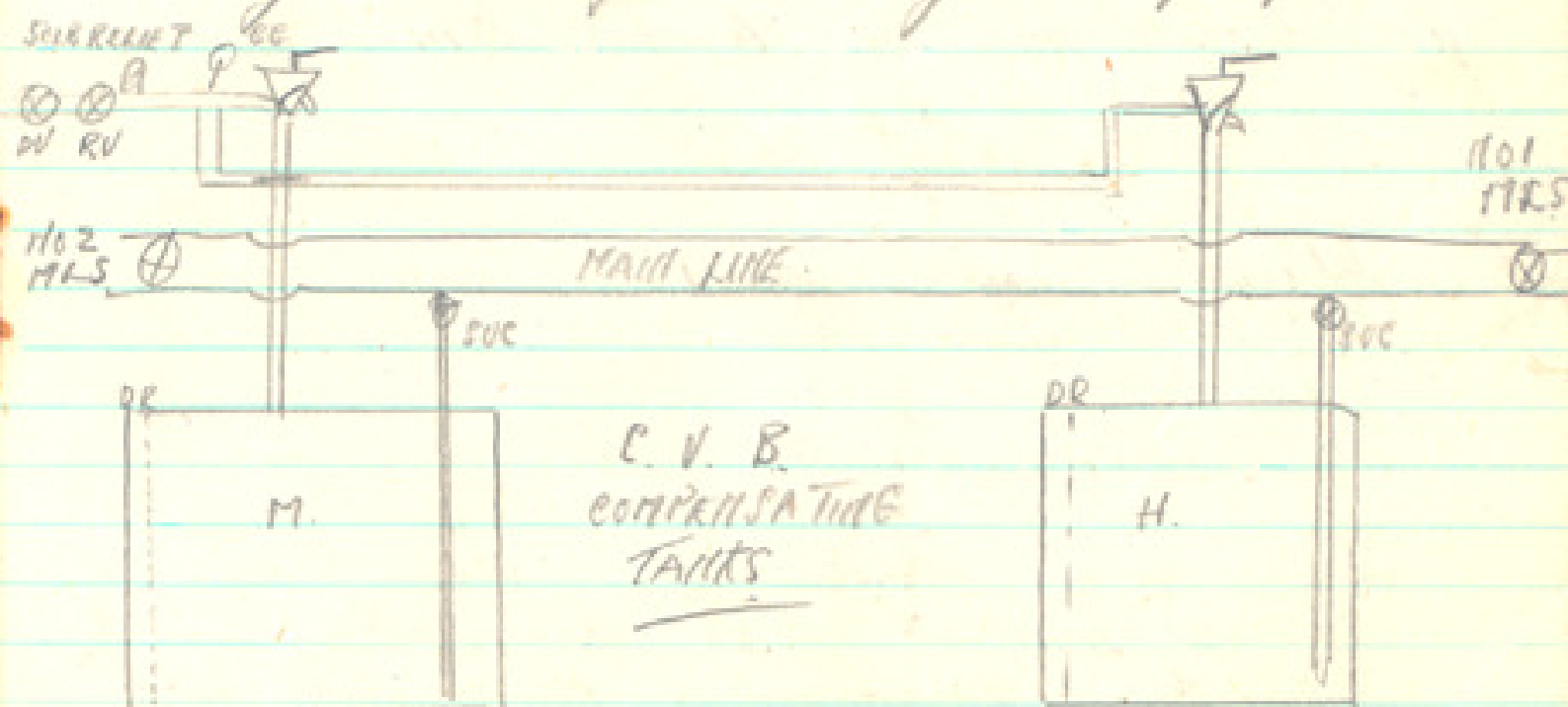
1/ Open the Kingston and Lobeater vent.

2/ Open the suction and inboard vent and flood from the sea through the 6 valve chest and the main line.

To take water out of an auxiliary tank.

1/ By putting the 3 position Kingston to Blow and blowing with HP air from the auxiliary panel in the control room.

2/ Open the suction and inboard vent and pump through the main line overboard, by means of the drydock pump.



COMPENSATING TANKS

H. 17. W. R. W. S. T. X.

Tested to 50 lbs.

Used to keep weight of submarine constant with loss or gain in weight (Fuel fresh water provisions etc) by putting in or taking out from these tanks.

FITTINGS on COMPENSATING TANKS

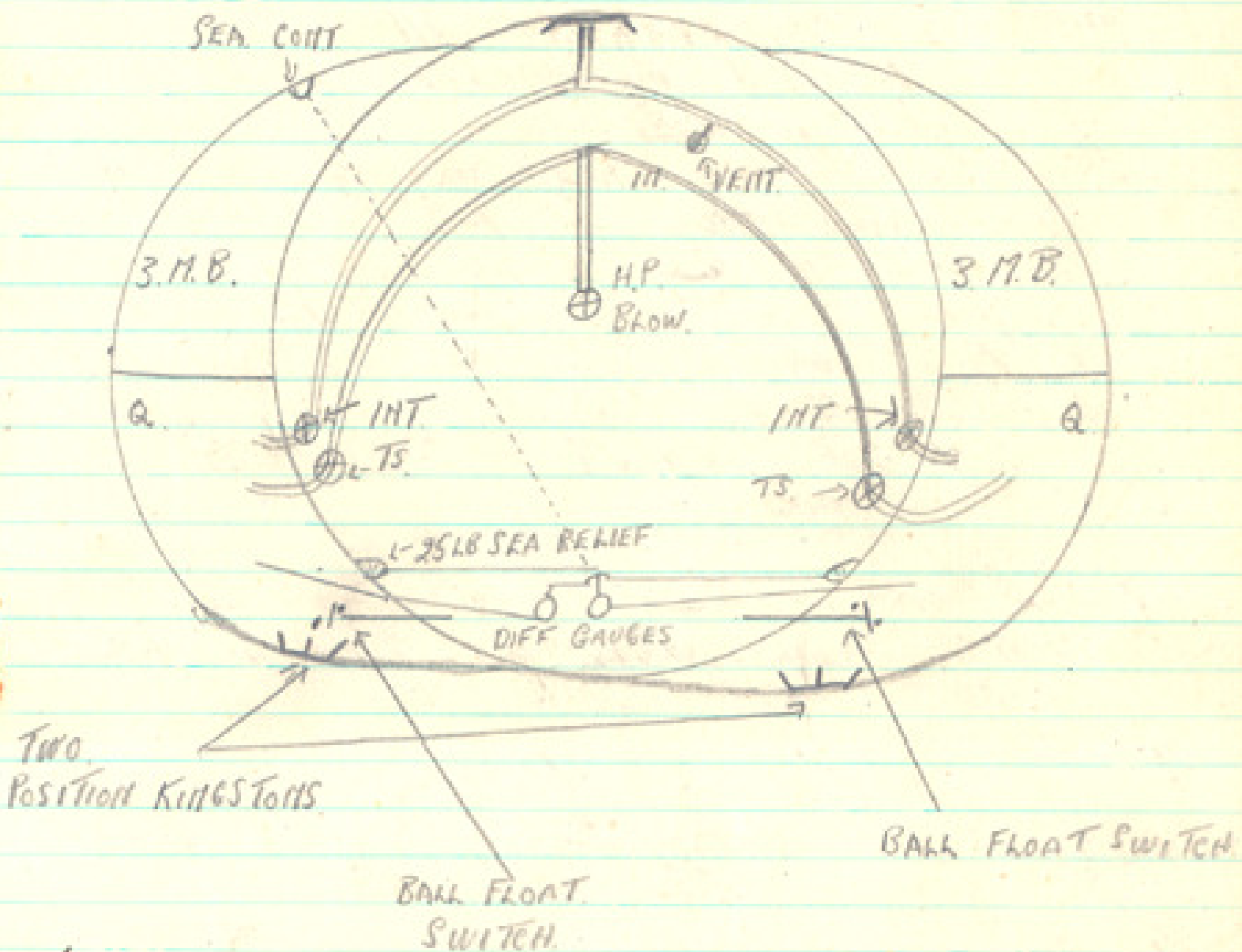
- 1/ A dip rod for measuring amount of water in the tank
- 2/ Suction to main line the only way by which water can be put in or taken out of these tanks.
- 3/ Combined vent and blow cocks water the tank common with other submersible vent or 50 lb. blowing station.

TWO WAYS OF PUTTING WATER INTO THESE TANKS

- 1/ By putting combined vent and blow to vent, open suction, and flood in from the sea, through 6 valve hose.
 - 2/ By putting in or blowing it from another tank.
- Two ways of taking water out.
- 1/ By pumping it out to sea.

or into another tank.
 2/ By blowing it out to sea, or into another
 tank. Comp. tanks are not directly
 connected to the sea.

HAND OPERATED O.V. Q. P. AND STAR.



A. Tank.

A Tank is a quick diving tank and is situated underneath No 3 main ballast (actuator). It must be capable of being flooded and blown very quickly. When flooded it gives the submarine ten tons negative buoyancy. And is usually flooded or blown by order of the Captain. Before reaching the depth ordered, it is blown so as to maintain a state of neutral buoyancy at that depth.

Ball float switches are fitted near the bottom of the tank. When blowing, these indicate when the tank is nearly empty and so prevent sending a bubble to the surface and giving away your position. Switch operates when there is only 300 galls left in tank.

FITTINGS ON A.T.

- 1/ Two way tele meter Kingston.
- 2/ Hand operated outboard and inboard vent.
- 3/ H.P. Blow with Tankwater.
- 4/ 25 lb sea relief.
- 5/ Differential Gauge.

6/ Ball float switches.

In lighter submarines it can be pumped out in main line, the object of this is to ensure that A is completely empty and at the same time obviate the danger of giving a bubble to the surface if completely emptying A by means of draining.

TANKS WHICH CAN BE PUMPED OUT AFT

A and Z auxiliaries

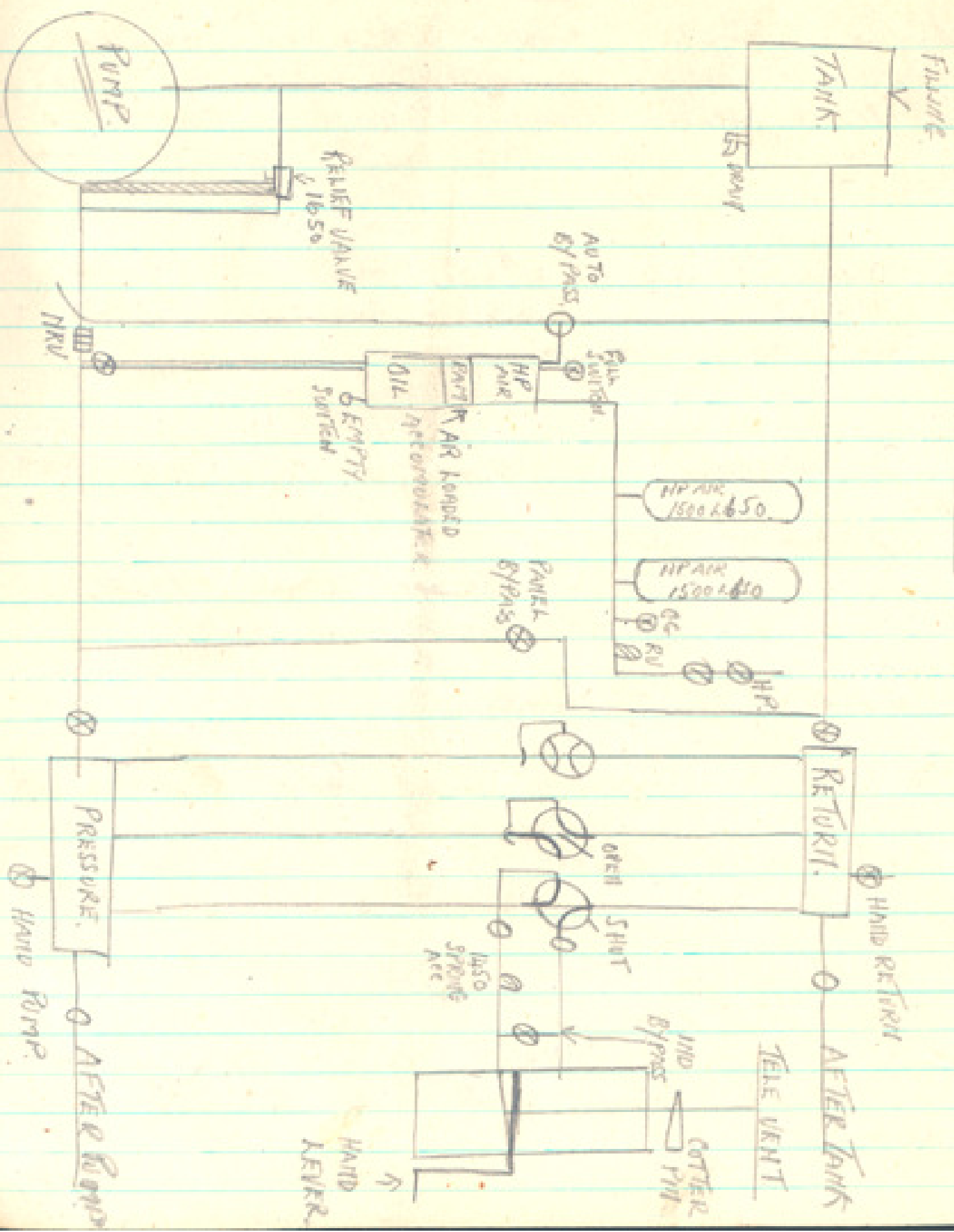
H. 17. W. W. P. and St and X compensating tanks.

also the magazine, battery tanks, conning tower, gun tower, dalgas, log tank and engines.

Magazine and Battery tank masters are always kept locked.

There are 4 types of valves on the main line

TANK MOTOR SYSTEM



TELEMOTE SYSTEM (DARK BLUE)

Telemeter is a system where oil under pressure is used to operate telemeter units, i.e. Telemeter vents, telemeter, levers, Bow caps, Torpedo lifting press. WT mast, periscopes, and engine clutches.

PUMPS

2 electrical and 1 Hand. Used for building up a pressure in the system from the tank.

AIR LOADED ACCUMULATOR

Allows a storage of oil to be built up under an air pressure so that the pump may be rested.

AUTOMATIC SPILLS

releases excess pressure when an loaded accumulator is fully charged.

AUTOMATIC PISTONS

Indicate when pressure is available, or accumulator empty.

NO.1 RETURN VALVE

Prevents a flow back through the pump.

1650 lb Spring relief

Prevents a greater pressure than 1650 lbs being built up in the system.

PRESSURE AND RETURN VALVES

Isolate pumps not in use.

PAUSE BY PASS

for equalizing pressure on the system quickly.

"D" LEVERS

for operating liberator units.

LOCKING VALVES

Locks a pressure on the unit when system is not in use.

1450 lb Spring Accumulator

Maintains a pressure on the shut side of unit, compensating for any leaks.

INDIVIDUAL B/PASS

Equalises pressure of on both sides of a unit so that it may be operated by Hand lever with 'D' lever in Neutral position.

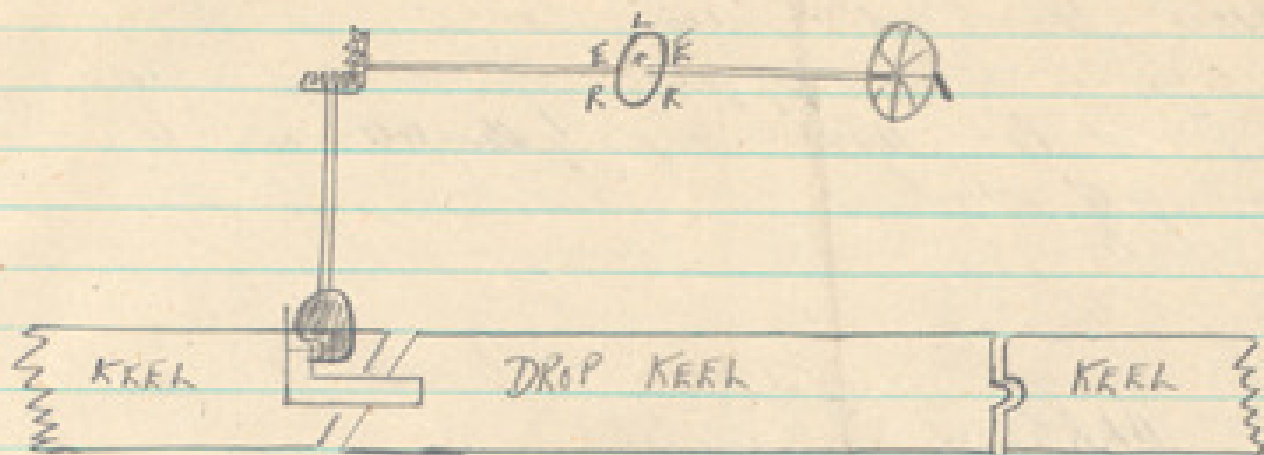
POTTER PHS

Locks vents shut in harbour to put pressure on the system.

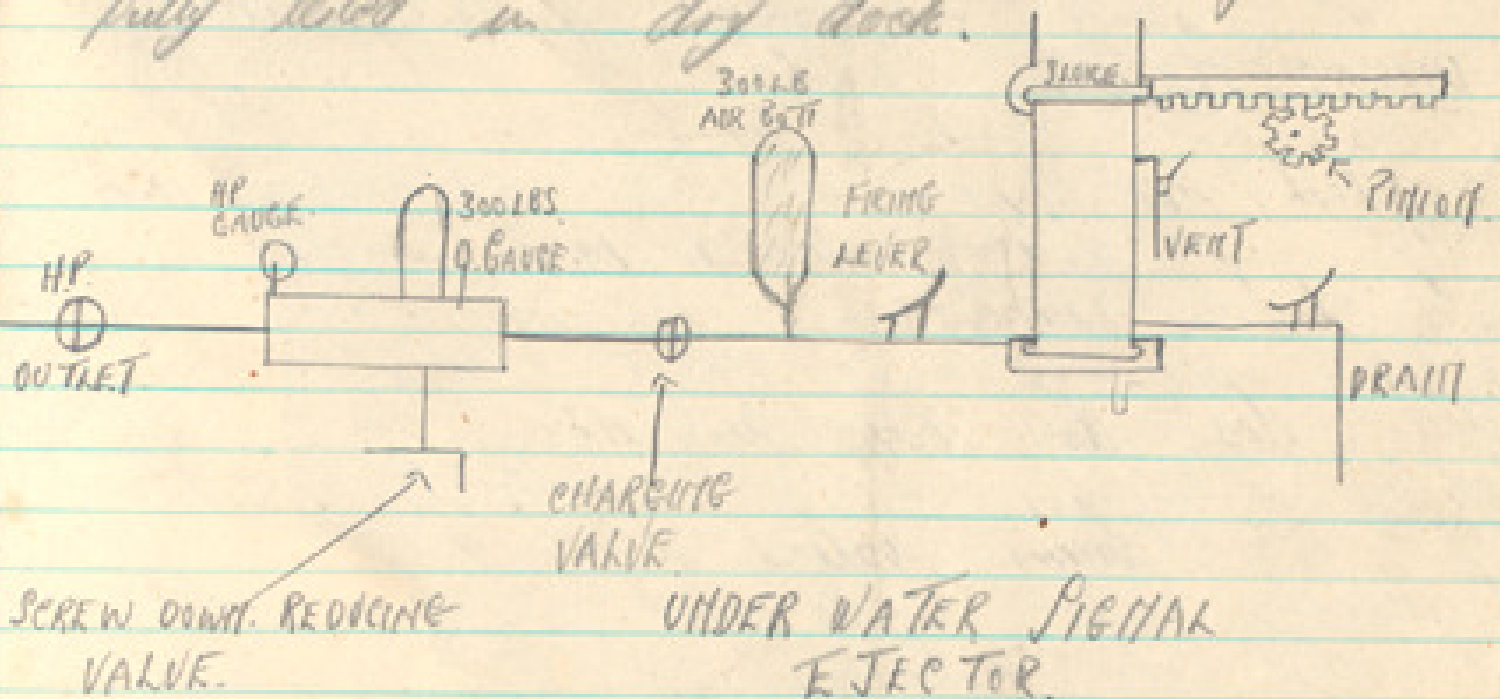
1/ Start the pump in use.

2/ Open locking valves required.

DROP KEEL



The keel of an "S" Boat is 120 tons, the centre section of which is detachable and weighs 10 tons. This may be released in an emergency to give the submarine 10 tons positive buoyancy. It is operated by a wheel in the control room, which is kept locked in harbour by a buffer stop and padlock and is unlocked when preparing for diving. It is greased and tested weekly and fully tested in dry dock.



UNDER WATER SIGNAL EJECTOR

is used to fire white or yellow smoke candles to the surface by air pressure. Drill for its use is printed on a board and hung alongside the ejector and should not be memorised.

ROU TIMES

HARBOUR STATIONS

Prepare for sea

- 1/ Test all machinery.
- 2/ Take and log the battery readings.
- 3/ Shut the ships and battery ventilation.
- 4/ Shut the tube space doors.
- 5/ Shut and clip all latches except the coaming lower latch.
- 6/ Start the steering motor.
- 7/ Put air on the navigation whistle.

DIVING STATIONS

- 1/ Check the ships and battery ventilation shut.
- 2/ Open up and put pressure on the telemeter system.
- 3/ Put air on the direct blow.
- 4/ Unlock the drop keel.
- 5/ Open Kingstons on No 2 and 4 Port and Star ocean ballast.
- 6/ Unlock upper seats.
- 7/ Check the Tanksides open.

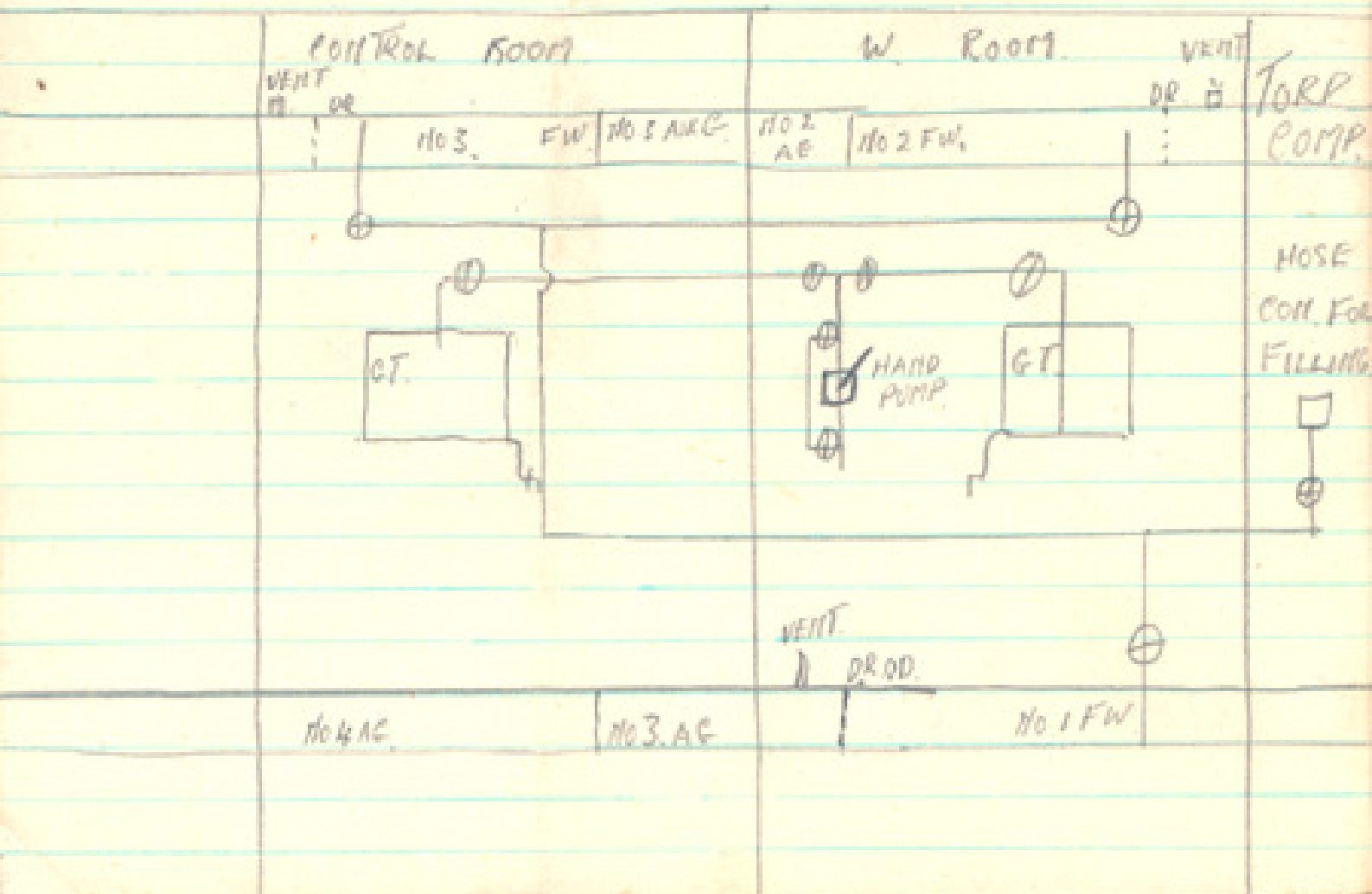
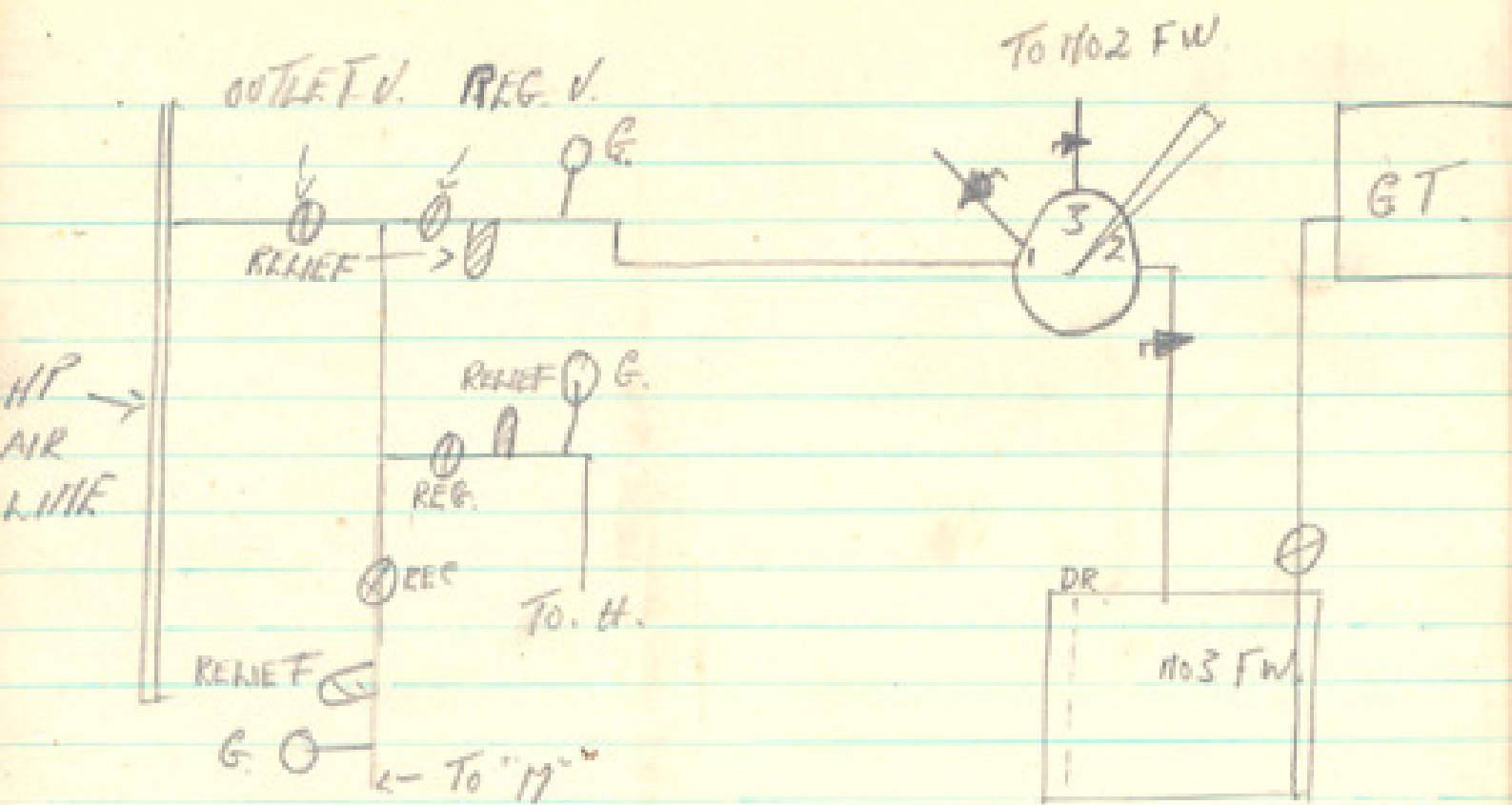
- 10/ Drain down and open the bridge voice pipe.
 - 11/ Open the W.T. trap hatch
 - 12/ When sufficient buoyancy, stop the blowers and shut L.P. master blow.
- SECURE FROM DIVITE

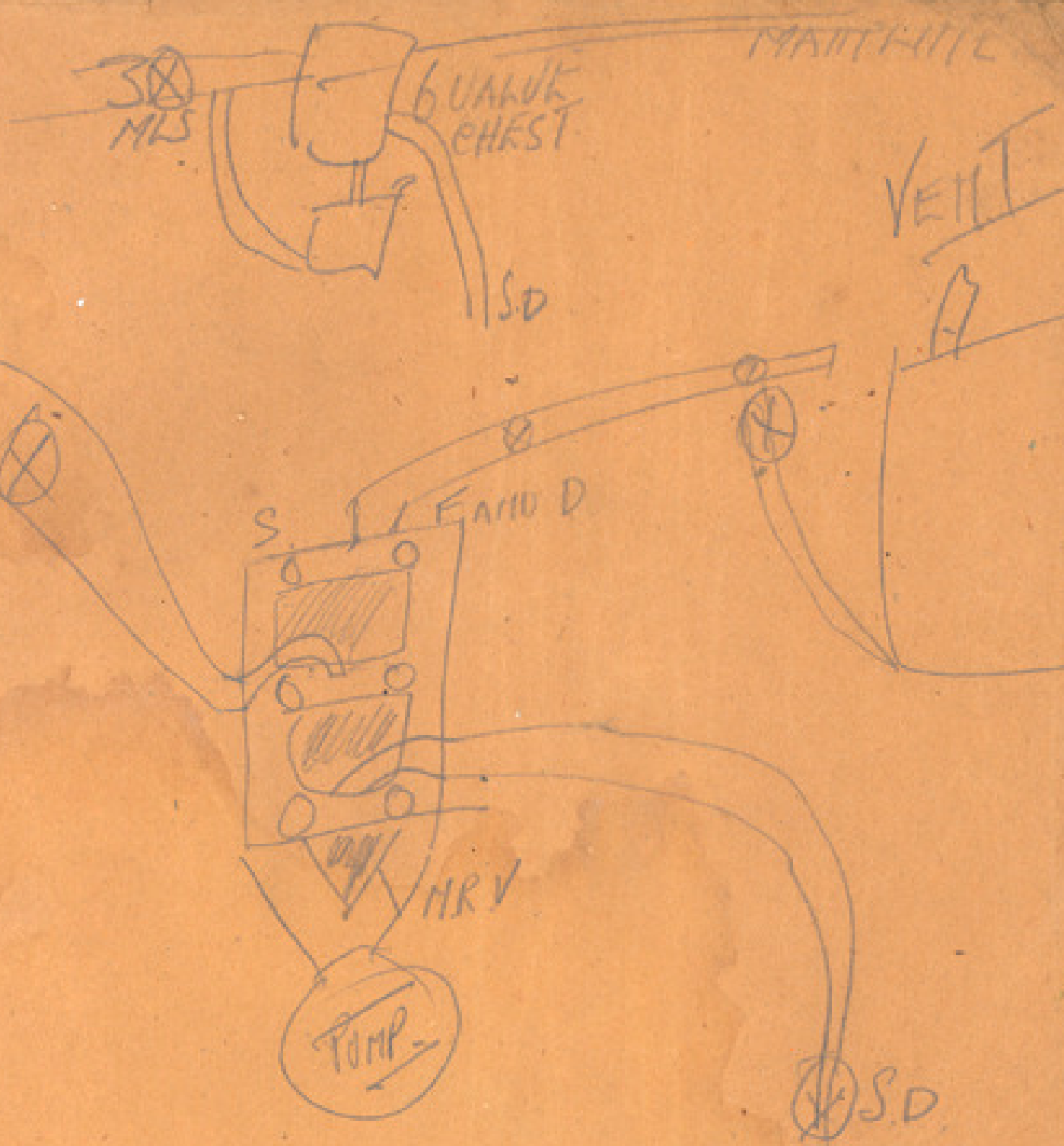
- 1/ Open L.P. master blow
 - 2/ Open the blowers outlets, and start the blowers
 - 3/ When full buoyancy stop the blowers and shut L.P. master blow
 - 4/ Take pressure off the telemeter system.
 - 5/ Take air off direct blowers.
 - 6/ Lock the air reel.
 - 7/ Shut main ballast longitudinal 2 and 4 to and star.
 - 8/ Close main vents.
 - 9/ Raise the wireless mast.
 - 10/ Change over to upper steering.
 - 11/ Put air on the navigators whistle.
- NIGHT ALARM

The signal is a number of flares on a low side buoy, the object of night alarm, is to carry out an attack whilst the submarine is on the surface, the state of the submarine at night is a standing charge on one side and signalling on the other, at least two torpedo tubes are blown up (at the Captain's discretion) and at the standby position.

One fore-end man closed up in the fore
end, Helmsman on the wheel, messenger
in the control room. Officers of the watch
and lookouts on the bridge, engine room
staff in the engine room and L.T.O. in
the under room, should any enemy ship
be sighted, the officer of the watch will
pass the order to the control room,
"Alarm, Alarm, Alarm", the helmsman presses
the night alarm button, all hands then
close up at diving stations, the K.R.A. of
the watch and the L.T.O. break the
charge, the K.R.A. stops the engine propelling
out engine clutch and in start clutch on
the charging side, the L.T.O. reports to the
control room when the main suction are
ready grouped up. The object of stopping
the main engines is to approach the
enemy as silently as possible, and also
the S/P is ready for instant diving.
The messenger puts both telegraphs to
"Stop" and then to whatever ordered by
the captain. Do not open main vents.
The fore-end man brings the stand-by
tubes to the ready, and reports and
stand-by to fire. In some S/P's, the
Captain's orders are, at the order night
alarm, the gun crew close up in the
gun tower, the Captain then carries out
the attack, passing the necessary orders

down the voice pipe to the helmsman, who
reports them to the officer working the attack
machine if during the attack the order is
passed. Dive, dive, dive, the normal crash
dive routine will be carried out.





METRIC MEASURES

Kilo- (1,000)	Hecto- (100)	Deka- (10)	Gramme (g) Metre (m)	Deci- 1/10	Centi- 1/100	Milli- 1/1,000
Kg. Km. Kl.	Hg. Hm. Hl.	Dg. Dm. Dl.	Litre (l)	dg. dm. dl.	cg. cm. cl.	mg. mm. ml.

(Note.—dm. with a small "d" is a decimetre = 1/10 of a metre.

Dm. with a capital "D" is a Decimetre = 10 metres.)

There are certain connections between the metric system and the British measures.

(They are only approximate.)

1 cm. = rather less than 2/5 in.	1 KM. = 5/8 mile or 5 furlongs.
1 m. = 39.37 ins. (rather more than a yd.)	1 l. = 1 1/2 pt. (rather less than 1 quart).
1 g. (.032 oz.) is the weight of 1 cc. of water.	1 Kg. = 2 1/2 lb.
1 cu. ft. of water = 6 1/2 galls. (approx.)	1 Hl. = 22 galls. (approx.)

WEIGHT

16 ounces (oz.)	= 1 pound (lb.)
14 lb.	= 1 stone
28 lb.	= 1 quarter (qr.)
4 qrs. or 112 lb.	= 1 hundredweight (cwt.)

20 cwt. or 2240 lb.	= 1 ton
1 lb. or 100 stone	= 1 ton
(Meat—) 14 lb. live : 8 lb. dead	= 1 stone

INDIAN WEIGHT

5 Toles	= 1 Chittack (2 oz. approx.)
16 Chittacks	= 1 Seer (2 lb. approx.)
40 Seer	= 1 Maund (80 lb. approx.)

SQUARE OR AREA MEASURE

(used to measure surfaces)

144 sq. in.	= 1 sq. ft.
9 sq. ft.	= 1 sq. yd.
484 sq. yd.	= 1 sq. ch.
1210 sq. yd.	= 1 rood
4840 sq. yd. or 4 roods or 10 sq. ch.	= 1 acre.
640 acres	= 1 sq. mile.

(N.B.—Six square feet must not be confused with six feet square.)

1 Hectare (Ha.)	= 100 ares = 2 1/2 acres (approx.)
100 Ha.	= 1 Sq. Km.

A football pitch is 1 1/2 acres (approx.)

To measure the surface of a rectangular shape it is necessary to multiply length by breadth (expressed in the same unit).

LENGTH

12 inches (in.)	= 1 foot (ft.)
3 ft.	= 1 yard (yd.)
22 yds.	= 1 chain (ch.)
	(length of cricket pitch)
10 chs. or 220 yds.	= 1 furlong (fur.)
8 fur. or 1760 yds. or 5280 ft. or 63360 ins.	= 1 mile.
3 mi.	= 1 league.
3 ft.	= 1 fathom.
A nautical mile	= 2025 1/2 yds.
A cable's length	= 1/10 nautical mile (taken as 200 yds.)

CUBIC MEASURE

(used to measure solids or volumes)

1728 cubic inches	= 1 cu. foot.
27 cu. ft.	= 1 cu. yard.
128 cu. ft. (a heap approx. 6' x 4' x 5')	= 1 cord of wood.

To measure the volume of a solid it is necessary to multiply together length and breadth and thickness (expressed in the same unit).

TROY WEIGHT

(For Gold, Silver and Jewels)

24 Grains	= 1 Pennyweight (dwt.)
20 Pennyweights	= 1 ounce (oz.)
12 ounces	= 1 Pound (lb.)

LIQUID MEASURE

4 gills	= 1 pint (pt.)
2 pts.	= 1 quart (qt.) (it is a quarter of a gallon).
4 qts.	= 1 gallon (gall.)
36 galls. (beer)	= 1 barrel.

DRY MEASURE

(Corn, etc.)

2 galls.	= 1 peck (pt.)
4 pks.	= 1 bushel (bush.)
8 bush.	= 1 quarter (2 sacks).
1 bush. (oats) weighs 40 lbs. (average)	
1 .. (barley) .. 50 lbs.	
1 .. (wheat) .. 60 lbs.	
1 sack flour weighs 280 lb. (approx.)	

MONEY

12 pence	= 1 shilling (1/-).
100 pence	= 8/4.
240 pence	= 1 pound (£1).
1000 pence	= £13.4.
10/-	= 1/2 £ or .5 of £1.
5/- (crown)	= 1/4 £ or .25 of £1.
2/-	= 1/5 £ or .2 of £1.
2/6 (half a crown)	= 1/10 £ or .125 of £1.
2/- (shilling)	= 1/20 £ or .1 of £1.
1/4	= 1/40 £ or .025 of £1.
1/3	= 1/30 £ or .033 of £1.
1/-	= 1/100 £ or .01 of £1.
6d.	= 1/200 £ or .005 of £1.

To convert shillings to decimal of £ multiply by 5 and divide by 100.

To convert decimal of £ to shillings divide by 5 and multiply by 100.

French 100 centimes =

1 franc (124-25 to the £ roughly)

American 100 cents =

1 dollar (4-86 to the £ roughly)

Indian { 3 Pies = 1 Pice.

12 Pies or 4 Pice = 1 Anna.

16 Annas = 1 Rupee (= 1/5).

German 100 Pfennige =

1 Mark (20-43 to the £ roughly)