TRIESTE II (DSV 1) QUALIFICATION NOTEBOOK

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BATHYSCAPH TRIESTE

ETC(SS) N.J. BRANDT

TRIESTE II (DSV-1)

QUALIFICATION

NOTEBOOK

2- INSTRUCTIONS

CONTENTS / INST.

TRIESTE II (DSV-1)
FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA 96601

TRIESTE II (DSV-1) INST 1414.3A
FG9/DSV1/JKN:gas
23 April 1977

TRIESTE II (DSV-1) INSTRUCTION 1414.3A

From: Officer In Charge, TRIESTE II (DSV-1)
To: Distribution

Subj: TRIESTE II (DSV-1) Operator Qualification; promulgation of

Ref: (a) COMSUBPACINST 1540.4
(b) COMSUBDEVGRUONEINST 1540.4

Encl: (1) Requirements for Qualification for Navy Operators of TRIESTE II (DSV-1)

1. Purpose. To promulgate procedures for qualification as a TRIESTE II (DSV-1) Operator.

2. Cancellation. TRIESTE II (DSV-1) Instruction 1414.3 dated 21 FEB 1975.

3. Discussion. References (a) and (b) discuss and delineate the requirements for qualification and certification as an operator of a deep submergence vehicle. Enclosure (1) is a consolidation of these requirements for qualification in TRIESTE and is to be utilized by operator candidates.

4. Action. The following procedures and requirements shall be followed for certification as an operator of TRIESTE II (DSV-1).

a. Certification Requirements. In accordance with references (a) and (b), and this instruction the operator candidate must complete the following requirements for operator certification:

(1) The candidate must be qualified in submarines.

(2) The candidate shall have completed enclosure (1) to this instruction.

(3) The candidate shall have demonstrated that he is tempermentally suited for submersible duty and that he possesses satisfactory qualities of good judgment and leadership.

(4) The candidate shall have demonstrated his knowledge of and capability to operate TRIESTE II (DSV-1) under normal and emergency conditions.

(5) The candidate shall have served onboard for duty for a minimum of three months, none of which may be spent in a shipyard or equivalent maintenance period.

(6) The candidate must be recommended by the Officer In Charge.

(7) The candidate must successfully pass an oral examination administered by a Certification Board appointed by COMSUBDEVGRU ONE. In addition, he shall be observed on at least one dive by a member of the Certification Board.

b. Certification Procedure.

(1) Candidate. Within six (6) months after reporting on board for duty as a submersible operator, the candidate shall submit to the Officer In Charge the documentation required to establish satisfactory completion of requirements (2) and (4) in paragraph 4.a.

(2) Officer In Charge.

(a) Review the written and practical factor requirements submitted by the candidate for accuracy and completeness.

(b) Submit a letter in accordance with reference (b) to COMSUBDEVGRU ONE, requesting the candidate be certified as an operator of TRIESTE II (DSV-1).

c. A copy of the operators completed qualification card (Enclosure (1)) shall be retained as a permanent record.

J. K. NEWELL

Distribution:
AOIC
Operator Candidates

REQUIREMENTS FOR QUALIFICATION FOR NAVY OPERATORS OF TRIESTE II (DSV-1)

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REQUIREMENTS FOR QUALIFICATION FOR NAVY OPERATORS OF TRIESTE II (DSV-1)

SECTION I. CHARACTERISTICS AND STABILITY.

1. Derive the following tactical characteristics and fully explain your work:

    a. Maximum sustained speed.

    b. Endurance at maximum speed.

    c. Cruising speed.

    d. Endurance at cruising speed.

2. List maximum turning rate and maximum controlled ascent and descent rates of the vehicle.

3. List the following characteristics:

    a. Length overall with bow frame.

    b. Beam of float.

    c. Breadth at wing motors.

    d. Height of mast extended ABL.

    e. Height of sail ABL.

    f. Height forward skeg BBL.

    g. Height after skeg BBL.

    h. Draft (ABL at stem & stern):

        (1) no gas, no shot
        (2) gas, no shot
        (3) gas, shot

    i. Dry weight.

    j. Ready to submerge displacement.

    k. Submerged displacement

    l. Depth capability

4. Inclining experiment.

    a. Define metacetric height and briefly explain its significance.

b. Describe the variation of metacentric height during gassing and shotting.

c. List the changes in displacement from dry launch through gassing, shotting and submerging.

d. Describe how lead ballast is used on board.

5. List and discuss aviation gasoline safety precautions.

SECTION II. HULL CONFIGURATION.

1. Describe the hull configuration, including the sphere, float, access trunk, sail, stabilizers and skegs, explaining the reasons for the shape and materials used in construction.

2. Sketch the following:

a. Topside arrangement.

b. Bottomside arrangement.

c. Sail arrangement.

3. Sketch and describe:

a. Tank arrangement.

b. AVGAS filling and pumping system.

c. AVGAS tank vent and drain system.

d. Nitrogen inerting system.

4. List all tanks and their capacities.

5. In one sketch show the:

a. blow and vent system,

b. flood and drain system,

c. 3,000 psi air system,

d. ballast tanks, electrical compensation tank and access trunk.

SECTION III. PRESSURE COMPENSATING SYSTEMS.

1. List the various compensating fluids used, describe the significant physical qualities of each, and describe the characteristics used to identify them. Explain any special reasons for the choice of a fluid for a particular application.

2. Describe the filling procedure for the various liquid-compensated systems.

3. Sketch and describe the pressure compensation system for the following:

a. 24 Volt and 120 Volt batteries.

b. Propulsion motors.

c. Motor contractors and battery breakers.

d. External electronic sensors.

e. Maneuvering gasoline tanks.

f. Main gasoline tanks.

g. Vent domes.

h. Equipment Compensation Tank.

i. Ante Chamber.

SECTION IV. LIFE SUPPORT.

1. Sketch and describe the main life support system.

2. Sketch and describe the emergency breathing system.

3. List and describe the atmosphere monitoring equipment.

4. Derive the capacity of the oxygen systems in man-hours for the conditions given:

a. main life support system

flow rate = 1.5 slpm
cabin pressure = 14.7 psia

(1) oxygen flask pressure = 1800 psig.

(2) oxygen flask pressure = 2250 psig.

b. Emergency breathing system

flow rate = 0.9 slpm (demand valve not actuated)
cabin pressure = 14.7 psia

(1) oxygen flask pressure = 1800 psig.

(2) oxygen flask pressure = 2250 psig.

5. Derive the CO_2 absorption capacity in man hours for a standard can of LiOH.

SECTION V. SILVER-ZINC STORAGE BATTERIES.

1. Battery.

a. What types are installed? What are their ratings?

b. How do you determine if a cell is contaminated?

2. List the various prescribed types of battery charges, explaining the purpose of each and briefly describing the charging procedures.

3. Discuss the following as related to battery charging:

(1) Watches.

(2) How is it determined that a charge is needed?

(3) What are the requirements for completion of a charge?

(4) How is resistance to ground determined?

(5) Does a silver-zinc battery evolve hydrogen? Is equipment available on board to measure it?

4. List and explain the safety precautions which must be observed in conducting a battery charge.

5. How can you determine the "state of charge" of the battery?

6. What are the procedures for exchanging the silver-zinc batteries in the sphere?

7. List and describe the maintenance requirements for a silver-zinc battery.

8. List the on board equipment using internal dry cell batteries.

SECTION VI. ELECTRICAL SYSTEMS AND PROPULSION.

1. Sketch the following systems. Completely label all components.

a. 120V D.C. power distribution system.

b. 24V D.C. external power distribution system.

c. 24V D.C. sphere power system and essential power system.

d. 60Hz power distribution system.

e. 400Hz power distribution system.

2. Describe the propulsion system including the motors, controllers and the propulsion control panel.

SECTION VII. AUXILIARY SYSTEMS.

1. Describe the ballast control system as follows:

a. Sketch and describe the maneuvering valve circuits;

b. Sketch and describe the shot valve circuits;

c. list the shot silo capacities;

d. sketch and describe the jettison circuits;

e. list the jettisonable items and weights;

f. describe the trail ball system;

g. briefly describe the remaining ballast control panel features.

2. Sketch and describe the manipulator including the hydraulic system and electrical control system.

3. Describe the bow winch.

4. Describe the installed depth sensors.

SECTION VIII. COMMUNICATIONS AND DATA GATHERING.

1. List and describe the installed communications equipment.

2. Sketch and describe the following:

a. multiplex system;

b. external lighting system;

c. television system including pan and tilt units;

d. 70mm camera system.

3. Prepare a list of all external lights including designation, type, power and beam width.

4. Briefly describe the sound velocimeter.

SECTION IX. SONAR AND NAVIGATION.

1. Sketch the navigational lights.

2. Discuss the gyro installation. What equipments receive inputs from the gyro and how do they use it.

3. Discuss the Doppler sonar system.

4. Discuss the navigation system.

5. Discuss the beacon release system.

6. List the sonar equipment on board giving:

a. Purpose.

b. General characteristics.

c. Transducer/hydrophone location.

d. Frequency range.

e. Information presentation.

f. Power source.

7. Describe the following transponders in terms of typical use, size, weight, maximum depth, frequency, operating life, launcher requirements, and maximum observed range:

a. Straza Model 7030B

b. Straza model 7030C

c. Straza model 7040

d. Bendix AN/BQN-8

e. AMF model 325

8. List the navigation and control (excluding propulsion and ballast) equipments vital for the successful completion of a mission.

SECTION X. TRANSPORTATION AND LAUNCHING.

1. Sketch and describe the various methods of transporting and loading the vehicle. Include safety precautions and pecularities of each method.

2. List the preparations for getting underway:

a. From port under tow.

b. From support ship.

SECTION XI. DUTY OFFICER AND SECURITY WATCH DUTIES.

1. What items or components of the vehicle are checked by the Duty Officer and Security Watch when the vehicle is:

a. Waterborne in port.

b. On land.

c. In the dockwell of the support ship.

d. Under tow.

SECTION XII. CERTIFICATION.

1. Discuss system certification requirements including action required to initially certify equipment, action required to replace previously certified components, requirements to sustain certification, and the applicability of quality assurance procedures to sustaining system certification.

2. Discuss PMS and its importance to sustaining system certification.

3. Discuss the dive log and its importance to sustaining system certification.

4. What are the probable effects of an implosion of a pressure resistant component?

5. Where is the central file for blueprints and test specifications for the vehicle maintained?

6. List the equipment within the scope of certification.

SECTION XIII. PILOT ACTIONS.

1. What action should be taken by a pilot in the following situations?

a. TRIESTE is descending at 2.5 fps when quite suddenly the depth rate falls off to zero and the computer depth display stops changing. You have not bottomed. What do you check first? If you have settled on a layer, what are your options?

b. While making a bottom approach at 30 ft. altitude you begin to ascend and your co-pilot notifies you that shot is dribbling from the port shot valve. You wish to bottom.

c. At 200 ft altitude, with a +1.0 fps depth rate (you're going too fast) the navigator informs you that the ballast control panel breaker has tripped and cannot be re-set.

d. Within one mile of the dive site the charted depth varies from 16,000 ft to 19,000 ft. The OOD tells the COW during the pilot pre-dives that the best sounding they could get is about 18,000 ft. How will this affect your procedures during descent?

e. You are driving on the ball at 8070 ft. when the 120V D.C. battery breaker trips. You secure all 120V D.C. loads and re-close the breaker to take a ground reading. The breaker trips again right away. All ICV's are normal.

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REQUIREMENTS FOR QUALIFICATION FOR NAVY OPERATORS OF TRIESTE II (DSV-1)

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Enclosure (1)

I

SECTION I CHARACTERISTICS AND STABILITY

1. DERIVE THE FOLLOWING TACTICAL CHARACTERISTICS AND FULLY EXPLAIN YOUR WORK:

a. MAXIMUM SUSTAINED SPEED

b. ENDURANCE AT MAXIMUM SPEED

c. CRUISING SPEED

d. ENDURANCE AT CRUISING SPEED

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a. MAXIMUM SUSTAINED SPEED IS APPROXIMATELY THREE KNOTST ON THE PORT AND STARBOARD WING AND CENTERLINE MOTOR WITH THE VEHICLE FREE OF THE BOTTOM.

b. ENDURANCE AT MAXIMUM SPEED IS DERIVED FROM 75% BATTERY CAPACITY AND 60 AMPS PER PROPULSION MOTOR (X3):

$$\frac{952AH \times .75}{60A \times 3} = \underline{3.96 \text{ HOURS}}$$

c. CRUSING SPEED IS ABOUT 1.5 KNOTS ON THE CENTERLINE MOTOR. DESIGN PREDICTION WAS 1.95 KT.

d. ENDURANCE AT CRUISING SPEED IS DERIVED FROM 75% BATTERY CAPACITY AND 60 AMPS DRAWN BY THE CENTERLINE MOTOR ONLY:

$$\frac{952AH \times .75}{60A} = 11.9 \text{ HRS}$$

d. ENDURANCE AT CRUISING SPEED IS ABOUT 12 HOURS (SIB). 65 AMPS AND 714 AMP-HRS GIVES 11.14 HOURS ENDURANCE.

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2. LIST MAXIMUM TURNING RATE AND MAXIMUM CONTROLLED ASCENT AND DESCENT RATES OF THE VEHICLE.

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a. MAXIMUM TURNING RATE OF THE VEHICLE IS APPROXIMATELY 72° PER MINUTE USING AN OPPOSING WING MOTOR THRUST CONFIGURATION AND AIDED BY THE BOW THRUSTER. TESTS CONDUCTED IN 1973 BY LT. R.D. BAKER PROVIDE THE ONLY KNOWN DOCUMENTATION OF TRIESTE'S TACTICAL CHARACTERISTICS. FOUR RUNS WERE MADE USING VARIOUS PROPULSION COMBINATIONS:

(1) CLOCKWISE YAW USING ONLY OPPOSING WING MOTOR THRUST: TURNING RATE 1 DEGREE PER SECOND; ADVANCE 70FT, TRANSFER 170FT.

(2) COUNTER-CLOCKWISE YAW USING OPPOSING WING MOTOR THRUST: TURNING RATE ABOUT 1° PER SECOND; ADVANCE 45FT, TRANSFER 75FT.

(3) COUNTER-CLOCKWISE YAW USING ONLY THE BOW THRUSTER: TURNING RATE 0.35 TO 0.42 DEGREES PER SECOND; ADVANCE 20FT, TRANSFER 65FT.

(4) CLOCKWISE YAW USING OPPOSING WING MOTOR THRUST AIDED BY BOW THRUSTER; TURNING RATE 1.2 DEGREES PER SECOND; NO ADVANCE AND TRANSFER GIURN IN AVAILABLE DATTA.

b. <u>MAXIMUM CONTROLLED ASCENT AND DESCENT RATES</u> ARE SET FORTH IN TRIESTE II INSTRUCTION 5100.1A, SORM. TO DESCEND, DROP SHOT AS NEEDED TO MAINTAIN A DESCENT RATE OF 2.5 FEET PER SECOND. AT APPROXIMATELY 1200FT ABOVE THE BOTTOM COMMENCE SLOWING THE DESCENT RATE TO TOUCH DOWN AT NO MORE THAN 0.2 FEET PER SECOND. TO ASCEND DROP JUST ENOUGH SHOT TO LIFT OFF THE BOTTOM AND START THE ASCENT. THE ASCENT RATE WILL INCREASE WITH DECREASING DEPTH DUE TO EXPANSION OF GASOLINE IN THE FLOAT. HOWEVER, THE ASCENT RATE SHOULD NOT BE MORE THAN 2.5 TO 3.0 FEET PER SECOND.

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3. LIST THE FOLLOWING CHARACTERISTICS:

a. LENGTH OVERALL WITH BOW FRAME = 86 FT 4 5/8 IN

b. BEAM OF FLOAT = 15 FT 3 1/4 IN

c. BREADTH AT WING MOTORS = 18 FT 9 IN

d. HEIGHT OF MAST EXTENDED ABL = 29 FT 2 IN

e. HEIGHT OF SAIL ABL = 21 FT 3 IN

f. HEIGHT FWD SKEG BBL = 3 FT 6 IN

g. HEIGHT AFT SKEG BBL = 5 FT 8 IN

h. DRAFT (ABL AT STEM + STERN):

(1) NO GAS, NO SHOT = 4.73 FT FWD, 4.69 FT AFT
(2) GAS, NO SHOT = 12.5 FT FWD, 13.0 FT AFT
(3) GAS, SHOT = 13.31 FT FWD, 12.74 FT AFT

i. DRY WEIGHT = 73.89 TONS; THIS VALUE USED FOR STABILITY CALCULATIONS. HOWEVER THE ACTUAL WEIGHT WHICH SHOULD BE USED FOR ESTABLISHING LIFT WEIGHTS IS 84.65 LONG TONS OR APPROXIMATELY 190,000 LBS.

~~k~~ j READY TO SUBMERGE DISPLACEMENT = 272.5 TONS.

k. SUBMERGED DISPLACEMENT = 302.66 TONS

l. DEPTH CAPABILITY = 20,000 FT (6098 METERS)

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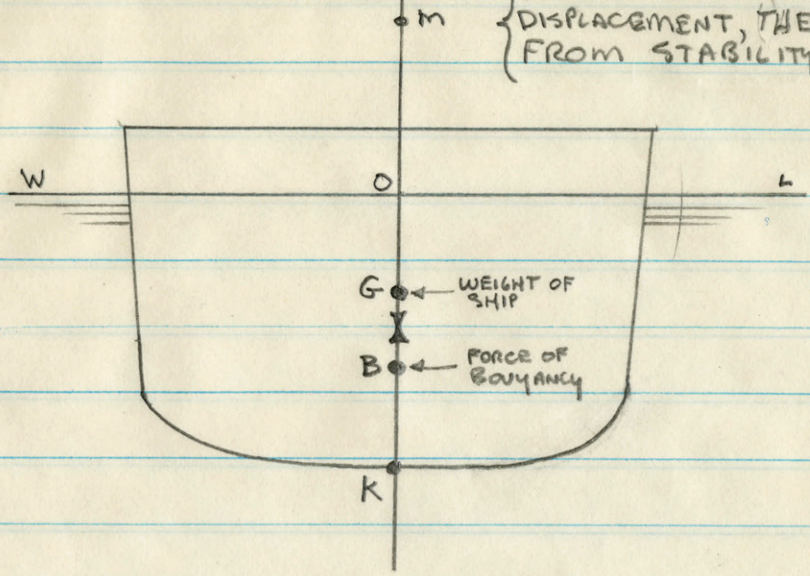
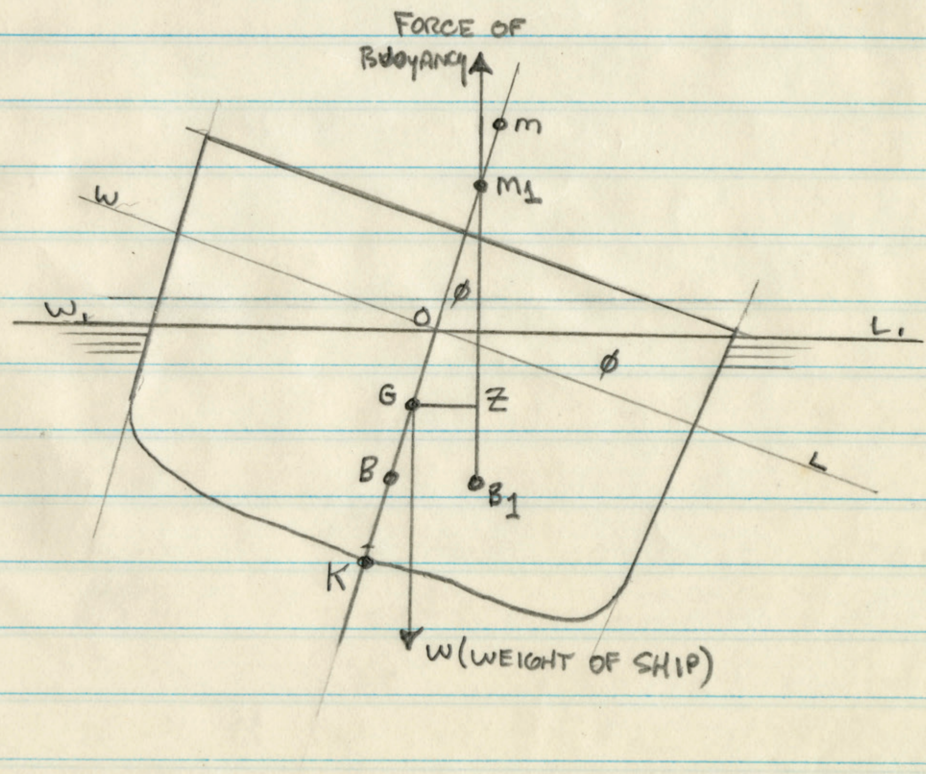
4. INCLINING EXPERIMENT.

a. DEFINE METACENTRIC HEIGHT AND BRIEFLY EXPLAIN ITS SIGNIFICANCE. THE METACENTER IS THAT POINT IN A FLOATING BODY AT WHICH A VERTICAL LINE DRAWN THROUGH ITS CENTER OF BUOYANCY WHEN IT IS UPRIGHT MEETS THE VERTICAL LINE THROUGH ITS CENTER OF BUOYANCY WHEN THE BODY IS SLIGHTLY DISPLACED FROM STABILITY. THE METACENTRIC HEIGHT IS THE DISTANCE BETWEEN THE CENTER OF GRAVITY (G) AND THE METACENTER (M) - ABBREVIATED GM. FOR STABILITY, THE METACENTER MUST BE ABOVE THE CENTER OF GRAVITY; THIS WILL GIVE THE OPTIMUM RIGHTING ARM TO MAKE THE VESSEL TEND TO RIGHT ITSELF WHEN DISPLACED FROM THE VERTICAL. THE RIGHTING ARM IS THAT FORCE VECTOR REPRESENTED BY A LINE DRAWN HORIZONTALLY FROM THE CENTER OF GRAVITY TO FORM A RIGHT ANGLE AT THE POINT WHERE IT INTERCEPTS THE LINE DRAWN VERTICALLY DOWNWARD FROM THE METACENTER AT A GIVEN ANGLE OF DISPLACE-

M EXISTS ONLY ASSUMING A SLIGHT DISPLACEMENT, THE LIMIT OF $\phi \to 0$, FROM STABILITY.



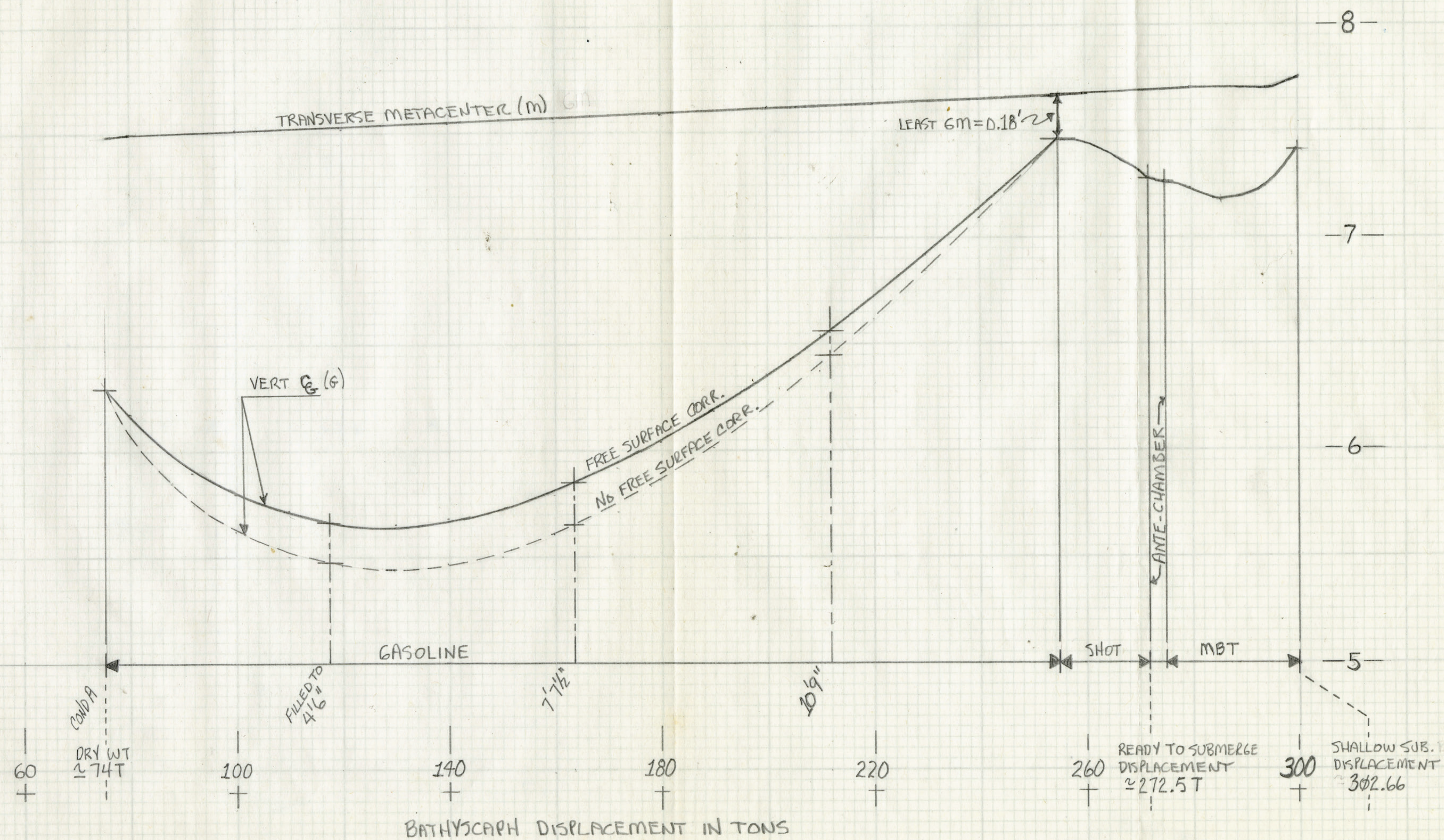


KNIGHTS MODERN SEAMANSHIP, 16TH EDITION, 1977.

PLOT OF $G\bar{M}$ WHILE GASSING SHOTTING & TRIMMING DOWN

WATER @ 64.033 LB/FT³ @ 60°F

AVGAS 114/145 @ 5.9012 LB/GAL @ 60°F



(FROM TRIESTE II (DSV-1) INCLINING EXPERIMENT REPORT)

MENT OF THR VESSEL FROM STABILITY. WITH A SMALL GM A SHIP WILL HAVE A VERY SMALL RIGHTING MOMENT AND WILL ROLL SLOWLY - IT MAY READILY CAPSIZE IN HEAVY SEAS OR IN A COLLISION.

SUBMARINES ENJOY PARTICULARLY GOOD STABILITY DUE TO THEIR VERY LOW CENTER OF GRAVITY AND NEARLY CIRCULAR CROSS SECTION. THIS IS GENERALLY TRUE OF TRIESTE. HOWEVER, WHEN EMPTY, TRIESTE WILL ROLL SLOWLY AND DEEPLY IN HEAVY SEAS MAKING HER TOPSIDES DANGEROUS TO PERSONNELL. AS SHE IS BEING FILLED WITH GASOLINE HER STABILITY GENERALLY IMPROVES BUT THE FREE SURFACE AREA OF PARTIALLY FILLED TANKS OFFSETS THIS IMPROVEMENT SOMEWHAT.

b. <u>DESCRIBE THE VARIATION OF METACENTRIC HEIGHT DURING GASSING AND SHOTTING</u>. AS BALLAST IS ADDED IN THE FORM OF GASOLINE, STEEL SHOT AND, FINALLY, SEA WATER THE CENTER OF GRAVITY AND THE CENTER OF BUOYANCY CHANGE. CONSEQUENTLY, THE METACENTRIC HEIGHT (GM) CHANGES ACCORDINGLY. THE SIGNIFICANT VALUES OF GM THROUGH MAJOR BALLASTING EVOLUTIONS ARE AS FOLLOWS:

(1) CONDITION A, DRY (NO BALLAST)

- KM = 7.41 FT ABL
- KG = 6.29 FT ABL
- GM = 1.02 FT

(2) FULLY GASSED, NO SHOT

- Km = 7.64 FT ABL
- KG = 7.46 FT ABL
- Gm = 0.18 FT

(3) FULLY GASSED AND SHOTTED

- Km = 7.64 FT ABL
- KG = 7.26 FT ABL
- GM = 0.38

(4) SHALLOW SUBMERGED

- Km = 7.77 FT ABL
- KG = 7.40 FT ABL
- Gm = 0.37 FT

(5) SUBMERGED, 4,000 FT

- Km = 7.77 FT ABL
- KG = 7.40 FT ABL
- GM = 0.37 FT

(6) SUBMERGED, 12,000 FT

- KM = 7.77 FT ABL
- KG = 7.43 FT ABL
- Gm = 0.34 FT

(7) SUBMERGED, 20,000 FT

- Km = 7.77 FT ABL
- KG = 7.45
- Gm = 0.32 FT

~~b(cont)~~. IT CAN BE SEEN IN THE ACCOMPANYING GM PLOT THAT, AS TRIESTE PROGRESSES THROUGH THE BALLASTING EVOLUTIONS, THE METACENTRIC HEIGHT CHANGES DRASTICALLY. THE CHANGE IS LARGLY A FUNCTION OF THE CHANGE IN THE CENTER OF GRAVITY. THE LARGEST GM OCCURS WHEN THE GASOLINE TANKS ARE FILLED TO ABOUT 6 FT. GM INCREASES AGAIN AS THE BALLAST TANKS ARE FILLED TO ABOUT HALF. AS THE VEHICLE DESCENDS AND THE GASOLINE COMPRESSES AND IS DISPLACED WITH SEA WATER GM AGAIN GOES THROUGH A SMALL DECREASE.

C. LIST THE CHANGES IN DISPLACEMENT FROM DRY LAUNCH THROUGH GASSING, SHOTTING AND SUBMERGING.

(1)	DRY LAUNCH	73.89 TONS
(2)	GASOLINE TO 4 FT 6 IN	116.96
(3)	GASOLINE TO 7 FT 7½ IN	163.37
(4)	GASOLINE TO 10 FT 9 IN	212.74
(5)	FULLY GASSED	254.50
(6)	SHOT IN AFT SILO (10.14)	264.64
(7)	SHOT IN FWD SILOS (8.32T)	272.96
(8)	ACCESS TRUNK (2.34T) + CREW (0.20)	275.50
(9)	FWD + AFT BALLAST TANKS HALF FLOODED 7'7½"	≃ 286.66
(10)	SHALLOW SUBMERGED	302.66
(11)	SUBMERGED 4,000'	304.47
(12)	" 12,000'	308.05
	16,000'	309.79
(13)	" 20,000'	311.53

NOTE: (a) FIGURES SHOWN INCLUDE:

- SW IN RECESSES = 0.95 T
- COMP SYSTEMS + MISC = 2.95 T
- ELECT. COMP TK (ECT) = 2.40 T
- RESIDUAL WATER = .28 T

(b) SUBMERGED DISPLACEMENT FIGURES WILL ILLUSTRATE THE QUANTITY OF SHOT TO DROP ON THE DESCENT.

2,

d. DESCRIBE HOW LEAD BALLAST IS USED ON BOARD. AS OF SEPTEMBER, 1975 TRIESTE II HAS NO LEAD BALLAST ON BOARD. HOWEVER, A PROVISION FOR 2.76 TONS STILL EXISTS. THE LEAD IN THE FORM OF 100 LB PIGS IS PLACED IN THE FORWARD BALLAST TANK AND IN THE AFTER SKEGS. THE LEAD WAS REMOVED UPON RECOMMENDATION OF THE RECOVERABILITY ANALYSIS, DATED OCTOBER 1975, CONDUCTED BY MARE IS. NAVAL SHIPYARD. THE RESULT IS ENHANCED RECOVERABILITY WITH A VERY SLIGHT SACRIFICE IN STABILITY (GM DECREASED 0.02 FT).

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e. LIST AND DISCUSS AVIATION GASOLINE SAFETY PRECAUTIONS. THE GASOLINE USED IN TRIESTE FOR FLOATATION BALLAST IS AVIATION GASOLINE ON THE ORDER OF 114 TO 145 OCTAIN. IT IS EXTREMELY VOLATILE WITH A FLASH POINT OF ABOUT -60°F. AVGAS ALSO PRESENTS THE ADDITIONAL HAZARD OF A TETRAETHYL-LEAD ADDITIVE. GASOLINE CAN CAUSE SEVERE CHEMICAL BURNS TO THE SKIN AND, MOST ESPECIALLY THE EYES. ALSO THE POSSIBILITY EXISTS OF GASOLINE BEING ABSORBED OR INGESTED INTO THE BODY. THE FOLLOWING SAFETY PRECAUTIONS WILL BE RIGIDLY ADHERED TO WHILE HANDLING AVIATION GASOLINE:

(1) THE SMOKING LAMP IS OUT

(2) USE ONLY NON-SPARKING TOOLS

(3) HANDLING EQUIPMENT WILL BE GROUNDED.

(4) PERSONNEL ON BOARD TRIESTE WILL WEAR SAFETY GOGGLES AND NON-SPARK SHOES.

(5) FIRE EXTINGUISHERS WILL BE AVAILABLE IN THE DOCK WELL DURING STRIPPING AND DE-FUMING.

(6) A CHARGED FIRE HOSE WILL BE ON DECK DURING GASSING AND DE-GASSING.

(7) FOAM STATIONS WILL BE MANNED AND CHARGED ON THE SUPPORT SHIP WHEN AVGAS IS BEING HANDLED.

(8) DOCKWELL FANS WILL BE RUNNING DURING STRIPPING AND DE-FUMING OPERATIONS.

(9) WHENEVER HANDLING, STRIPPING OR DEFUMING OPERATIONS ARE IN PROGRESS THERE WILL BE NO WORK IN THE TRUNK OR SPHERE; AND NO OPEN FLAMES OR SPARK PRODUCING EVOLUTIONS WITHIN 100' OF THE BATHYSCAPH.

(10) WHEN STRIPPING AVGAS ASHORE THE FIRE DEPARTMENT WILL HAVE PERSONNEL STANDING BY WITH CHARGED FIRE HOSES.

f (ADDITIONAL ITEM) FIRST AID

(1) GASOLINE SPILLED ON THE BODY. REMOVE ANY GASOLINE SATURATED CLOTHING IMMEDIATELY, AND RINSE (DO NOT SCRUB) EXPOSED AREAS WITH LARGE AMOUNTS OF WATER. SEEK IMMEDIATE MEDICAL ATTENTION.

(2) PERSON OVER-COME BY GASOLINE FUMES. REMOVE TO SAFE ATMOSPHERE AND COMMENCE MOUTH-TO-MOUTH RESUSCITATION IMMEDIATELY. SUMMON MEDICAL AID AND START OXYGEN RESUSCUTATION AS QUICKLY AS POSSIBLE.

(3) GASOLINE SPLASHED IN THE EYES. FLUSH WITH WATER IMMEDIATELY, EVEN SALT WATER AND SUMMON MEDICAL AID. IF MEDICAL AID IS NOT IMMEDIATELY AVAILABLE BATHE THE EYES WITH STERILE OPTHALMIC OINTMENT.

II

1. DESCRIBE THE HULL CONFIGURATION, INCLUDING THE SPHERE, FLOAT, ACCESS TRUNK, SAIL, STABILIZERS + SKEGS, EXPLAINING REASONS FOR THE SHAPE AND MATERIALS USED IN CONST.

a. <u>GENERAL</u>. TRIESTE IS A SELF-PROPELLED GASOLINE FILLED BATHYSCAPH. THE NAME IS DERIVED FROM TWO GREEK WORDS BATHOS, MEANING DEEP AND SCAPHOS, MEANING SHIP OR BOAT. THE VEHICLE CONSISTS OF A NUMBER OF MAJOR HULL COMPONENTS TO PROVIDE BUOYANCY, BALLAST, STABILITY AND HABITABILITY. THE MAJOR COMPONENTS AND APPENDAGES ARE: THE FLOAT AND STABILIZERS; THE SAIL AND SUPERSTRUCTURE; AND THE PERSONNEL SPHERE AND ACCESS TRUNK, OR ANTECHAMBER. THE FLOAT HOUSES THE THREE SHOT SILOS AND, IN RECESSES IN ITS UNDERSIDE THE TRAIL BALL WINCH AND MANIPULATOR.

b. <u>BATHYSCAPH/DIRIGIBLE ANALOGY</u>. THE BATHYSCHAPH IS AN UNDERWATER DIRIGIBLE. THE DIRIGIBLE'S HELIUM IS TO AIR WHAT THE SUBMERSIBLE'S GASOLINE IS TO SEA WATER. THE GOODYEAR BLIMPS HAVE THE LUXURY OF A FAR LIGHTER AND VASTLY MORE COMPRESSIBLE BOUYANCY FLUID AND AS SUCH CAN USE COMPRESSED AIR BAGS TO ADJUST BOUYANCY, OR LIFT. THE BATHYSCAPH MUST EXPEND ITS BOUYANCY FLUID BY VENTING IT INTO THE SEA. THE DIRIGIBLE HAS SAND BALLAST WHICH IS COMPARABLE TO THE BATHYSCAPH'S SHOT BALLAST AND SERVES THE SAME PURPOSE. THE PROPULSION AND STABILIZERS ARE GENERALLY COMPARABLE EXCEPT THAT THE DIRIGIBLE HAS A RUDDER WHERE THE SLOW MOVING BATHYSCAPH MUST RELY ENTIRELY ON VARIOUS PROPULSION MODES FOR MANEUVERING. OF COURSE, THE GONDOLA AND THE SPHERE SERVE A SIMILAR PURPOSE. THE DIRIGIBLE MUST, IN ITS MEDIUM FOLLOW THE INSTRUMENT AND VISUAL FLIGHT REGULATIONS OF THE ~~[illegible]~~ AIRWAYS. THE BATHYSCAPH PLUMBS THE DEEPEST AND DARKESTS DEPTHS OF THE ~~[illegible]~~ OCEAN — THERE ALL SIMILARITY MUST END.

b. BATHYSCAPH/DIRIGIBLE ANALOGY. THE BATHYSCAPH SHARES SOME COMMON CHARACTERISTICS WITH THE DIRIGIBLE. THEY BOTH DERIVE BOUYANCY FROM A LARGE VOLUME OF FLUID LESS DENSE THAN THE MEDIUM IN WHICH THEY OPERATE. THE DIRIGIBLES HELIUM IS TO AIR WHAT THE BATHYSCAPHS GASOLINE IS TO SEA WATER. THE DIRIGIBLE HAS THE LUXURY OF A VERY LIGHT AND HIGHLY COMPRESSIBLE BOUYANCY "FLUID." THE DIRIGIBLE, THEREFORE, USES THE DISPLACEMENT METHOD OF CONTROLLING ALTITUDE THROUGH INFLATION/DEFLATION OF ITS TWO BALLONETS. THE DIRIGIBLE HAS SAND BALLAST NORMALLY ONLY FOR EMERGENCY USE. THE BATHYSCAPH EXPENDS ITS BOUYANCY FLUID, AVGAS, INTO THE SEA AND STEEL SHOT BALLAST IS USED ROUTINELY TO CONTROL BOUYANCY. THE AVGAS AND SHOT ARE ONE FACTOR WHICH LIMITS THE MISSION TIME OF THE BATHYSCAPH. THE DIRIGIBLE'S HELIUM TO SOME EXTENT LIMITS ITS FLIGHT BECAUSE THE SMALL MOLECULES OF THAT GAS SLOWLY PERMEATE THE RUBBER OF THE BALLONETS CAUSING A SLOW LOSS OF LIFT. PROPULSION FOR THE BATHYSCAPH IS OF NECESSITY, ELECTRIC FROM STORAGE BATTERIES; THE DIRIGIBLE USES AIRCRAFT PISTON ENGINES. FOR HORIZONTAL MANEUVERING THE DIRIGIBLE HAS THE LUXURY OF UP TO 50 MPH SPEEDS AND USES A RUDDER. THE BATHYSCAPH USES VARIOUS PROPULSION COMBINATIONS ON ITS THRUSTERS TO MANEUVER ITS SLOW MOVING BULK.

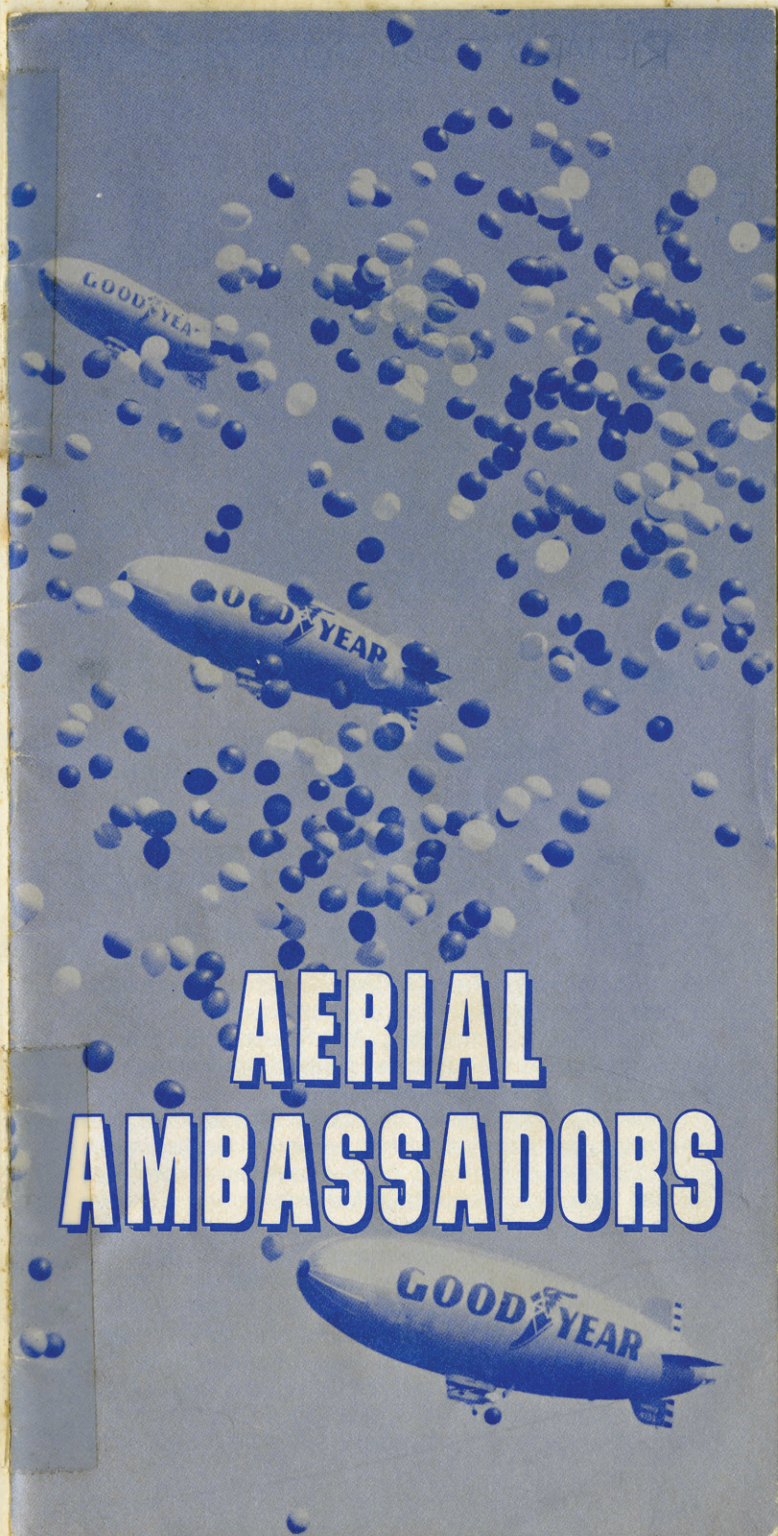
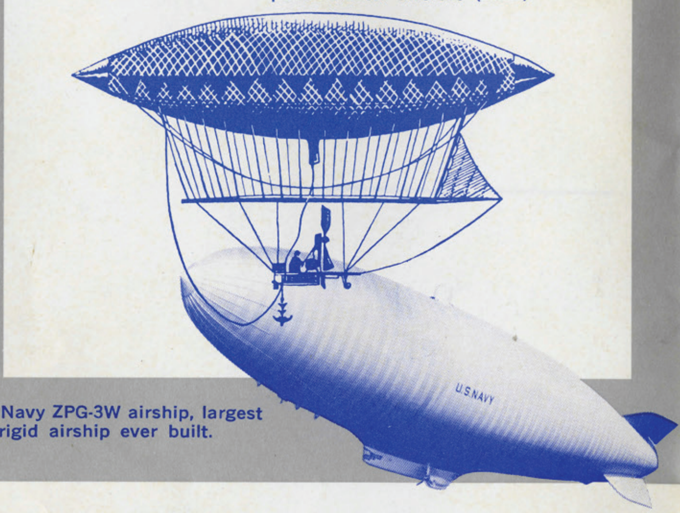


FIGURE 2-1

RICHARD TODD

Henri Giffard's airship, world's first power-driven aircraft (1852).



U.S. Navy ZPG-3W airship, largest non-rigid airship ever built.

The airships America, Columbia and Mayflower visit many communities each year in their travels as "Aerial Ambassadors" of Goodyear.

Leader in lighter-than-air... GOODYEAR

To millions of Americans, the word "blimp" means just one thing—Goodyear. For 50 years, the Goodyear airships have been performing yeoman service as the company's "Aerial Ambassadors." The graceful lighter-than-air craft log nearly two hundred thousand air miles each year in their travels across the United States and Europe.

Even in this sophisticated age of space exploration and supersonic jets, the blimps command maximum attention wherever they go. They are indeed a romantic link to the colorful past of aviation.

The America, Columbia, Mayflower and Europa are symbolic of Goodyear's continuing role in the aviation and aerospace fields.

Since 1917, Goodyear has built 301 lighter-than-air craft, more than any other company in the world. Of that number, 57 have been commercial airships, like the America, Columbia, Mayflower and Europa, which Goodyear has used for public service, public relations, advertising and research activities.

The remaining 244 airships were constructed under contract for the Army and Navy.

The America, Columbia, Mayflower and Europa are the only four airships in the world which operate on a regular, year-around basis. They trace their ancestry back almost 200 years to 1783, when the Montgolfier brothers of France launched their first lighter-than-air device—a 35-foot hot air balloon made of paper.

First power-driven aircraft was a 145-foot balloon built in 1852 by French inventor Henri Giffard. It was powered by a three-horsepower steam engine.

Lighter-than-air flight came of age during World War I when the huge airships built by Count Ferdinand von Zeppelin enabled Germany to bomb the British Isles.

During the 1930s, people around the world marveled at the aerial feats of the huge airships such as the USS Akron and USS Macon (both Goodyear built), the Graf Zeppelin and the Hindenburg.

Non-rigid airships, or blimps, were developed to a high degree of efficiency by Goodyear for the U.S. Navy during and after World War II. Used primarily for anti-submarine patrol during the war, airships escorted more than 89,000 ships in convoy without the loss of a single vessel.

Largest non-rigid airship ever built was the ZPG-3W, a Navy blimp so big it could carry a complete radar antenna within its envelope. It had almost 10 times the volume of today's Mayflower.

The Army withdrew from lighter-than-air operations in the 1930s. The Navy phased out its airships in 1962, leaving the skies to the ships of the Goodyear fleet.

FIGURE 2-1

SKILLED MEN AND SPECIAL EQUIPMENT KEEP AIRSHIPS FLYING

A team of qualified specialists, supported by equipment especially designed for lighter-than-air activities, makes possible the efficiency of Goodyear Airship Operations.

As special representatives of the world's largest rubber company, personnel associated with the operation are selected not only for their professional skill, but for their outstanding character as well.

The Columbia, America and Europa are sister airships of a new and larger design introduced in 1969. Each ship is staffed by a crew of 23, including five pilots, 17 ground crewmen and a public relations representative. The crew of the smaller Mayflower numbers 19, including 13 ground crewmen and a PR representative.

The pilot-in-charge of each airship is responsible for the crew and equipment. Based on weather conditions and other circumstances, the decision to fly on any given day is the responsibility of the pilot-in-charge.

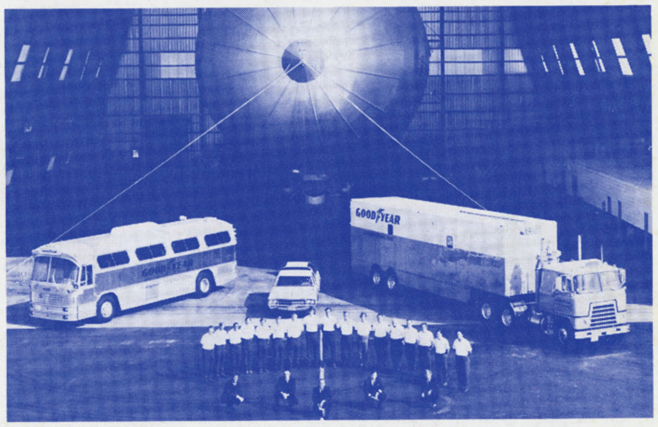
Since safety is a prime consideration in airship operations, the airships do not normally fly in adverse weather, although they are fully equipped with the instruments to do so.

Each of the company's 20 pilots completed a comprehensive Goodyear lighter-than-air training program before receiving FAA pilot certification.

Ground crewmen play dual roles. In addition to handling the airship during takeoffs, landings and moorings, they also serve as licensed radio technicians, mechanics, riggers, electricians, night sign specialists and clerks.

America's hangar dominates landscape at new blimp base 22 miles north of Houston.

Crew of 23 men and three vehicles supports operations of airships America and Columbia.



Equipment includes a ground crew bus, a large tractor-trailer rig and a station wagon.

In addition to transporting the crew, the bus serves as a radio and office headquarters. The station wagon is used as a command car when the ground vehicles are enroute to an operation, and as a utility vehicle.

The tractor unit is a mobile maintenance facility, including a machine shop and night sign and television equipment facilities. It also carries the portable mooring mast, spare parts and supplementary equipment needed for operations in the field.

The airships and all vehicles are linked by two-way radio communication.

FIGURE 2-1

FLYING THE AIRSHIP

An airship pilot is indeed a specialist. To obtain his license from the Federal Aviation Administration (FAA) he must complete a comprehensive training program.

His "office" is the cabin of the airship. This picture shows the interior of the cabin as you look over the pilot's shoulder.

1. **Overhead Control Panel:** Contains controls for communications, fuel and electrical systems.
2. **Throttles and Propeller Pitch Controls:** Throttles regulate speed of engines. Pitch controls regulate angle at which propeller blades "bite" the air. Propellers are constant speed and reversible.
3. **Fuel Mixture and Heat Controls:** Regulate the degree to which fuel is mixed with air in the engine and control the temperature of the fuel-air mixture to prevent icing.
4. **Envelope Pressure Controls:** These regulate helium and ballonet air pressure to maintain the trim and shape of the airship envelope.
5. **Communication Equipment:** The pilot always maintains radio contact with the airship ground crew and, when required, with airport control towers.
6. **Main Instrument Panel:** Contains (from left to right) flight, navigation and engine indicator instruments.
7. **Rudder Pedals:** Regulate right and left directional control of the airship.
8. **Elevator Wheel:** Controls up and down direction of the airship.

FIGURE 2-1

VITAL STATISTICS

	MAYFLOWER	COLUMBIA, AMERICA & EUROPA
Overall Dimensions:		
Length	160 feet	192 feet
Height	58 feet	59 feet
Width	51 feet	50 feet
Volume	147,300 cubic feet	202,700 cubic feet
Car Dimensions:		
Length	23 feet	23 feet
Height	8 feet	8 feet
Width (at ceiling)	7 feet	7 feet
Width (at floor)	$4\frac{1}{3}$ feet	$4\frac{1}{3}$ feet
Weight and Lift:		
Maximum Gross Weight	9,234 lbs.	12,320 lbs.
Weight Empty	6,943 lbs.	9,039 lbs.
Maximum Lift	2,291 lbs.	3,281 lbs.
No. of Passengers	Six plus pilot	Six plus pilot

COMPONENTS OF AN AIRSHIP

1. Nose Cone Battens (supports)
2. Forward Ballonet (air bag inside envelope)
3. Catenary Curtain and Suspension Cables (inside envelope)
4. Aft Ballonet
5. Control Surfaces (rudders and elevators)
6. Car—Passenger Compartment
7. Engines
8. Night Sign Lamps
9. Air Scoops (channel air to ballonets)
10. Air Valves (regulate air in ballonets)
11. Helium Valve

	MAYFLOWER	COLUMBIA, AMERICA & EUROPA
Power:		
Twin Continental Engines (6 cylinders, pusher type)	175 hp. each	210 hp. each
Cruising Speed	35 mph.	35 mph.
Maximum Speed	53 mph.	50 mph.
Operational Limits:		
Normal Altitude	1,000-3,000 feet	1,000-3,000 feet
Maximum Altitude	10,000 feet	8,500 feet
Range	500 miles	500 miles
Envelope Fabric:		
Material (2-ply)	Rubber-coated Polyester Fabric	Rubber-coated Polyester Fabric
Surface Area	1,879 sq. yds.	2,400 sq. yds.
Weight With Fittings	2,975 lbs.	3,771 lbs.
Night Sign:	"Skytacular"	"Super Skytacular"
Number of lights	3,080 (total both sides)	7,560 (total both sides)
Height of Sign	14 feet	24.5 feet
Length of Sign	105 feet	105 feet
Amount of Wiring	25 miles	80 miles
Readability	1 miles	1 mile
Colors	Red, Green, Blue, Yellow	Red, Green, Blue Yellow

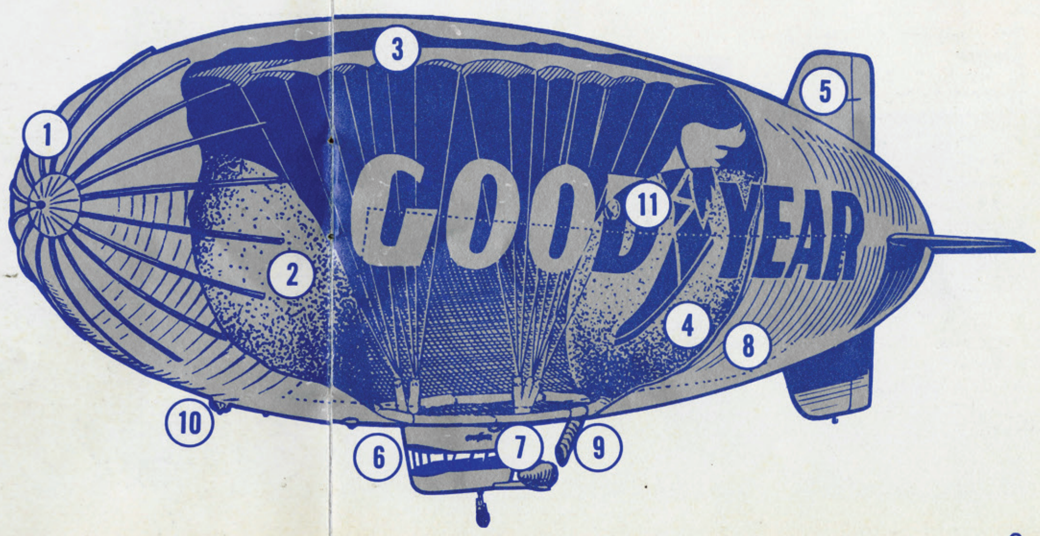
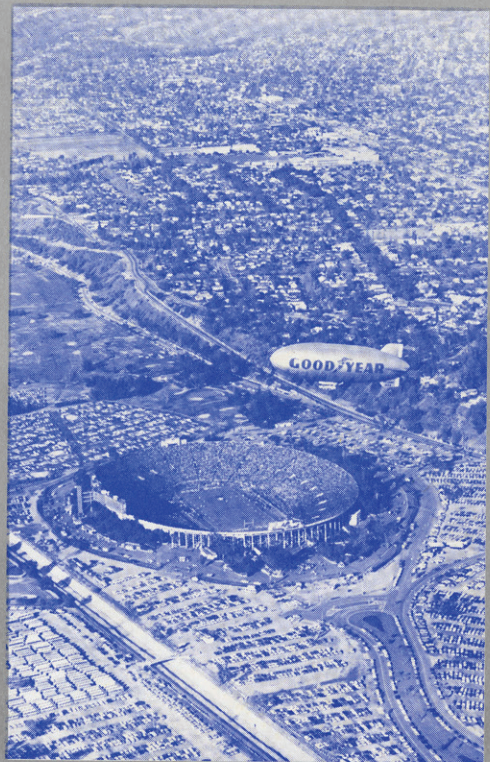
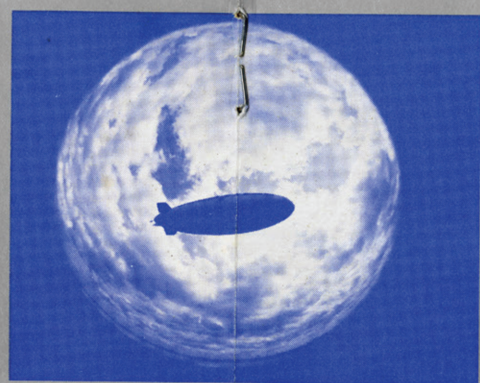


FIGURE 2-1

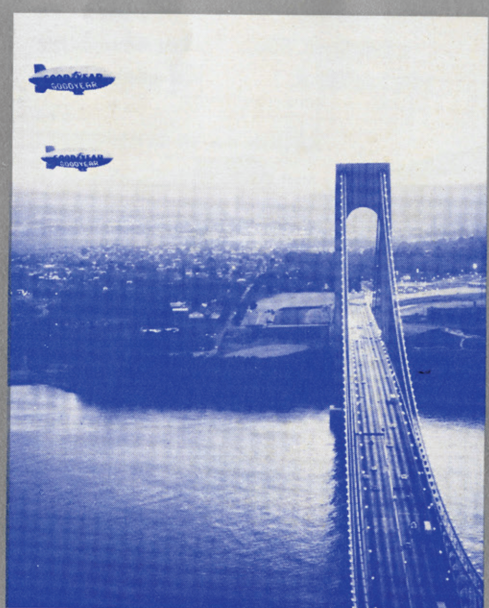
AROUND THE WORLD WITH THE GOODYEAR BLIMPS . . .



A blimp's-eye view of the Rose Bowl



Threading Seattle's Space Needle



Over New York's Verrazano-Narrows Bridge

At the World Cup Soccer Championship — Frankfurt, Germany

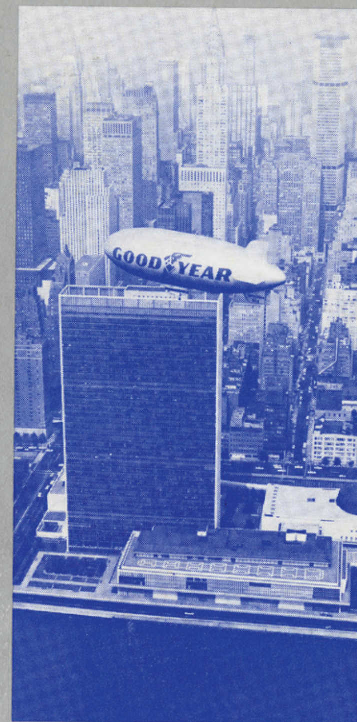
FIGURE 2-1

AROUND THE WORLD WITH THE GOODYEAR BLIMPS . . .

USCG ship **Eagle** at Kiel, Germany

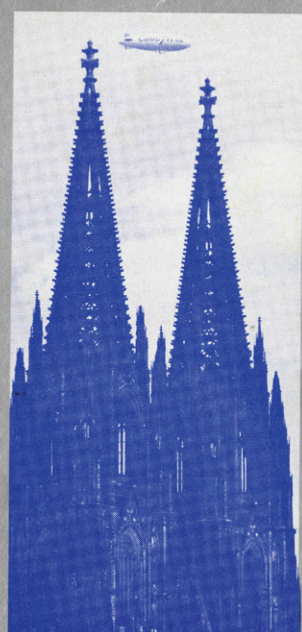
Lighting the skies over Houston

Among Miami's sheltering palms



Crossing New York's skyline


Three stately ladies


Cologne Cathedral

Drifting by Vancouver, B. C.

FIGURE 2-1

EUROPA

AN AIRSHIP FOR EUROPE

A Goodyear airship—a sister to the lighter-than-air craft that are a familiar sight to millions of Americans—is now plying the skies of Europe and England.

The airship, christened Europa, tours the Continent annually during the spring and summer, following schedules similar to her American sister ships Mayflower, Columbia and America.

During the winter months, Europa operates from a new $2½-million home base at Capena, Italy, just 18 miles north of Rome.

The Europa is a frequent visitor at sports events, auto races and air shows, and a staunch supporter in helping celebrate and promote community activities and civic projects. Her activities continue the public service and public relations traditions established in 50 years of Goodyear airship operations in the United States.

Europa boasts the same dimensions as two of her American sister ships, the America and the Columbia (see "Vital Statistics" on pages 8 and 9). Like her sisters, Europa is equipped with Goodyear's "Super Skytacular" night signs which flash animated and specially designed public service and community interest messages in four colors.

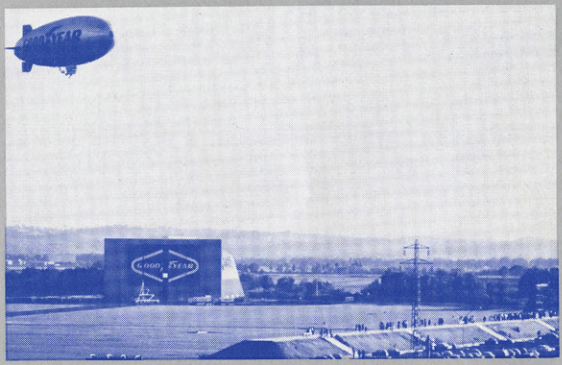
Special messages promote traffic safety, charities, tourism, education, national holidays and conservation of national resources in the countries along the Europa's tour routes.

Components of the airship were constructed at Goodyear facilities in Akron, Ohio and Litchfield Park, Arizona, in 1971.

The completed subassemblies were airlifted to the Royal Aircraft Establishment's historic airship hangars at Cardington, England. The Europa was erected and test flown there before making her first English Channel crossing and European tour in 1972.

The Europa was the first airship to be seen over Britain for more than 20 years. An American-trained, multinational Goodyear crew operates the ship in its travels across Western Europe.

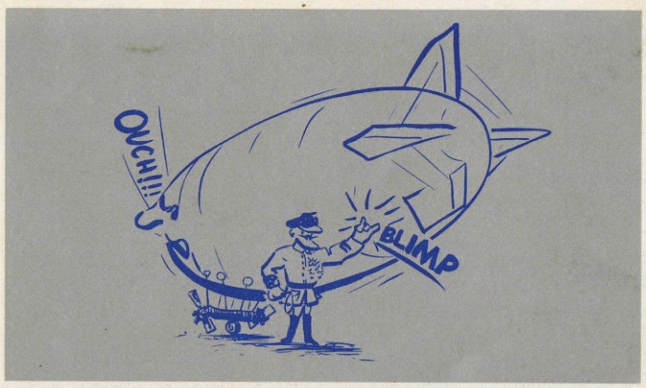
Shadow of blimp crosses historic Rome Colosseum.



The airship Europa circles over its home base near Capena, Italy, 18 miles north of Rome.

The Goodyear Europa was assembled at Royal Aircraft Establishment's airship hangars at Cardington, England.

FIGURE 2-1



WHY A BLIMP IS CALLED A BLIMP

Why is a non-rigid airship called a blimp? There have been several theories, all attributed to the British.

For years, airship historians and etymologists (those savants who study the origin and history of words) believed that "blimp" was a contraction of the military designation of a World War I British airship known as "Balloon, Type B, limp."

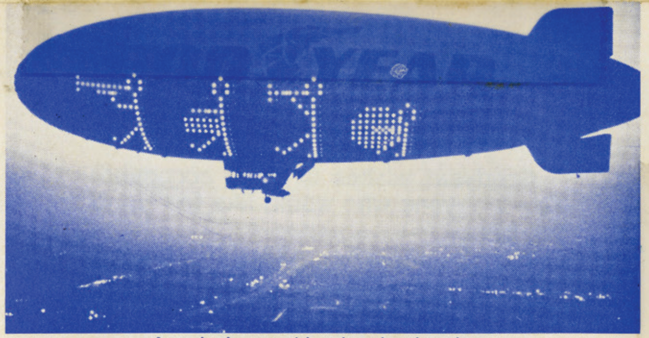
A variation of this theory claimed "blimp" was a contraction for "bloody limp." This takes into account the habit of the British in liberally lacing their speech with the adjective, "bloody."

These theories appear to be so much hot air with a recent revelation by airship historians that the British never had an airship with a "limp" designation before, during or after World War I, nor did they have anything referred to as "Type B."

The most plausible explanation, the experts now claim, is that the term originated with Lt. (later Air Commodore) A. D. Cunningham of the Royal Navy Air Service, who, in December of 1915, was commanding officer of a British air station at Capel.

As the story goes, Cunningham was conducting a weekly inspection tour of the station. While inspecting His Majesty's Airship SS-12, he playfully reached up and flipped his thumb at the gasbag. An odd noise echoed off the taut fabric.

Cunningham smiled, then orally imitated the sound his thumb had drummed out of the airship bag: "BLIMP!" Those nearby saw and heard this unusual interlude in the inspection, and its account quickly spread.



America's marching band animation

AIRSHIPS RIVAL STARS WITH NIGHT SIGNS

All four airships of the Goodyear fleet are equipped with incandescent night signs to flash after-dark messages from the sky.

The "Super Skytacular" signs on each side of the America, Columbia and Europa are 105 feet long and 24.5 feet high. Each includes 3,780 lamps, or a total of 7,560 per ship.

Messages to be run on the sign are born on exotic electronic equipment in a special lab in Akron. A technician "draws" the animation and copy on a cathode ray tube with a light gun. From there a computer takes over. The process results in a magnetic data tape.

A typical six-minute tape consists of 40 million pieces or bits of "on-off" information which, when run through special electronic readers aboard the airship, control lamp and color selection.

Mayflower's "Skytacular" night sign is smaller—105 feet long and 14 feet high—but no less spectacular. Controlled by pre-punched plastic-base tapes fed into an electronic reader, Mayflower's 3,080 colored lights also present a panorama of messages and animation.

Through the wonders of "Skytacular" and "Super Skytacular," Santa's sleigh and reindeer flash across the Yuletide skies . . . a turkey narrowly escapes becoming a Thanksgiving dinner . . . a giant Fourth of July firecracker explodes to form an American flag . . . and many others, including special animations flown by Europa to commemorate European holidays and activities.

Approximately 75 per cent of the messages run on the night signs of the Goodyear airships are devoted to public service projects in behalf of non-profit charities and service organizations.

FIGURE 2-1

C. <u>THE SPHERE</u>. THE PASSENGER COMPARTMENT IS THE MAJOR PRESSURE RESISTANT UNIT OF THE BATHYSCAPH. THE SPHERICAL SHAPE WAS CHOSEN BECAUSE ITS INHERENT CHARACTERISTICS MAKE IT THE MOST EFFICIENT, PRESSURE RESISTANT SHAPE WITH MAXIMUM SPACE ENCLOSED BY THE LEAST MATERIAL. MAXIMUM STRUCTURAL INTEGRITY IS RETAINED BY MINIMIZING HULL PENETRATIONS AND INCREASING THICKNESS OF THE HULL TO COMPENSATE FOR MATERIAL REMOVED. THE THICKNESS OF THE SPHERE, THERE-FORE RANGES FROM ABOUT FOUR TO SIX INCHES. THE INSIDE DIAMETER OF THE SPHERE IS 7 FEET AND IT WEIGHTS ABOUT 16.5 TONS. THE SPHERE IS DESIGNED FOR A SUBMERGED PRESSURE OF 30,000 FT AND HAS BEEN HYDROSTATICALLY TESTED TO 22,000 FT.

(1) THE SPHERE CONSISTS OF TWO HEMISPHERES OF FORGED AND MACHINED HY-120 STEEL. THE TWO HALVES ARE MATED WITH A 1 INCH THICK FLANGE; THREE CRES GUIDE RING SEGMENTS; AN O-RING (OUTSIDE THE GUIDE-RINGS); AND A CLAMP RING MADE ALSO OF FORGED AND MACHINED HY-120 STEEL.

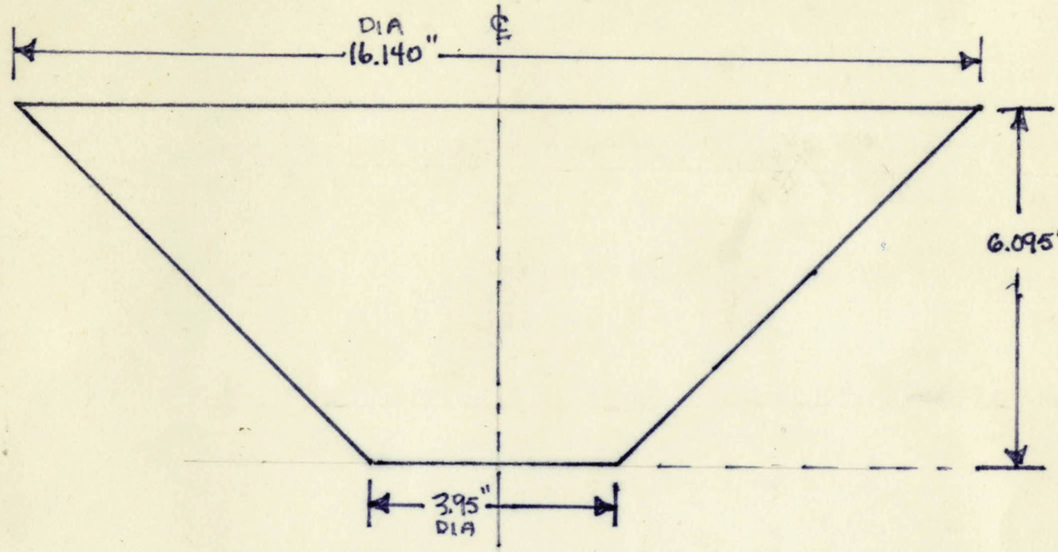
(2) THROUGH OUT FABRICATION OF THE SPHERE DETAILED QUALITY ASSURANCE TESTING WAS CARRIED OUT. THE FULLY ASSEMBLED SPHERE WAS FITTED WITH STRAIN GUAGES AND HYDRO-STATICALLY TESTED TO A SUBMERGENCE PRESSURE OF 22,000 FT. THE SPHERE WAS BUILT BY MIDVALE STEEL CORP. IN PHILADELPHIA, PA.

(3) THE HATCH IS A FORGED TRUNCATED CONE, MACHINED AND LAPPED TO FIT A 37° CONICAL SOCKET CUT IN THE SPHERE. IT HAS A LOW PRESSURE GASKET WITH A RETAINING RING ON ITS OUTER PERIMETER. THE HATCH IS SECURED FROM THE INSIDE BY MEANS OF A SINGLE

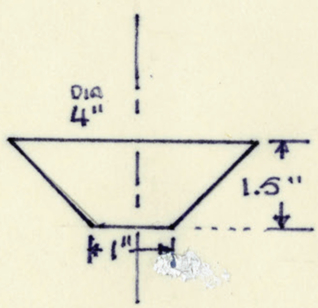
DOG WHICH CAN BE BROKEN OPEN BY A JACKING DEVICE FROM THE OUTSIDE IN CASE OF EMERGENCY. A TORSION SPRING MECHANISM ALLOWS THE HEAVY HATCH TO BE OPERATED EASILY IN EITHER DIRECTION. THE PEEP IN THE CENTER OF THE HATCH IS THE SAME AS THE PEEP AT THE BACK OF THE SPHERE.

(4) THE MAIN VIEWPORT IS A 90° TRUNCATED CONE FABRICATED FROM PLEXIGLASS-G, A THERMO-PLASTIC ACRYLIC RESIN EXHIBITING HIGH GRADE OPTICAL QUALITIES. THIS MATERIAL IS DIMENSIONALLY STABLE UNDER A WIDE PRESSURE RANGE AT TEMPERATURES UP TO 200°F. THE WINDOW IS 6.095 INCHES THICK, 16.14 INCHES IN DIAMETER OUTSIDE AND 3.95 INCHES INSIDE. IT IS MACHINED AND LAPPED TO FIT A SOCKET IN THE SPHERE WALL. FIGURE 2-2 SHOWS THE WINDOWS.

(5) THE TWO PEEP WINDOWS (AFT AND HATCH) ARE CONSTRUCTED NEARLY THE SAME AS THE MAIN VIEWPORT BUT ARE MUCH SMALLER. THEY ARE 1.5 INCHES THICK, 4 INCHES IN DIAMETER OUTSIDE AND 1.0 INCH INSIDE. THERE IS A



MAIN VIEWPORT



AFT & HATCH PEEP LENS

FIGURE 2-1 TRIESTE SPHERE WINDOW & PEEPS

1.0 INCH HOLE THROUGH THE REMAINING HULL THICKNESS. ALL WINDOWS ARE FITTED ON THE OUTSIDE WITH A SOFT RUBBER GASKET AND A CRES RETAINING RING WHICH SERVES AS A LOW PRESSURE SEAL.

(6) ELEVEN ELECTRICAL PENETRATOR ASSEMBLIES ARE LOCATED IN THE REAR OF THE UPPER HEMISPHERE. THEY ARE IN TWO CONCENTRIC CIRCULAR ARRAYS OF 5 WITH ONE IN THE CENTER. THE PENETRATOR ARRAY IS DESIGNED SUCH THAT THERE ARE NO MORE THAN THREE HOLES IN A STRAIGHT LINE ACCROSS THE CENTER AND THE HOLES ARE NOT EQUIDISTANT. DETAILS OF THE PENETRATORS ARE SHOWN IN THE ACCOMPANYING DRAWINGS, FIGURES 2-3, 4 AND 5.

(7) THE SPHERE IS ATTATCHED TO THE FLOAT, OR RATHER SUSPENDED FROM IT, BY MEANS OF TWO DIAGONAL STRAPS. THE STRAPS CONSIST OF TWO HTS I SECTIONS WELDED WHERE THEY CROSS AT A 45° ANGLE OFF THE SPHERE CENTER LINE. THE STRAPS ARE ATTATCHED TO A STRUCTURE IN THE SPHERE RECESS WITH HY-80 EYE BOLTS AND PINS.

SIX HEAVY RUBBER BUMPERS ARE LOCATED INSIDE THE SPHERE RECESS TO CUSHION ANY SHOCK OR VIBRATION THAT MAY OCCUR. THE BUMPERS ARE SANDWICHED BETWEEN TWO QUARTER-INCH PLATES AND SECURED WITH CRES BOLTS. THEY ARE COMPRESSED ABOUT THREE-EIGHTHS OF AN INCH WHEN THE SPHERE IS STRAPPED IN PLACE.

(8) THE MAIN VIEW PORT IS TILTED 25 DEGREES BELOW THE HORIZONTAL. THE HATCH IS 20 DEGREES AFT OF VERTICAL. SPHERE IS LOCATED INSIDE THE SPHERE RECESS SUCH THAT ITS HORIZONTAL CENTERLINE IS LOCATED ON THE BASE LINE OF THE FLOAT.

(9) THE SPHERE IS SEALED TO THE ACCESS TRUNK BY A "HORSECOLLAR" GASKET, BONDED TO THE SPHERE, WHICH MATES TO THE KNIFE EDGE OF A SKIRT ATTATCHED TO THE UNDERSIDE OF THE SPHERE RECESS FLAT. THE SKIRT MATES TO THE RECESS FLAT BY MEANS OF A FLANGE WITH A THICK RUBBER GASKET SANDWICHED BETWEEN; SECURED WITH THIRTY-THREE CRES BOLTS AND SELF-LOCKING NUTS.

d. <u>THE SPHERE ACCESS TRUNK OR ANTECHAMBER</u> ALLOWS ACCESS FROM TOPSIDE, INSIDE THE SAIL, DOWN THROUGH THE FLOAT TO THE SPHERE. THE TRUNK IS CYLINDRICAL AND ABOUT 3 FEET IN DIAMETER AND 16 FEET DEEP FLAIRING TO A CONICAL SHAPE AT THE BOTTOM WHERE IT MEETS THE RECESS FLAT. IT HAS A LIGHT WEIGHT SCUTTLE AT THE TOP. AND, FOR CONVENIENCE IN ASCENT AND DESCENT, A LADDER WITH ELEVEN RUNGS. THE TRUNK, JUST PRIOR TO DIVING, CHANGES ITS FUNCTION AND BECOMES A BALLAST TANK HOLDING ABOUT 2.6 TONS OF SEA WATER. THE TRUNK IS FILLED PART WAY (TO THE WATER LINE) THROUGH THE FLOOD VALVE AND TOPPED OF WITH A FIRE HOSE TO WITHIN SIX INCHES OF THE TOP. THE TRUNK CAN BE BLOWN FROM INSIDE THE SPHERE ON SURFACING USING THE HIGH PRESSURE AIR SYSTEM OR WITH LOW PRESSURE AIR AFTER THE TOW IS MADE UP.

e. FLOAT.

(1) THE FLOAT WAS DESIGNED TO PROVIDE FOR STABILITY UNDER TOW, GOOD HYDRODYNAMIC QUALITIES FOR SUBMERGED PROPULSION EFFICIENCY AND FOR AN OPTIMUM HULL WEIGHT TO VOLUME RATIO. THE HYDRODYNAMIC SHAPE IS A STREAMLINED BODY OF REVOLUTION WITH A LENGTH TO DIAMETER RATIO OF 4.86. THE MAIN BODY OF THE FLOAT IS 15 FEET 3 INCHES IN DIAMETER AND 74 FEET LONG BETWEEN PERPENDICULARS (≃ 4.86 : 1 L/D) THE BOW IS HEMISPHERICAL; THE STERN IS CONICAL AND ATTATCHED TO THE CYLINDRICAL MAIN BODY BY A TORRICONICAL SECTION. THE HULL PLATING IS 10 GAGE (0.134 INCH) HIGH TENSILE STEEL (HTS). THE STABILIZERS ARE 3/16 INCH HTS PLATE.

(2) THE FLOAT IS COMPARTMENTED IN WAY OF 25 AVGAS TANKS, TWO SALT WATER BALLAST TANKS AND AN ELECTRICAL EQUIPMENT COMPENSATION TANK (ECT). LONGITUDINAL STRENGTH FOR THE HULL IS PROVIDED BY TWO LONGITUDINAL BULKHEADS LOCATED 2 FEET 6 INCHES OFF THE CENTER LINE FROM THE BOW TO THE FORWARD BULKHEAD OF TANKS 9A AND 9B. A CENTERLINE BULKHEAD DIVIDES TANKS 9A AND 9B TO THE STERN.

(3) INTERNAL BULKHEADS ARE 10 GAGE HTS; STRENGTHENED BY VERTICAL AND HORIZONTAL "T" AND FLAT PLATE STIFFENERS. THE MAIN BODY OF THE FLOAT IS LONGITUDINALLY FRAMED TO FRAME 27. THE CONICAL SECTION AFT OF FRAME 27 IS TRANSVERSELY FRAMED WITH 13 CIRCULAR "T" FRAMES WITH STRUTS INTERSECTING THE FRAMES AND LONGITUDINAL BULKHEADS.

f. STABILIZERS. FOUR FREE FLOODING HYDROFOIL SHAPED STABILIZERS ARE LOCATED ON THE AFT CONICAL SECTION BETWEEN FRAMES 33 AND 39. THE UPPER STABILIZERS ARE RAISED 38° ABOVE THE HORIZONTAL AND MOUNT THE WING PROPULSION MOTORS AT 10FT 9IN ABL. LOWER STABILIZERS ARE LOCATED RADIALLY 90° FROM THE UPPERS. A HORIZONTAL STABILIZER CONNECTS THE TIPS OF THE LOWER STABILIZERS TO ACT AS A STRENGTH MEMBER TO STIFFEN THEM AGAINST LANDING SHOCKS. THE LOWER EXTREMITIES OF THE AFTER STABILIZERS ARE FITTED WITH AIR RIDE SHOCK ABSORBERS; THE FORWARD SKEGS ARE SIMILARLY FITTED. THERE ARE 3 AIR RIDES AFT AND 4 FORWARD. THE LOWER STABILIZERS (AND FWD SKEGS) ARE DESIGNED TO WITHSTAND NORMAL BOTTOM AND DOCKWELL LANDING LOADS. THE UPPER STABILIZERS ARE BUILT TO WITHSTAND 1000 LB/SQ.FT. WAVE SLAP.

g. SAIL AND SUPERSTRUCTURE. THE ALUMINUM SUPERSTRUCTURE CONSISTS OF A PORTABLE FALSE DECK AND SIDES THAT COVER THE TOPSIDE OF THE FLOAT FROM THE AFTER END OF THE FORWARD BALLAST TANK AFT TO THE AFTER BALLAST TANK, AS SHOWN IN FIGURE 2-6. THE SUPERSTRUCTURE SERVES BOTH AS A FAIRING FOR TOPSIDE EQUIPMENT AND AS A WALKING PLATFORM. THE ENTIRE WALKING SURFACE CONSISTS OF SECTIONS OF REMOVABLE GRATINGS TO FACILITATE TOPSIDE MAINTENANCE AND SERVICING. THOUGH THE ENTIRE SUPERSTRUCTURE IS DESIGNED TO BE PORABLE, ONLY THE AFTER OR TURTLEBACK SECTION IS ROUTINELY REMOVED FOR ACCESS TO THE AFTER BALLAST TANK PATCH FOR BATTERY MAINTENANCE. THE SAIL, AS SHOWN IN FIGURE 2-9 SERVES AS A PROTECTIVE ENCLOSURE FOR THE SPHERE ACCESS TRUNK, BATTERY CHARGING PANELS AND HIGH AND LOW PRESSURE AIR SYSTEMS. THE SAIL AND SUPERSTRUCTURE ARE DESIGNED TO WITHSTAND 500 LB/SQ FT OF WAVE SLAP.

h.

2. SKETCH THE FOLLOWING:

a. TOPSIDE ARRANGEMENT: FIGURE 2-7

b. BOTTOMSIDE ARRANGEMENT: FIGURE 2-8

c. SAIL EQUIPMENT ARRANGEMENT: FIGURE 2-9

3. SKETCH AND DESCRIBE:

a. TANK ARRANGEMENT: FIGURE 2-10 AND 2-14

b. AVGAS FILLING AND PUMPING SYSTEM: FIGURE 2-11

c. AVGAS TANK VENT AND DRAIN SYSTEM: FIGURE 2-12

d. NITROGEN INERTING SYSTEM: FIGURE 2-13

(e) FLOAT ARRANGEMENT SHOWING ACCESSES: FIGURE 2-44

a. TANK ARRANGEMENT.

(1) THE FLOAT IS COMPARTMENTED INTO 25 AVIATION GASOLINE TANKS. THIS SYSTEM PROVIDES BOUYANCY FOR THE BATHYSCAPH AND AT THE SAME TIME PROVIDES THE MAXIMUM POSSIBLE PROTECTION AGAINST POTENTIAL COLLISION DAMAGE CAUSING LOSS OF AVGAS. THE TANK ARRANGEMENT IS SHOWN IN FIGURE 2-10.

(2) THE AVGAS TANKS ARE ARRANGED SUCH THAT THERE ARE 9 WING TANKS ON EACH SIDE AND 6 CENTERLINE TANKS DOWN THE MIDDLE. THE AVERAGE CAPACITY OF THE WING TANKS IS ABOUT 2400 GALLONS. THE CENTERLINE TANKS ARE ON THE ORDER OF 4000 GALLONS. THE SMALLEST AVGAS TANK IS FORWARD MANEUVERING (344 GAL.). THE LARGEST IS TANK 4C, MAIN MANEUVERING (4990 GAL.)

(3) 23 OF THE AVGAS TANKS ARE INTERCONNECTED BY A SYSTEM OF PIPES AND LIMBER HOLES WHICH FORM THE FLOAT COMPENSATION SYSTEM. THE TWO MANEUVERING TANKS ARE SEPARATE FROM THE THE REST OF THE AVGAS SYSTEM.

THEY FORM PART OF THE VARIABLE BALLAST SYSTEM. AS SUCH THEY ARE FITTED WITH ELECTROMAGNETIC VENT VALVES TO ALLOW DISCHARGE OF AVGAS FOR BOUYANCY CONTROL. FORWARD MANEVERING HAS A SINGLE VALVE. THE MAIN MANEUVERING TANK HAS AN ATHWARTSHIPS PARTITION EXTENDING TO WITHIN ABOUT 18 INCHES OF THE BOTTOM. THIS TANK HAS TWO ~~[illegible]~~ VALVES. THE PARTITION ~~PREVENT~~ ALLOWS A LOSS OF ONLY ABOUT 50 PERCENT OF MANEVERING GAS IN THE EVENT A VALVE STICKS OPEN.

(4) AN ADDITIONAL TANK ARRANGEMENT FEATURE IS THE ARRANGEMENT OF AVGAS TANKS INTO COMPENSATION GROUPS. THIS GROUPING ("T's" AND "U's") CAN BE READILY SEEN IN FIGURE 2-10. THE TANKS ARE SO GROUPED FOR RECOVERABILITY AND FOR TRIM AND LIST CONTROL DURING FILLING AND PUMPING (SEE FIGURE 2-11).

(5) THE SEAWATER BALLAST TANKS ARE PROVIDED FOR SURFACE BOUYANCY. WHEN READY TO DIVE THE BALLAST TANKS PROVIDE THE FINAL 27 TONS OF BALLAST TO START THE BATHYSCAPH'S DESCENT. THE

FORWARD BALLAST TANK FORMS THE BATHYSCAPH'S BLUFF BOW AND HOLDS 3650 GALLONS OR 13.92 TONS OF SEA WATER. THE AFTER BALLAST TANK SERVES DOUBLE DUTY AS A BATTERY WELL. THE MAIN 120V AND 24V BATTERIES, COMPENSATORS AND BREAKER BOXES ARE LOCATED IN THE AFTER BALLAST TANK. A LARGE BOLT-DOWN PATCH COVERS THE AFTER BALLAST TANK TO PROVIDE FOR REMOVAL OF THE BATTERIES. THE AFTER BALLAST TANK HOLDS 3445 GALLONS OR 13.17 TONS OF SEA WATER. SEE FIGURES 2-10 AND 2-15 FOR ILLUSTRATION OF THESE TANKS.

(6) THE ELECTRICAL COMPENSATION TANK AND THE ANTECHAMBER ALSO PROVIDE A CERTAIN AMOUNT OF SEA WATER BALLAST WEIGHT ESSENTIAL TO OPERATION. THE ECT HOLDS 2.27 TONS AND THE ANTECHAMBER 2.38 TONS.

b. AVGAS FILLING AND PUMPING SYSTEM

(1) THE AVGAS FILLING AND PUMPING SYSTEM CONSISTS OF A SIGHT GLASS MANIFOLD AND A TOTAL OF 12 VALVES USED TO CONTROL THE FLOW OF GASOLINE DURING FILLING AND PUMPING OPERATIONS. FIGURE 2-11 SHOWS THE DETAILED ARRANGEMENT OF THE SYSTEM. NOTE THE LOCATION OF SUCTION/DISCHARGE POINTS. THE TWO AFTER GROUPS HAVE ONE VALVE EACH WITH THE SUCTION/DISCHARGE LOCATED IN THE FORWARD END OF THEIR RESPECTIVE GROUP AT THE LOW POINT. TANKS 5A AND 5B AND MAIN MANEUVERING ARE SIMILARLY CONFIGURED. THE FORWARD GROUPS HAVE TWO VALVES EACH WITH THE SUCTIONS/DISCHARGES LOCATED AT THE VARIOUS LOWPOINTS CREATED BY THE SPHERE RECESS. FORWARD MANEVERING HAS ONE VALVE WITH A PIPE RUNNING DOWN TO THE LOW POINT AT THE AFTER END OF THE TANK. ALL VENT VALVES ARE LOCATED AT THE TANK HIGH POINTS AND EXCEPT FOR 8 AND 9 A AND B ALL ARE AT THE AFTER END OF THE TANKS. THIS ARRANGEMENT NECESSITATES FILLING AND PUMPING THE BATHYSCAPH WITH A TRIM BY THE BOW.

(2) ALL COMPONENTS IN THE AVGAS FILLING AND PUMPING SYSTEM ARE FABRICATED OF COPPER-NICKEL ALLOY, MONEL, BRASS OR ALUMINUM TO PREVENT SPARKING. ALL TOOLS USED ON THE BATHYSCAPH DURING SERVICING EVOLUTIONS ARE NON-SPARKING.

C. AVGAS TANK VENT AND DRAIN SYSTEM.

(1) AS DISCUSSED ABOVE EACH TANK IS FITTED WITH A VENT VALVE (4C HAS 2). THERE ARE 26 VENTS IN ALL. THE LOCATION OF EACH VALVE IS SHOWN IN FIGURE 2-7, TOPSIDE ARRANGEMENT. IN ADDITION, THERE ARE A TOTAL OF 33 MICHEL DRAIN VALVES LOCATED AT VARIOUS LOW POINTS OF THE AVGAS TANKS. FIGURE 2-8, BOTTOM SIDE ARRANGEMENT SHOWS THE DRAIN VALVE LOCATIONS. FIGURE 2-12 SHOWS A REPRESENTATIVE VENT AND DRAIN ARRANGEMENT FOR A TYPICAL AVGAS TANK.

(2) THE VENTS ARE USED IN THE AVGAS FILLING PROCESS TO EXPELL INERTING NITROGEN AS THE TANKS ARE FILLED. DURING THE PUMPING AND STRIPPING PROCESS THE VENTS ARE USED IN CONJUNCTION WITH THE NITROGEN INERTING SYSTEM TO INTRODUCE NITROGEN TO SUPPRESS AVGAS VAPOR AS THE TANKS ARE EMPTIED. THE

VENTS ~~ARE~~ ALSO SERVE AS ~~A~~ SOUNDING AND ~~FRESH~~ WATER LANCING PORTS.

(3) THE VENT VALVES ARE 1 INCH PLUG COCK VALVES MOUNTED ON ROUND BASE WHICH IS COVERED WITH A SCREW-ON METAL DOME. ALL VENTS ARE LOCATED AT THE SAME LEVEL AROUND THE TOP OF THE FLOAT. THE CENTERLINE VENTS ARE LOCATED AT THE TANK-TOP LEVEL. WING TANK AND AFT-END VENTS ARE ELEVATED TO CENTERLINE LEVEL BY 6 INCH TRUNKS. THIS IS DONE TO MAINTAIN ALL TANKS AT THE SAME HIEGHT LEVEL FOR EQUAL PRESSURE HEAD. THE VENT DOMES ARE NOT DESIGNED FOR PRESSURE AND ARE COMPENSATED BY A LENGTH OF RUBBER HOSE HANGING FROM THE UNDERSIDE OF THE DOME MOUNTING PLATES. THE VENT DOME COMPENSATORS ARE FILLED WITH SEA WATER PRIOR TO CLOSURE FOR A DIVE. THE VENT DOMES PREVENT LOSS OF AVGAS IN THE EVENT OF VENT VALVE LEAKAGE.

(4) THE DRAIN VALVES AT THE TANK LOW POINTS ARE USED DRAIN ALL RESIDUAL AVGAS FROM THE FLOAT

AFTER RECOVERY. THEY ARE HOOKED UP THROUGH TYGON TUBING TO A "PORCUPINE" MANIFOLD WHICH IS THEN CONNECTED, FIRST TO A PUMP FOR STRIPPING, THEN TO A BLOWER FOR DEFUMING.

d. NITROGEN INERTING SYSTEM.

(1) THE NITROGEN INERTING SYSTEM IS USED, TO DISTRIBUTE INERTING NITROGEN THROUGH THE AVGAS TANK VENT VALVES PRIOR TO UNDOCKING AND GASSING THE VEHICLE. DURING DEGASSING THE SYSTEM IS USED TO SUPPLY NITROGEN TO INERT THE FLOAT AS GASOLINE IS PUMPED OUT. THE SYSTEM IS ALSO USED TO PROVIDE AIR VENTILATION DURING DEFUMING AND DURING WORK INSIDE OF THE AVGAS TANKS.

(2) THE NITROGEN INERTING SYSTEM IS SHOWN IN FIGURE 2-13. THE SYSTEM CONSISTS OF A NET WORK OF COPPER-NICKEL PIPES TERMINATED IN A SHORT LENGTH OF HOSE LOCATED NEAR EACH VENT VALVE. THE HOSES ARE CONNECTED TO A THREADED ELBOW WHICH IS SCREWED IN TO THE VENT VALVED FOR USE. THE SYSTEM IS DIVIDED

INTO 4 GROUPS WITH AN ISOLATION VALVE FOR EACH GROUP. THE 4 GROUPS CORRESPOND TO THE 4 ~~SEPARATE~~ TANK ACCESS ZONES SHOWN IN FIGURE 2-14. EACH ZONE CAN BE VENTILATED SEPARATELY.

(3) THE SYSTEM IS PROVIDED WITH A PORTABLE NITROGEN REGULATOR MANIFOLD, ALSO SHOWN IN FIGURE 2-13. THE REGULATOR IS SET TO MAINTAIN 3.3 +Ø, -.5 PSIG REGULATED PRESSURE WITH 86 ± 14 PSIG INLET PRESSURE AT A NOMINAL FLOW OF 60 SCFM. THE MANIFOLD IS FITTED WITH A 0-5 PSIG GAGE AND 2 RELIEF VALVES SET AT 3.5 PSIG.

4. LIST ALL TANKS AND THEIR CAPACITIES.

a. AVGAS TANKS (5.8311 LB/GAL AND 2240 LBS/L.TON)

TANK NO.	GALLONS	TONS
1A	2338	6.086
1B	2338	6.086
1C	4059	10.566
2A	2315	6.026
2B	2315	6.026
2C	4975	12.950
3A	2368	6.164
3B	2368	6.164
3C	2600	6.768
4A	2388	6.216
4B	2388	6.216
4C (MAIN MANEUVERING TK.)	4990	12.989
5A (STBD MAIN COMP. TK.)	3582	9.324
5B (PORT MAIN COMP. TK)	3582	9.324
5C	3023	7.869
6A	2400	6.247
6B	2400	6.247
6C	2686	6.992
7A	2404	6.258
7B	2404	6.258
8A	2142.5	5.577
8B	2142.5	5.577
9A	1734	4.513
9B	1734	4.513
FWD. MANEUVERING	344	0.895
→ TOTALS	66019	171.751 TONS

b. SALT WATER TANKS (8.52 LBS./GAL.)

TANK	GALLONS	TONS
FORWARD MAIN BALLAST	3650	13.56
AFTER MAIN BALLAST	3445	12.79
ANTECHAMBER	520	1.93
ELECTRICAL COMPENSATION	627	2.32
⟶ TOTALS	8242 GAL.	30.6 TONS

5. IN ONE SKETCH SHOW THE: (FIGURE 2-15)

a. BLOW AND VENT SYSTEM

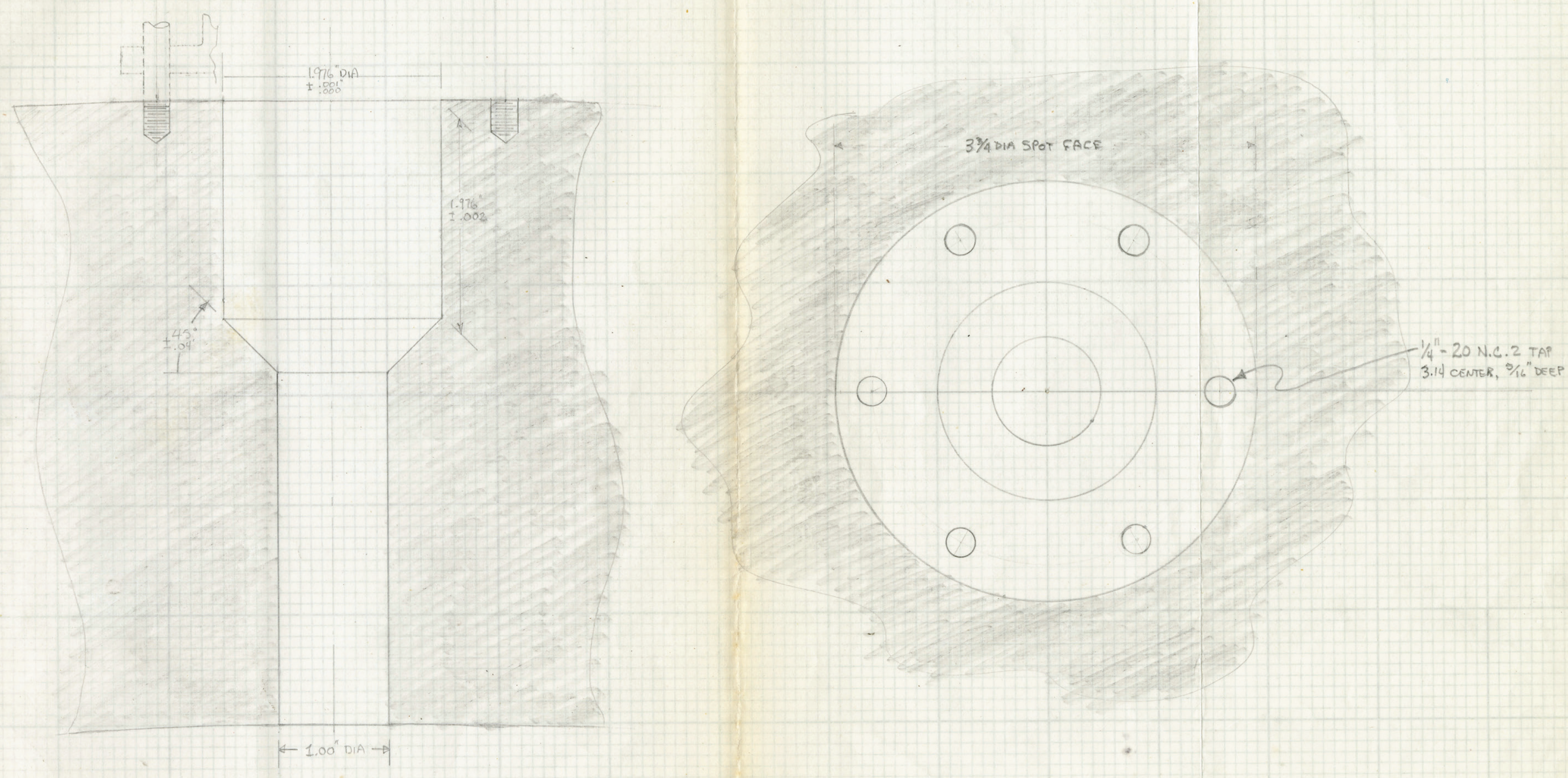
b. FLOOD AND DRAIN SYSTEM

c. 3,000 PSI AIR SYSTEM

d. BALLAST TANKS, ELECTRICAL COMPENSATION TANK AND ACCESS TRUNK.

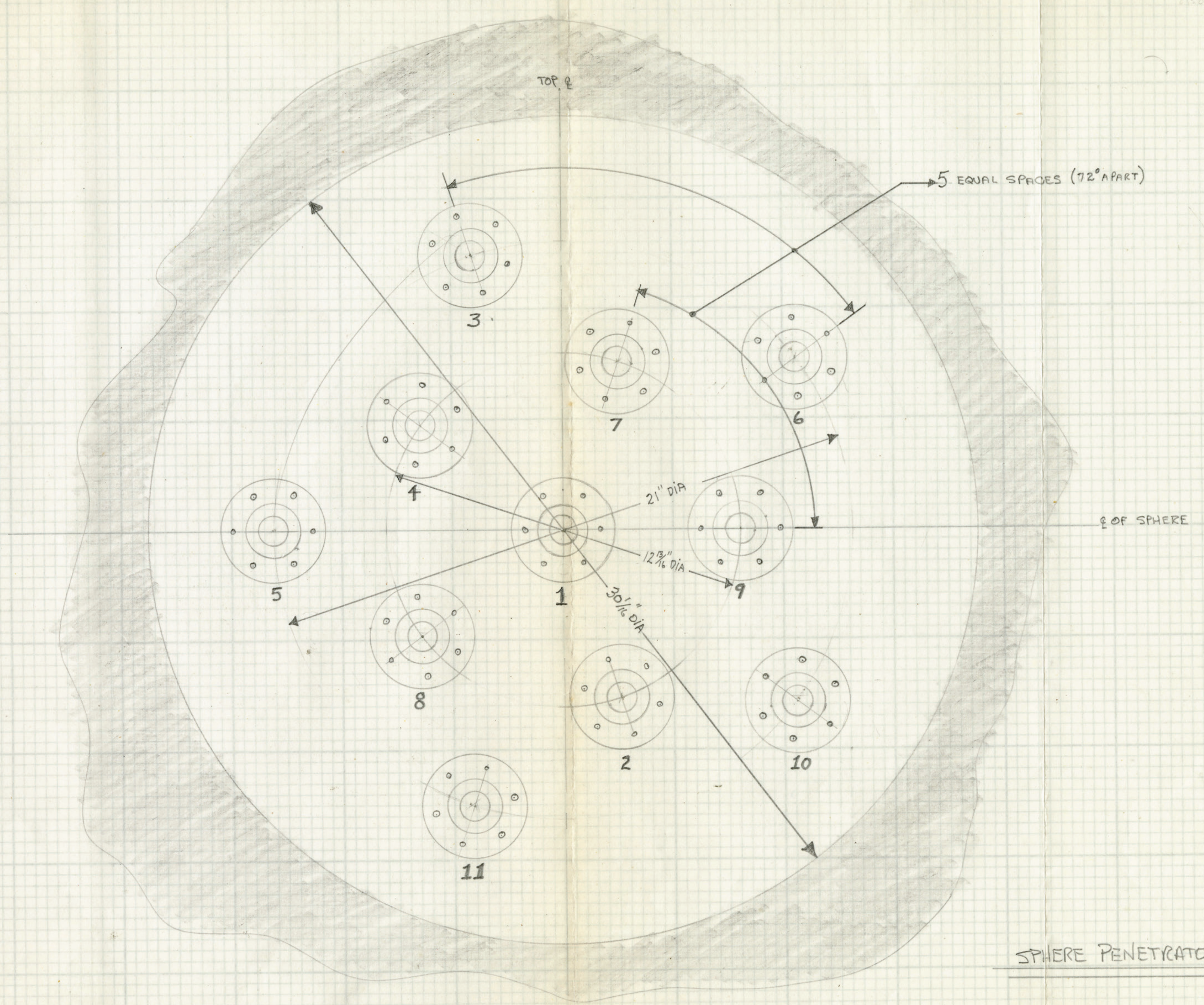
ADDITIONAL

FIGURES, 2-16 THROUGH 2-18 SHOW INDIVIDUAL AIR SYSTEM SCHEMATICS AND DRAWINGS OF VARIOUS HP AIR SYSTEM COMPONENTS.



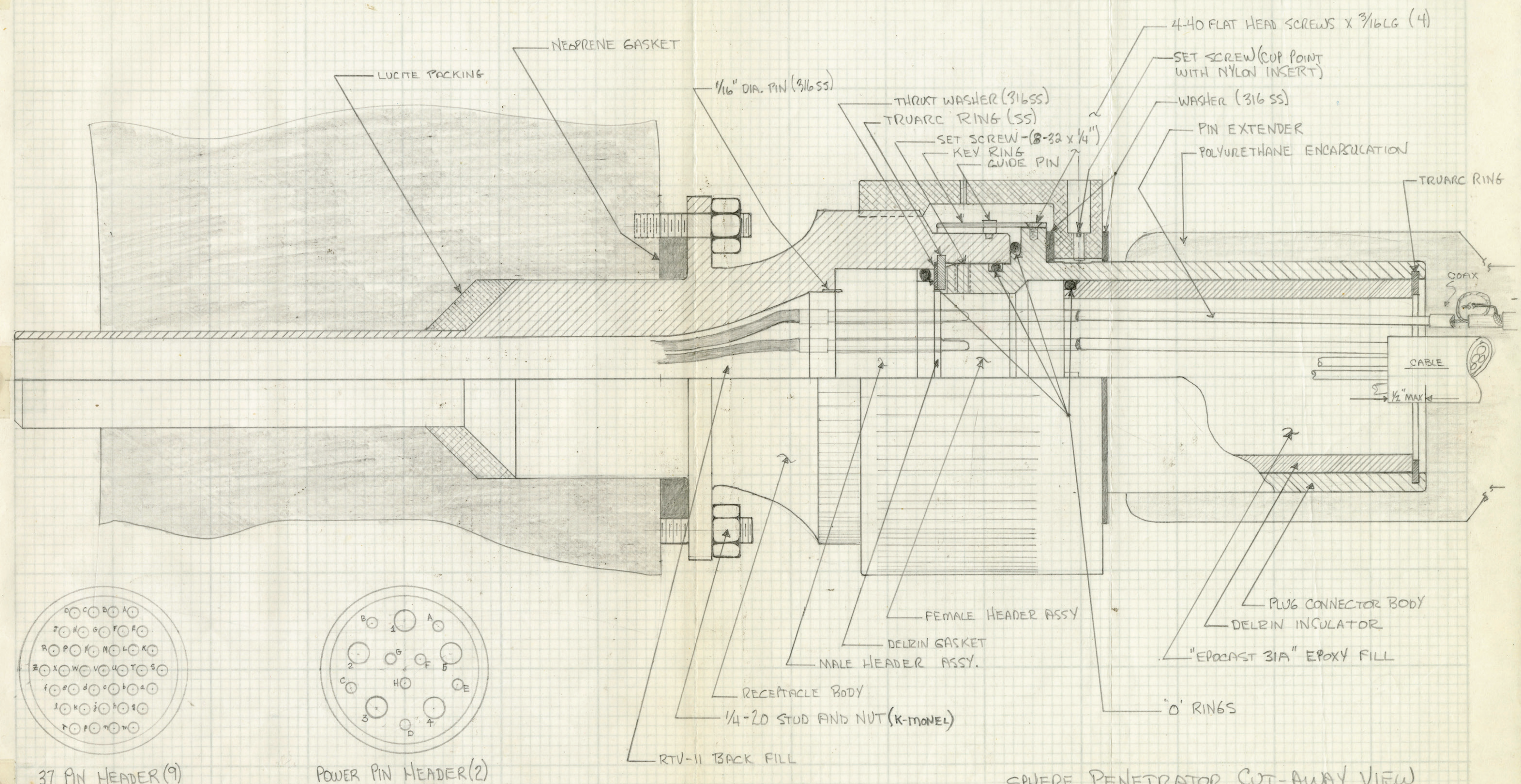
SECTION THROUGH SPHERE PENETRATOR

FIGURE 2-3



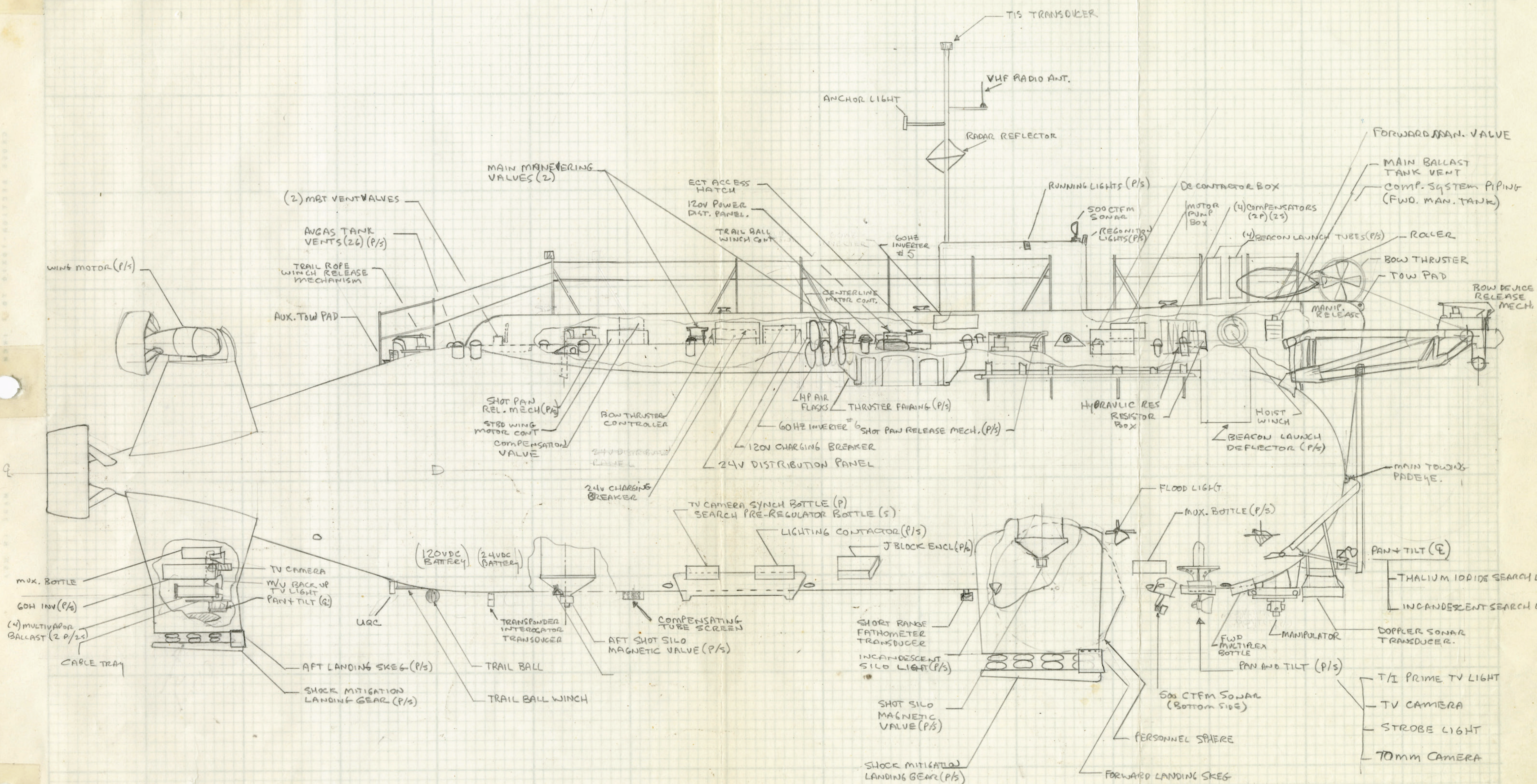
SPHERE PENETRATOR ARRANGEMENT

FIGURE 2-4



SPHERE PENETRATOR CUT-AWAY VIEW

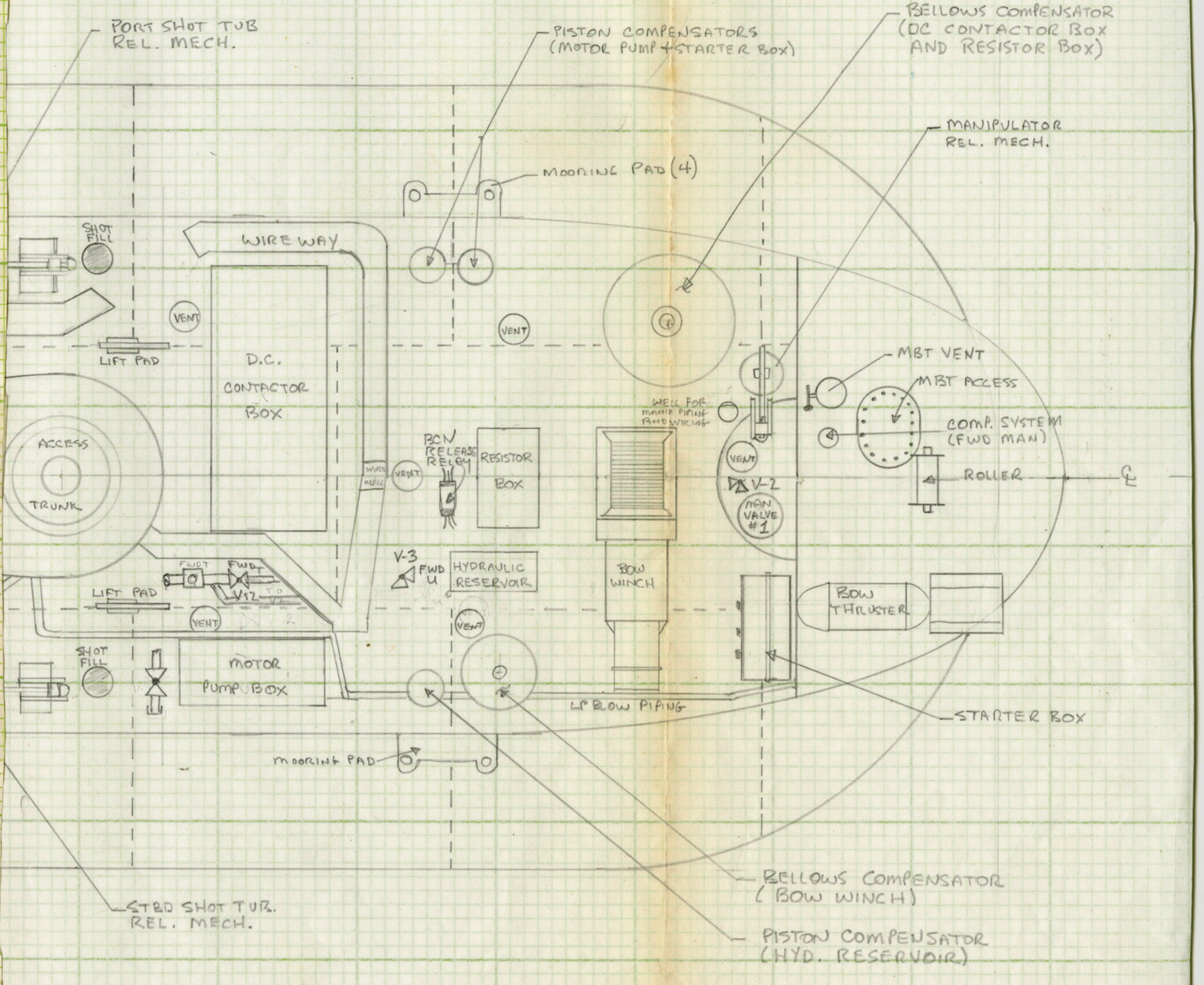
FIGURE 2-5



TIS TRANSDUCER
VHF RADIO ANT.
ANCHOR LIGHT
RADAR REFLECTOR
FORWARD MAN. VALVE
MAIN BALLAST TANK VENT
COMP. SYSTEM PIPING (FWD. MAN. TANK)
MAIN MANEUVERING VALVES (2)
ECT ACCESS HATCH
12OV POWER DIST. PANEL.
TRAIL BALL WINCH CONT
(2) MBT VENT VALVES
AVGAS TANK VENTS (26) (P/S)
TRAIL ROPE WINCH RELEASE MECHANISM
WING MOTOR (P/S)
AUX. TOW PAD
60HZ INVERTER #5
CENTERLINE MOTOR CONT.
RUNNING LIGHTS (P/S)
500 CTFM SONAR
RECOGNITION LIGHTS (P/S)
DC CONTACTOR BOX
MOTOR PUMP BOX
(4) COMPENSATORS (2P) (2S)
(4) BEACON LAUNCH TUBES (P/S)
ROLLER
BOW THRUSTER
TOW PAD
ROW DEVICE RELEASE MECH.
MANIP. RELEASE
SHOT PAN REL. MECH (P/S)
STBD WING MOTOR CONT
COMPENSATION VALVE
BOW THRUSTER CONTROLLER
HP AIR FLASKS
THRUSTER FAIRING (P/S)
60HZ INVERTER #6
SHOT PAN RELEASE MECH. (P/S)
12OV CHARGING BREAKER
24V DISTRIBUTION PANEL
24V CHARGING BREAKER
HYDRAULIC RES
RESISTOR BOX
HOIST WINCH
BEACON LAUNCH DEFLECTOR (P/S)
MAIN TOWING PADEYE.
FLOOD LIGHT
MUX. BOTTLE (P/S)
TV CAMERA SYNCH BOTTLE (P)
SEARCH PRE-REGULATOR BOTTLE (S)
LIGHTING CONTACTOR (P/S)
J BLOCK ENCL (P/S)
(120VDC BATTERY)
(24VDC BATTERY)
PAN + TILT (℄)
THALIUM IODIDE SEARCH LT.
INCANDESCENT SEARCH LT.
MUX. BOTTLE
TV CAMERA
60H INV (P/S)
M/U BACK UP TV LIGHT
PAN + TILT (℄)
(4) MULTIVAPOR BALLAST (2 P/2S)
CABLE TRAY
UQC
TRANSPONDER INTERROGATOR TRANSDUCER
COMPENSATING TUBE SCREEN
AFT SHOT SILO MAGNETIC VALVE (P/S)
AFT LANDING SKEG (P/S)
TRAIL BALL
SHOCK MITIGATION LANDING GEAR (P/S)
TRAIL BALL WINCH
SHORT RANGE FATHOMETER TRANSDUCER
INCANDESCENT SILO LIGHT (P/S)
FWD MULTIPLEX BOTTLE
MANIPULATOR
DOPPLER SONAR TRANSDUCER.
PAN AND TILT (P/S)
T/I PRIME TV LIGHT
TV CAMERA
STROBE LIGHT
70mm CAMERA
500 CTFM SONAR (BOTTOM SIDE)
SHOT SILO MAGNETIC VALVE (P/S)
PERSONNEL SPHERE
SHOCK MITIGATION LANDING GEAR (P/S)
FORWARD LANDING SKEG

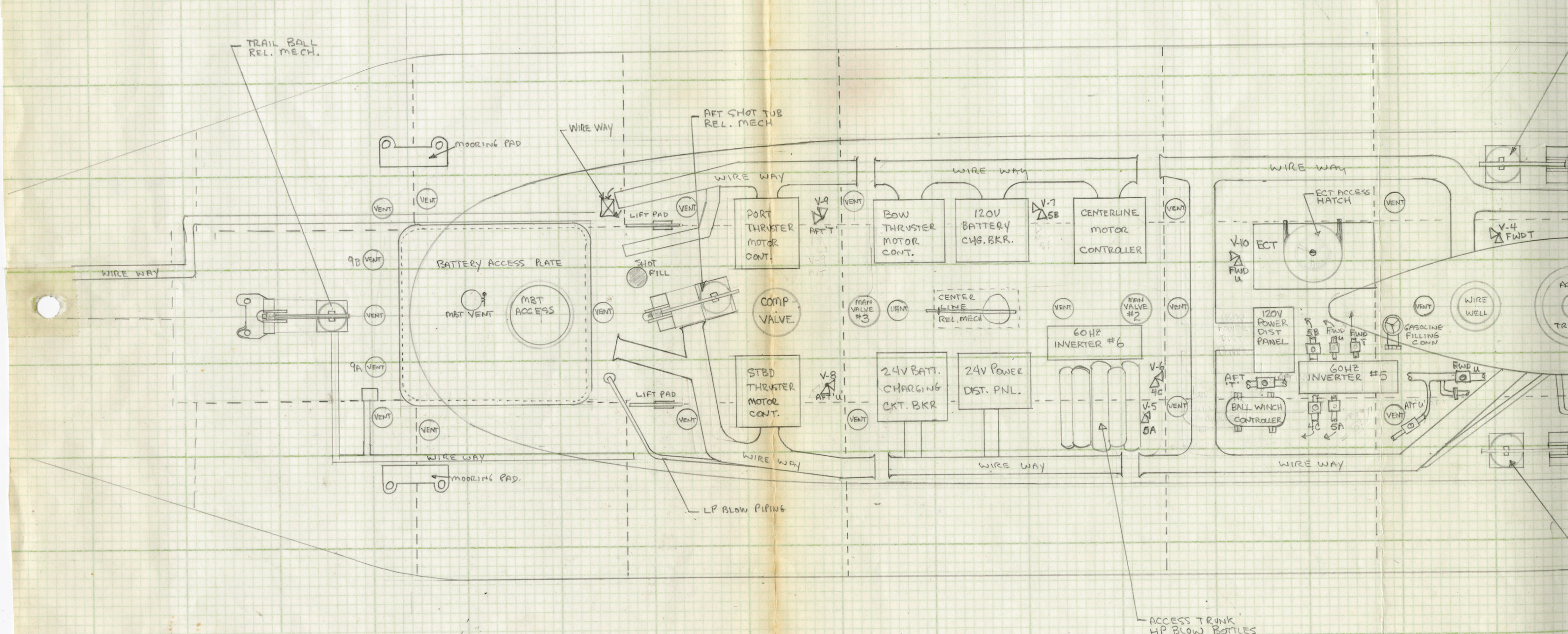
FIGURE 2-6

DIGITIZATION NOTE: This is a 3 part, folded map.
See next page of scan for continuation

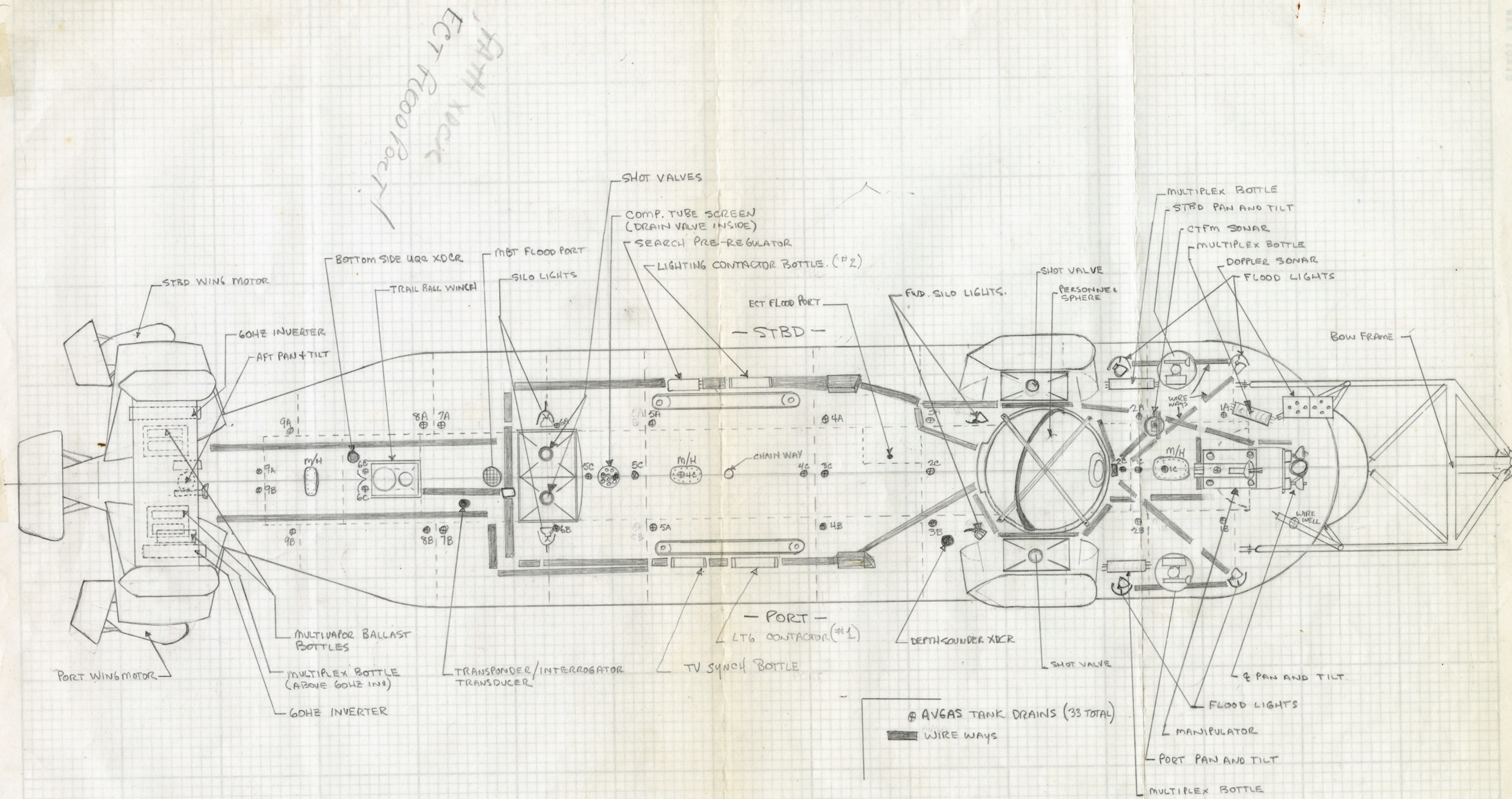


...IPMENT LAYOUT

FIGURE 2-7

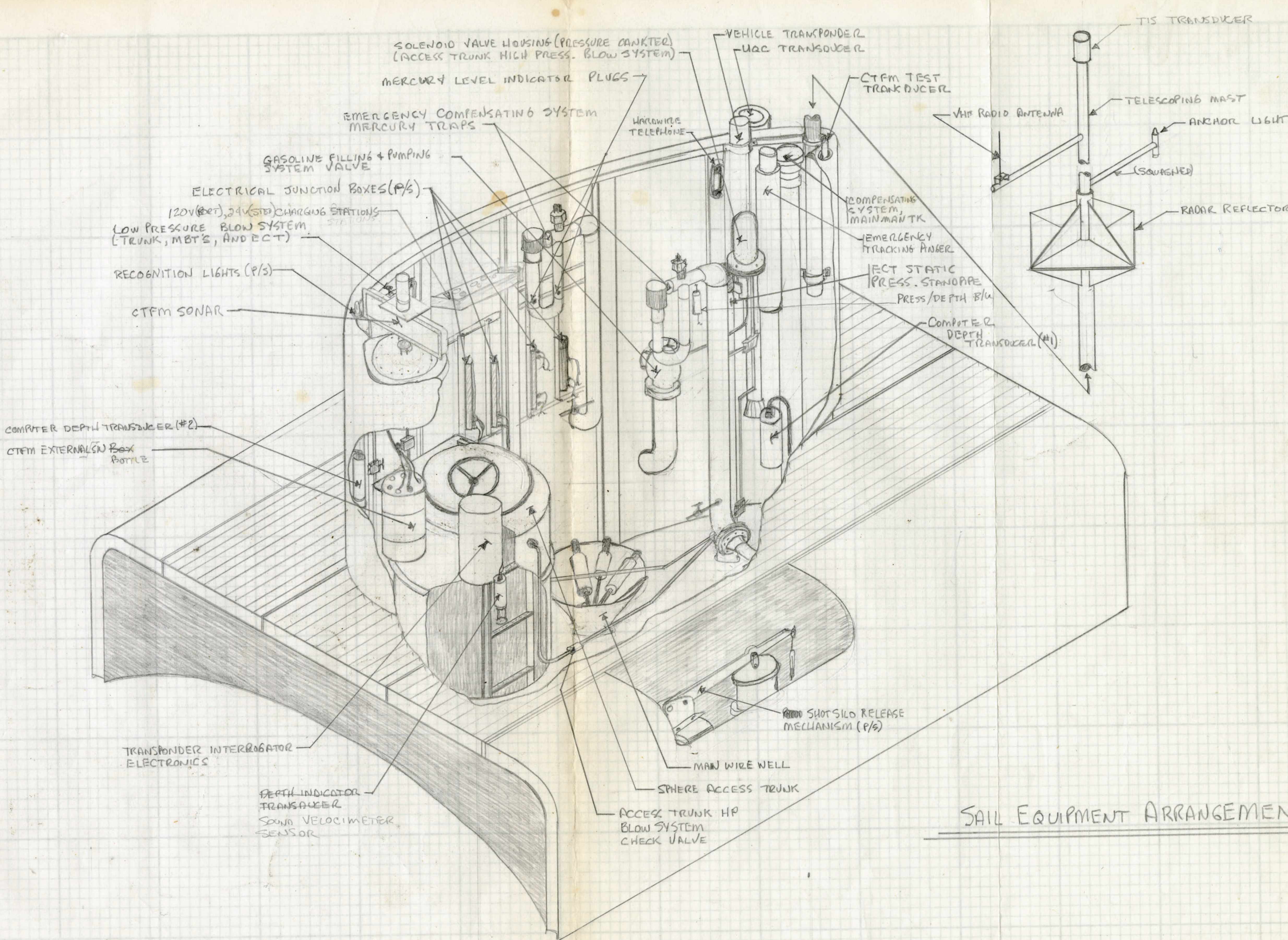


TOP SIDE EQUIP



BOTTOMSIDE ARRANGEMENT

FIGURE 2-8



SAIL EQUIPMENT ARRANGEMENT

FIGURE 2-9

DIGITIZATION NOTE: This is a 3 part, folded map.
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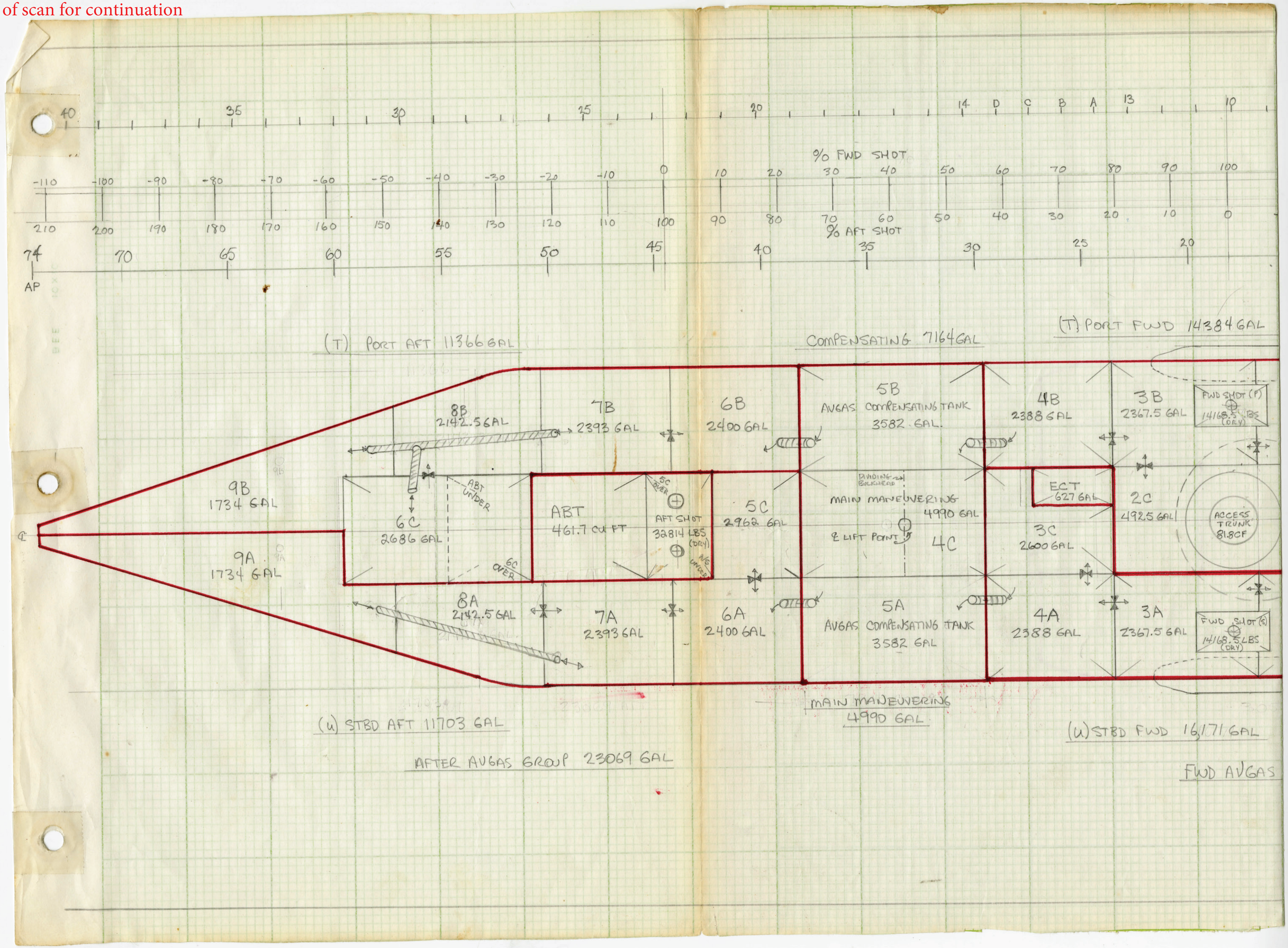


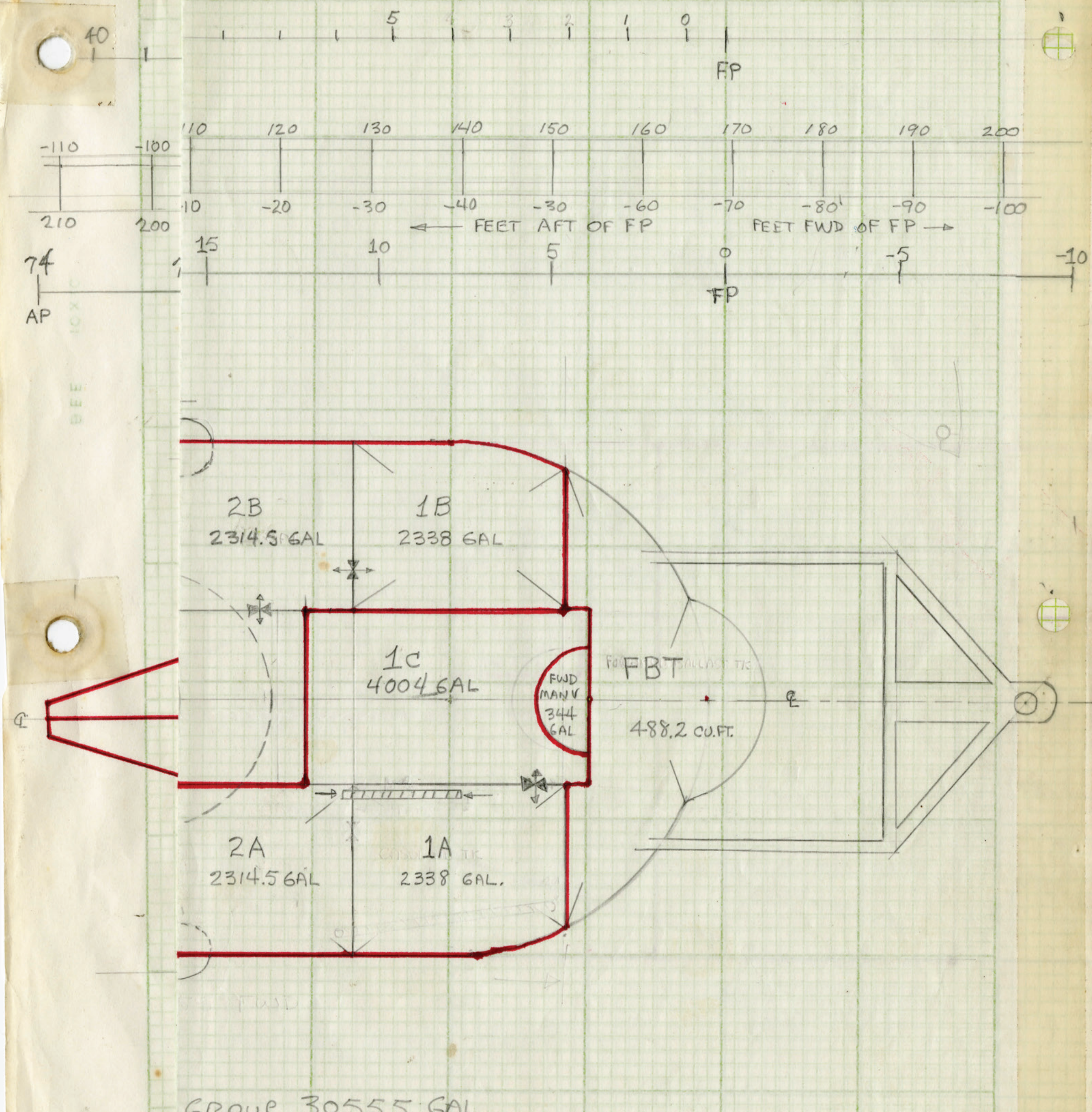

40
5 4 3 2 1 0
FP
110 120 130 140 150 160 170 180 190 200
-110 -100
210 200
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100
← FEET AFT OF FP
FEET FWD OF FP →
74
AP
15 10 5 0 -5 -10
FP
2B
2314.5 GAL
1B
2338 GAL
1C
4004 GAL
FWD MAN V 344 GAL
FBT
488.2 CU.FT.
2A
2314.5 GAL
1A
2338 GAL.
GROUP 30555 GAL

FIGURE 2-10

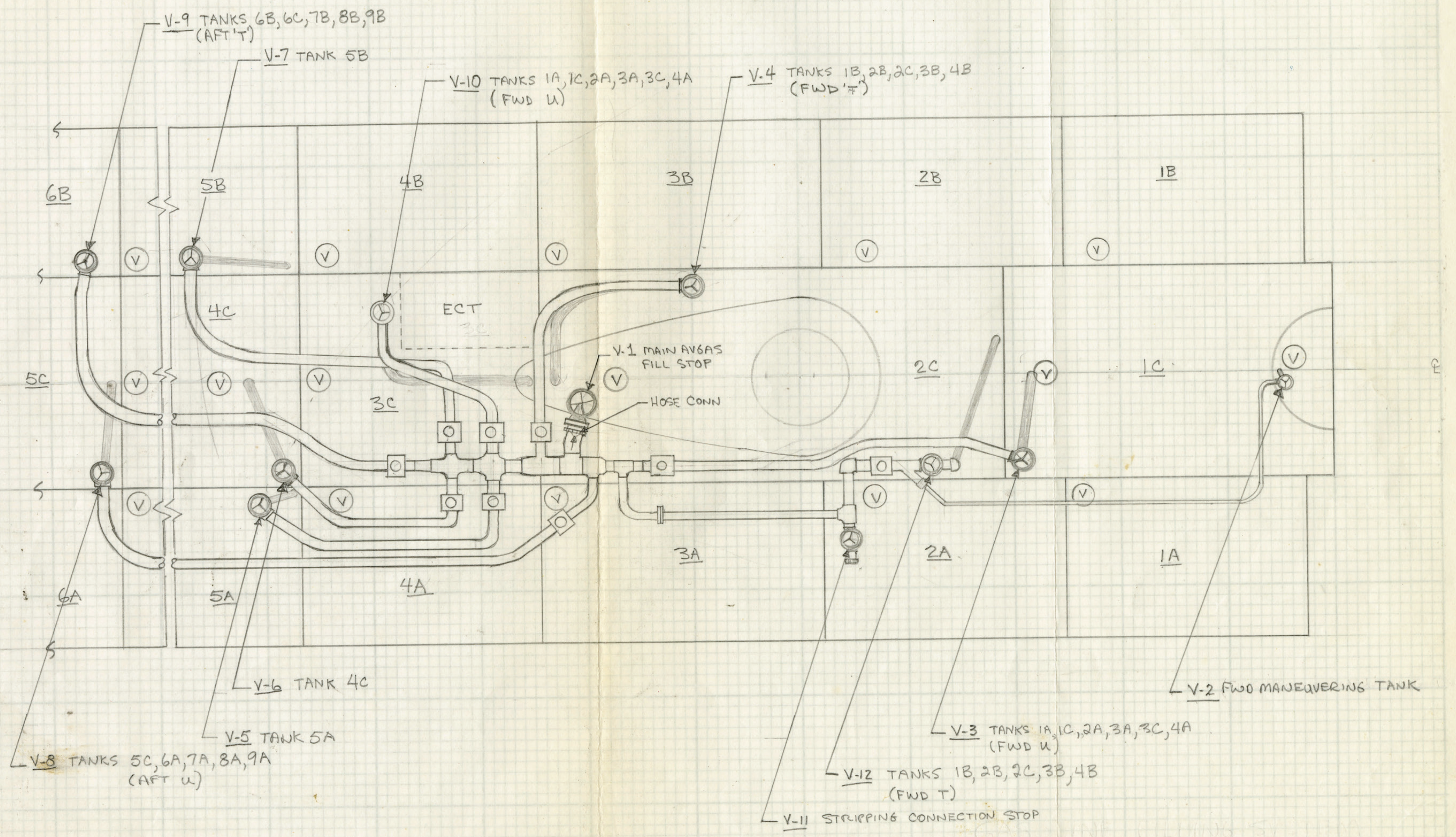
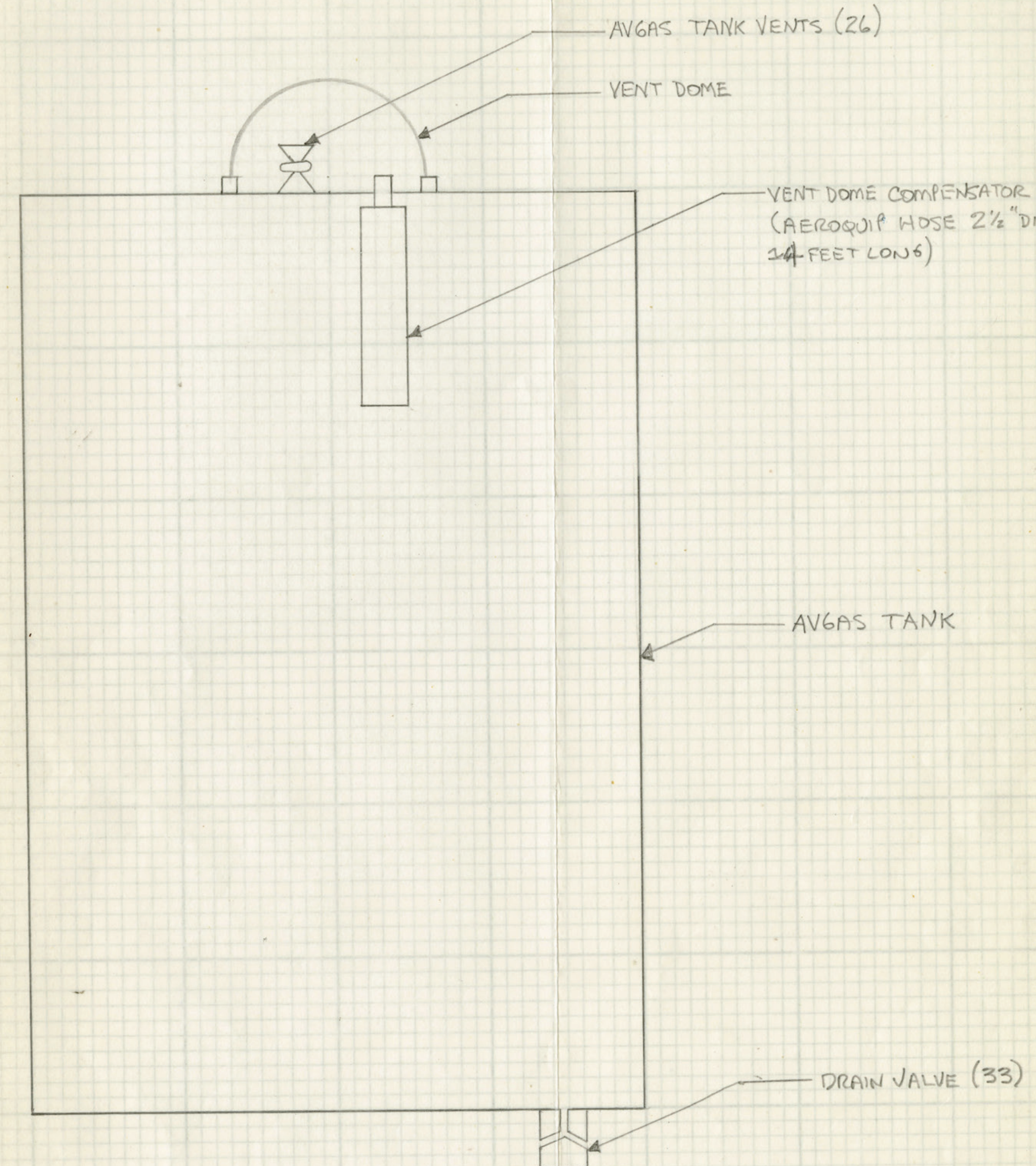
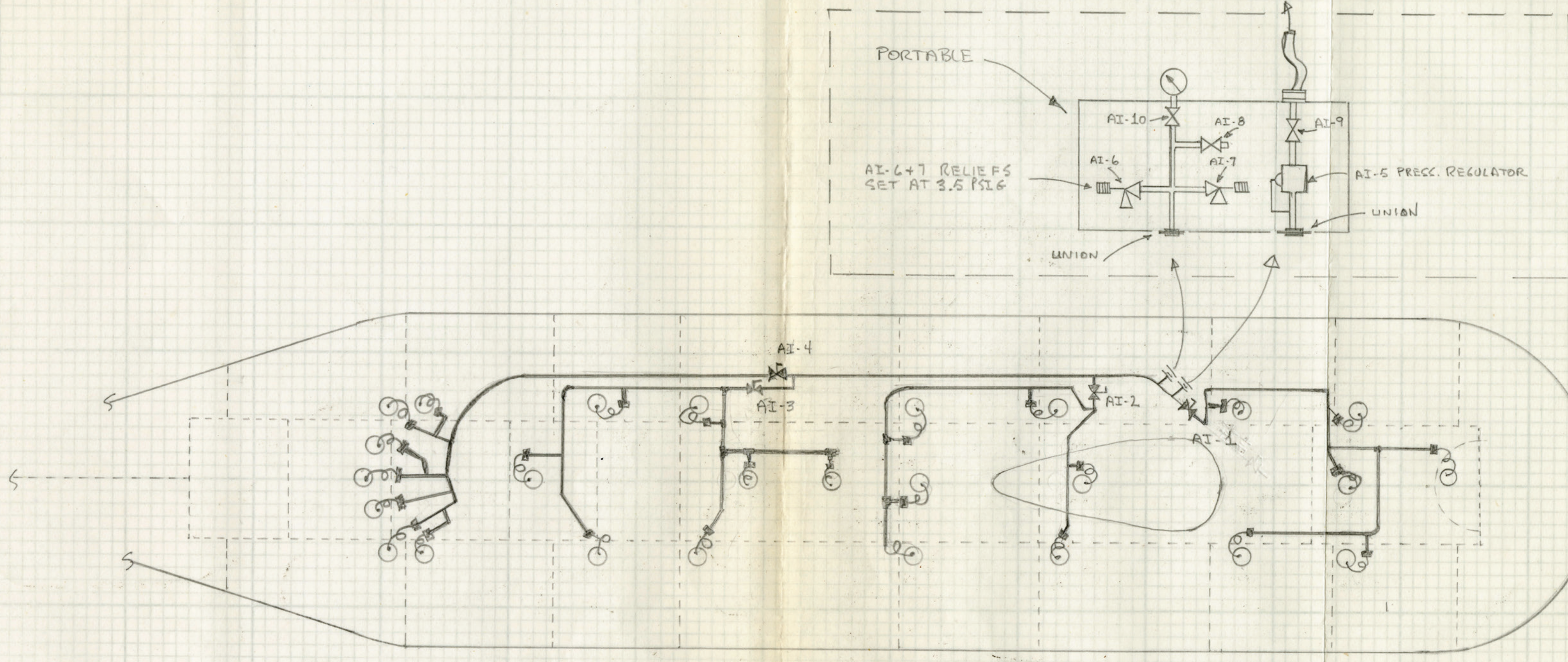

V-9 TANKS 6B, 6C, 7B, 8B, 9B (AFT 'T')
V-7 TANK 5B
V-10 TANKS 1A, 1C, 2A, 3A, 3C, 4A (FWD U)
V-4 TANKS 1B, 2B, 2C, 3B, 4B (FWD 'T')
6B
5B
4B
3B
2B
1B
4C
ECT
V-1 MAIN AVGAS FILL STOP
HOSE CONN
5C
3C
2C
1C
3A
2A
1A
6A
5A
4A
V-6 TANK 4C
V-5 TANK 5A
V-8 TANKS 5C, 6A, 7A, 8A, 9A (AFT U)
V-2 FWD MANEUVERING TANK
V-3 TANKS 1A, 1C, 2A, 3A, 3C, 4A (FWD U)
V-12 TANKS 1B, 2B, 2C, 3B, 4B (FWD T)
V-11 STRIPPING CONNECTION STOP

FIGURE 2-11



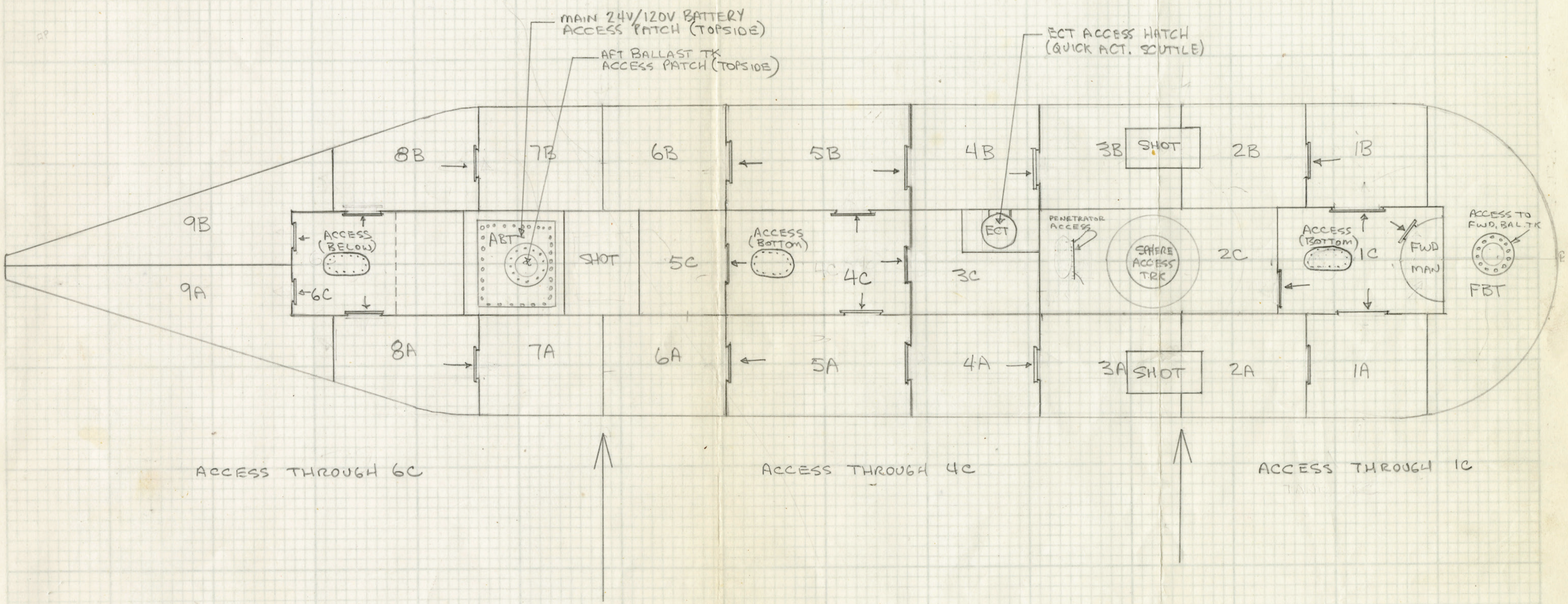
AVGAS TANK VENT + DRAIN SYSTEM

FIGURE 2-12



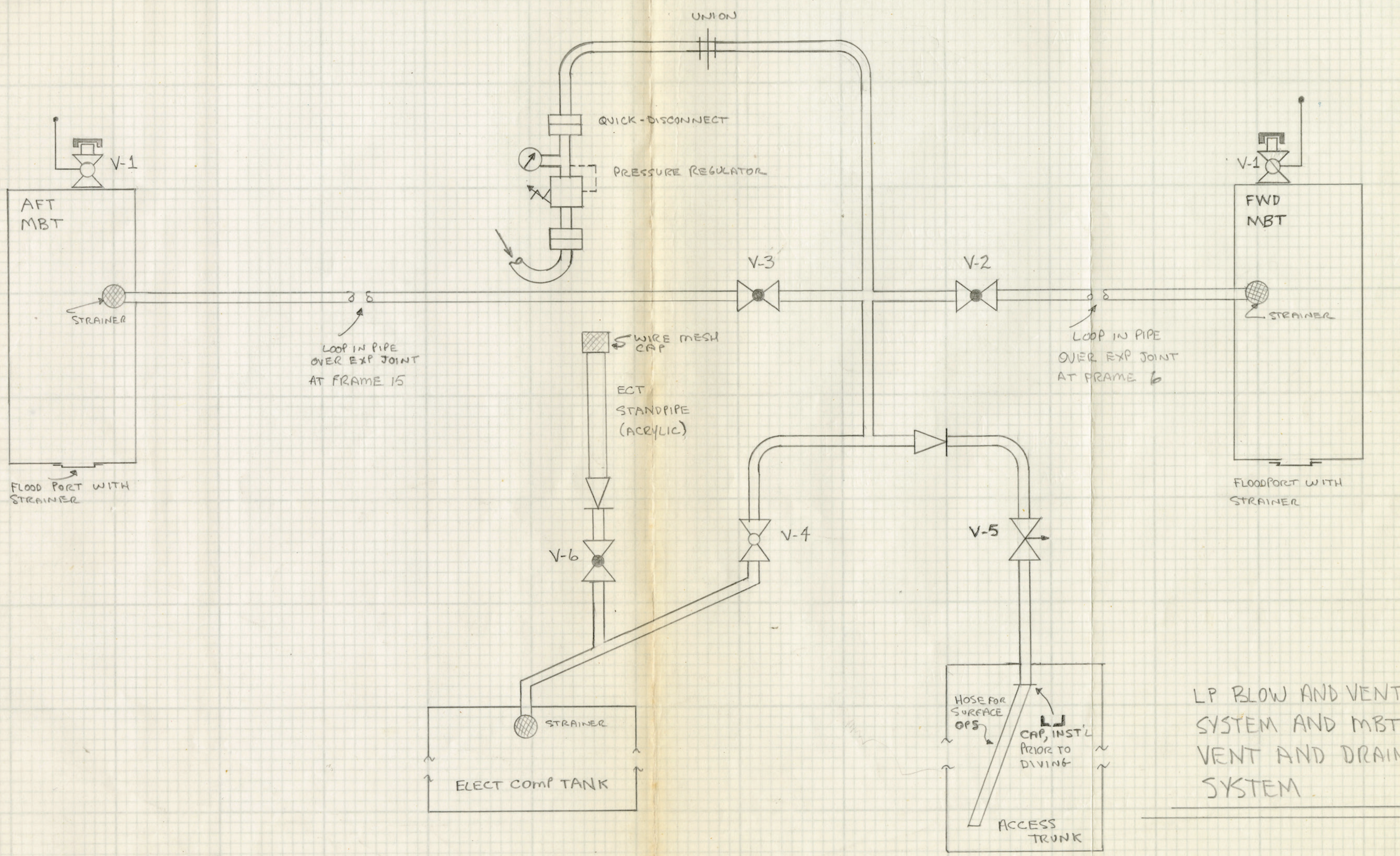
NITROGEN INERTING SYSTEM

FIGURE 2-13



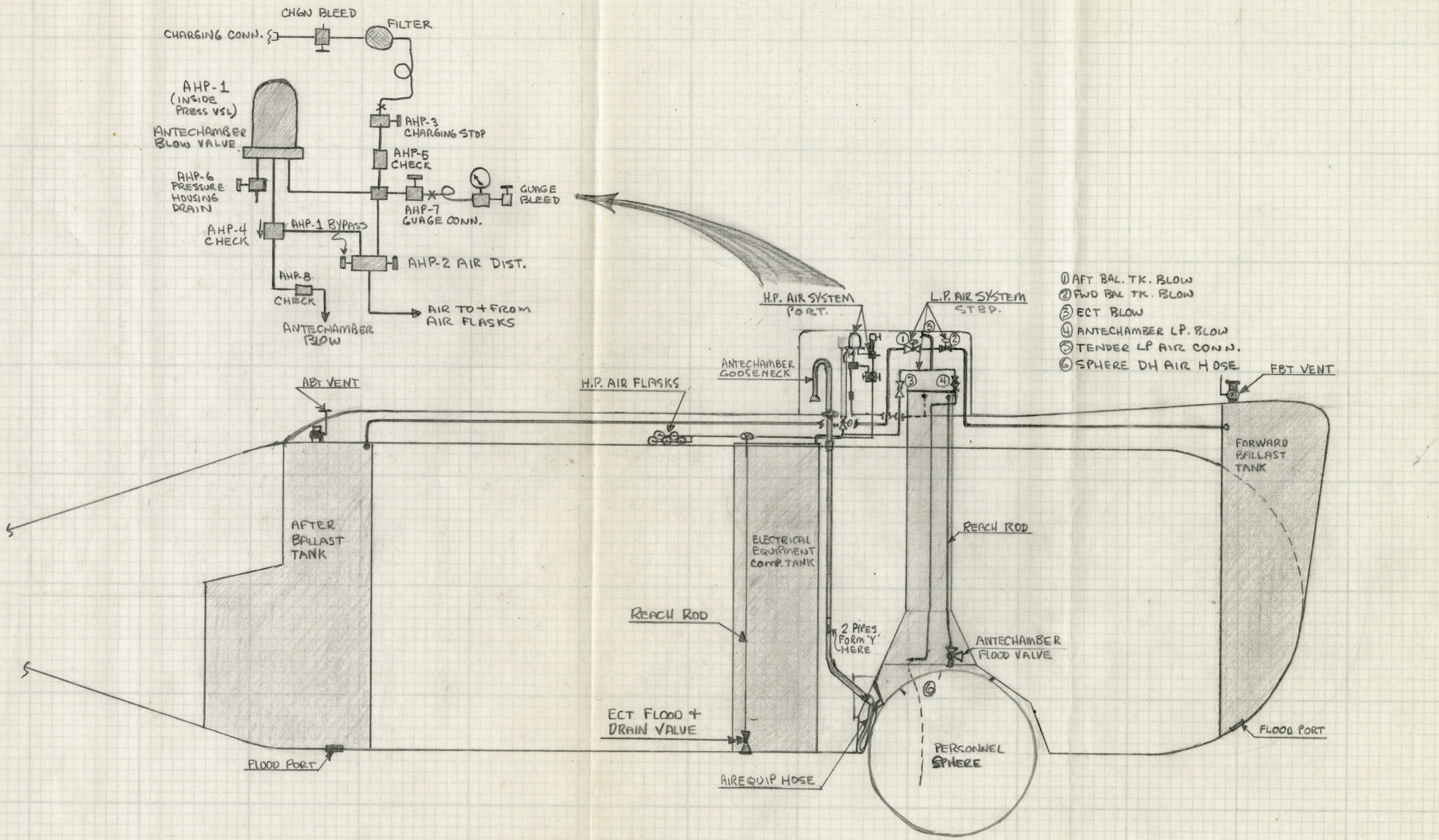
FLOAT ARRANGEMENT SHOWING ACCESSES

FIGURE 2-14



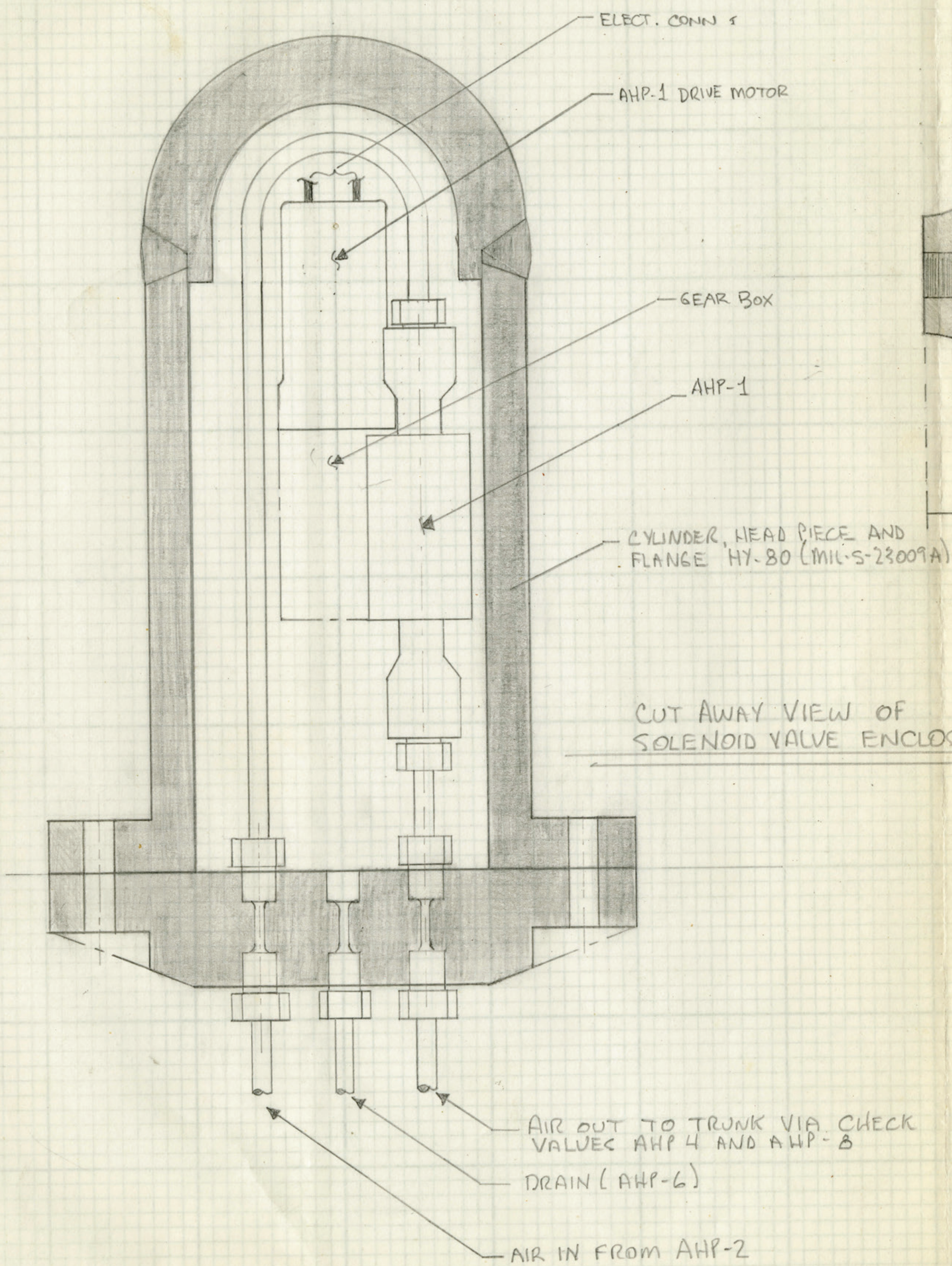
LP BLOW AND VENT SYSTEM AND MBT VENT AND DRAIN SYSTEM

FIGURE 2-17

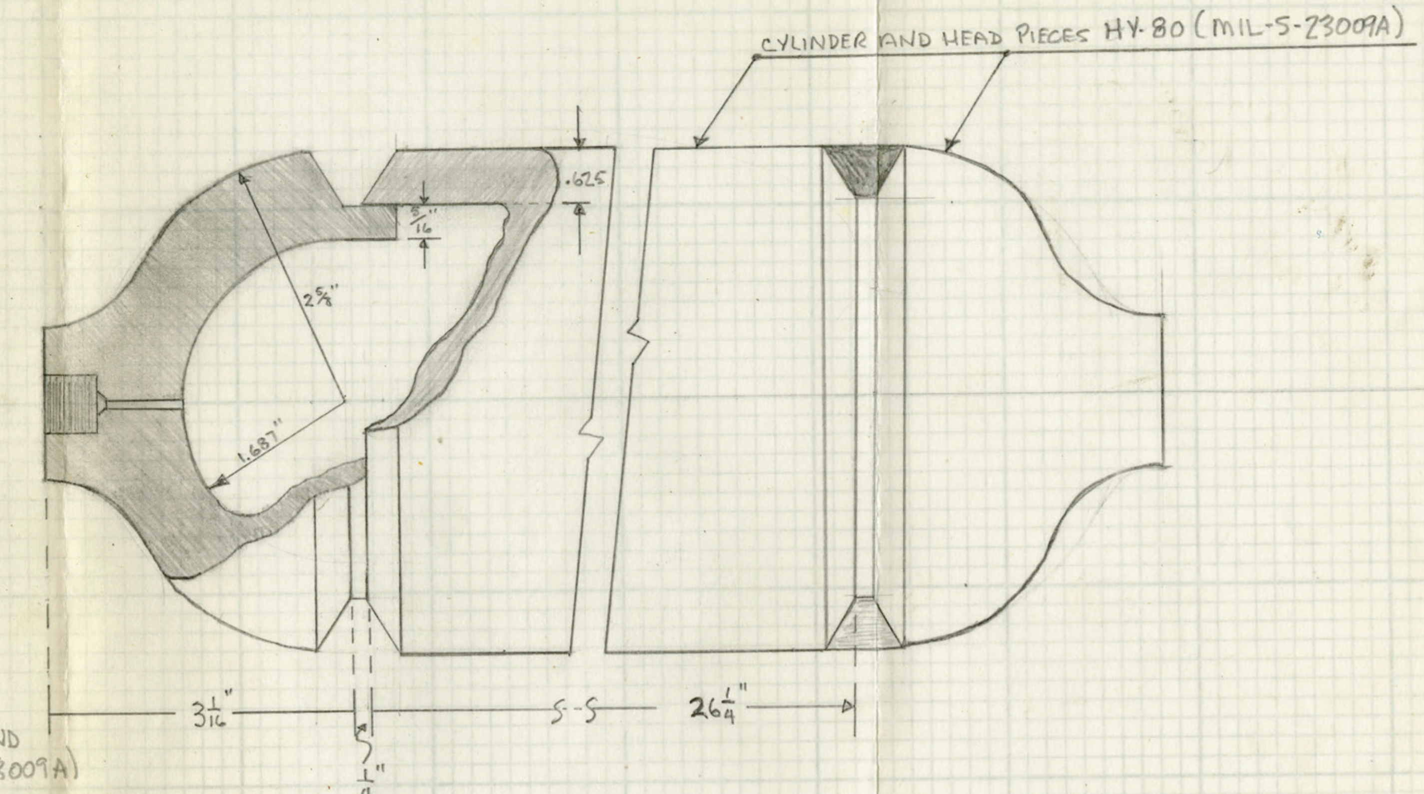


H.P. AIR, L.P. AIR SYSTEMS
BALLAST TANK & ECT FLOOD & DRAIN

FIGURE 2-15

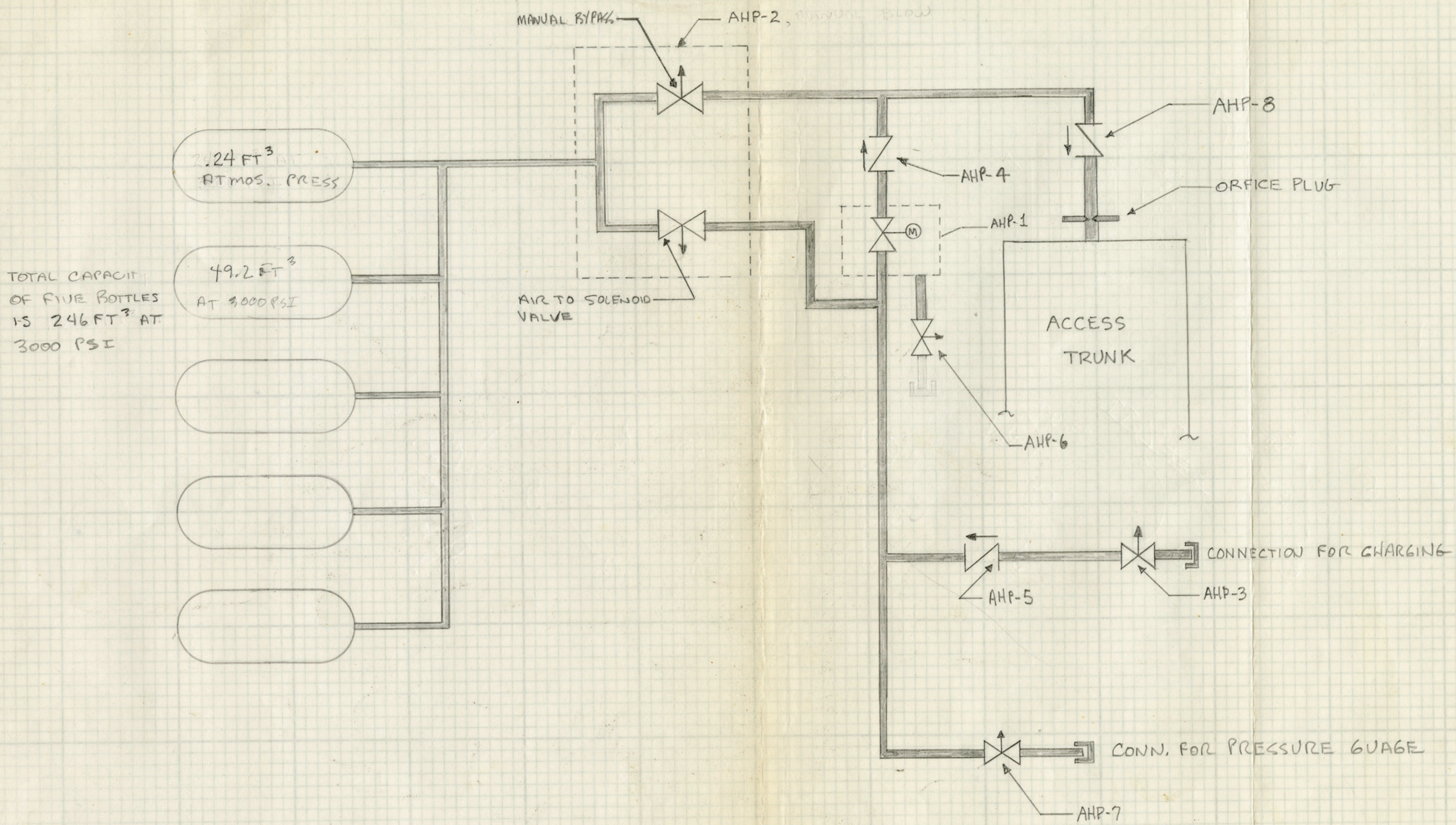


CUT AWAY VIEW OF SOLENOID VALVE ENCLOSURE



HIGH PRESSURE AIR BOTTLE

FIGURE 2-16



3000 PSI HP. AIR SYSTEM

FIGURE 2-18