

INSTRUCTION MANUAL

for

"CATHELCO"

ELECTROLYTIC PROTECTION SYSTEM

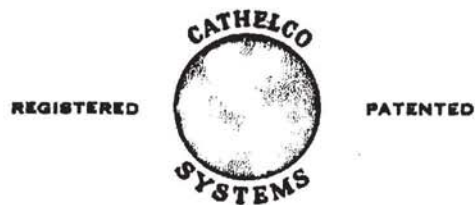
REFERENCE No: 222-820M11 - EMCS. NO. 18-2008A

NAME OF VESSEL: C.C.G.S. "FRANKLIN"

OWNER OF VESSEL: GOVERNMENT OF CANADA

SHIPBUILDER: BURRARD DRY DOCK CO. LTD.

HULL No: 222 DATE:



Phone
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ELECTROLYTIC MARINE CORROSION SERVICES LTD.
HEAD OFFICE P.O. BOX 663 VICTORIA BRITISH COLUMBIA

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C O N T E N T S

	<u>Page</u>
HISTORY OF SYSTEM.....	1
INTRODUCTION	2
UNDERWATER EQUIPMENT	3
SEA BOXES OR CHESTS	3a
ANODES	4
CONTROL PANELS	5
METERS	6
SIGNAL LIGHTS	6
TOGGLE SWITCHES	7
CARE OF SEA CHESTS	8
LIST OF ANODES	9,a,b,c,d
MAIN PANEL PARTS LIST	10,a,b,c,d
DRAWINGS	

HISTORY OF THE SYSTEM

THE "CATHELCO" SYSTEMS IS A 100% CANADIAN PRODUCT RESEARCHED AND ENGINEERED BY CANADIAN ENGINEERS AND ELECTRO-CHEMISTS IN VICTORIA, BRITISH COLUMBIA. -- THE FIRST SYSTEM OF THIS TYPE WAS INSTALLED IN THE S.S. "PRINCESS KATHLEEN" OF THE CANADIAN PACIFIC COAST SERVICES IN 1950 UNDER THE PROTECTION OF PATENTS GRANTED TO F. LEWIS CHAPPELL OF VICTORIA, B.C. THIS INSTALLATION WAS MADE ON A "NO CURE - NO PAY BASIS" FOR A PERIOD OF ONE YEAR. WITHIN NINE MONTHS IT WAS CONSIDERED BENEFICIAL TO THE OPERATION OF THE VESSEL, RESULTING IN THREE ADDITIONAL C.P.R. COAST STEAMSHIP VESSELS BEING FITTED WITH THE SYSTEM IN 1951-52. SINCE THAT TIME CONSIDERABLE PROGRESS HAS BEEN MADE BY THE COMPANY BOTH IN RESEARCH AND APPLICATION. VALUABLE ASSISTANCE HAS BEEN RECEIVED FROM THE PACIFIC NAVAL LABORATORIES AND THE ENGINEERS OF VARIOUS CANADIAN GOVERNMENT AND PROVINCIAL GOVERNMENT SHIPPING DEPARTMENTS. TO ALL THOSE AGENCIES WHO CONTRIBUTED TOWARD OUR PRESENT SUCCESS WE OFFER GRATEFUL THANKS. RESEARCH IS CONTINUING UNDER THE GUIDANCE OF THE TECHNICAL DIRECTOR -- TO CONTINUALLY INCREASE THE EFFICIENCY AND SIMPLICITY OF THE "CATHELCO" SYSTEMS WITH THE RAPID EXPANSION OF OUR FOREIGN MARKETS -- GIVING OUR TECHNICAL STAFF A TREMENDOUS FIELD OF VARIATIONS OF APPLICATION.

I N T R O D U C T I O N

YOUR VESSEL HAS BEEN EQUIPPED WITH A DUAL PURPOSE PROTECTIVE SYSTEM FOR THE CONTROL OF CORROSION AND SHELL FISH INFESTATION IN SEA WATER CIRCULATING SYSTEMS: KNOWN AS THE "CATHELCO" SYSTEM.

THE ELECTRICAL CONTROL PANELS DIFFER ONLY IN THE NUMBER OF OUTLETS REQUIRED FOR ANY SPECIFIED VESSEL -- ALSO IN THE AREA IN WHICH THE VESSEL WILL SERVE, EXAMPLE: A DEEP SEA SHIP WILL PLY IN MANY SEA WATER CHANGES, THEREFORE AUTOMATION WITHIN THEIR CONTROL PANELS TO MEET THESE CHANGES ARE INCLUDED WHICH IS NOT ONLY TIME SAVING FOR THE ENGINEERS WHO WOULD HAVE TO MANUALLY PERFORM THE TASK: BUT IT IS ALSO MORE EXACTING. --- IN ALL CASES A SPARE PARTS LIST, WITH THE COMPONENTS PROPERLY NUMBERED IS INCLUSIVE IN ORDER THAT MALFUNCTIONS CAN BE ORDERED IMMEDIATELY AND REPLACED AS SPEEDILY AS POSSIBLE.

SAVRIFICIAL ANODES OF SPECIAL ALLOYS AND CATALYSTS, ARE STRATEGICALLY ARRANGED IN THE SEACHESTS AND SEAWELL, THIS IS THE PRIME REACTION AREA WHERE ALL RAW SEA WATER MUST PASS THROUGH BEFORE ENTERING THE VARIOUS SEA WATER CIRCULATING SERVICES OF THE VESSEL IN THE FOLLOWING SEQUENCE:--

U N D E R W A T E R E Q U I P M E N T

ANODES & CONNECTIONS

MOST OF OUR INSTALLATIONS OVER THE YEARS HAVE BEEN IN NEW SHIPS AND ELECTRICAL POWER PLANTS, THIS, OF COURSE HAS BEEN A TREMENDOUS ADVANTAGE BOTH IN DESIGN AND EFFICIENCY OF THE "CATHELCO" SYSTEM HAVING A PREPARED PLACE IN WHICH TO INSTALL IT DURING THE SHIP'S CONSTRUCTION PERIOD, AND FURTHER, IN THE MAJORITY OF CASES, HAVING "CATHELCO" MARINE ENGINEERS APPOINTED TO SUPERVISE THE SEA-WATER PIPING LAYOUT, RESULTING IN A MINIMUM OF INDUCEMENTS TO CORROSION SUCH AS DISSIMILAR METALS AND UNNECESSARY PIPING FITMENTS INTRODUCING WATER TURBULENCE WITHIN THE SYSTEM. HOWEVER, IN A VESSEL ALREADY IN SERVICE OUR TASK BECOMES A LITTLE MORE DIFFICULT BECAUSE ANODES ARE NOT JUST PLACED ANYWHERE IN A COOLING SYSTEM, THEY MUST BE PLACED IN A STRATEGIC POSITION, THIS IS NOT ALWAYS POSSIBLE OWING TO THE ALREADY CRAMPED LAYOUT OF THE COOLING SYSTEM SO THAT OTHER MEANS OF POSITIONING THESE ALL IMPORTANT ANODES RESULTED IN TIME AND MONEY CONSUMING RESEARCH TO FIND OTHER MEANS OF INSTALLATION IN ALMOST INACCESSABLE POSITIONS USING THE USUAL STANDARD METHODS.

S E A B O X E S

IN ORDER TO SUCCESSFULLY TREAT THE RAW SEA-WATER IN A SHIP, IT IS NECESSARY NOT ONLY TO CENTRALIZE THE FLOW INTO THE VESSEL, BUT ALSO PROVIDE TREATMENT AT THE SOURCE OF WATER INTAKE, CHIEFLY AT THIS POINT OWING TO THE MARINE GROWTH INFESTATION WHICH IS NOT ONLY A MENACE FROM THE BLOCKAGE ANGLE, BUT INFESTATION WITHIN THE PIPING AND UNITS ARE INDUCIVE TO CORROSION OWING TO THE TURBULENCE CREATED IN THE FLOW.

IT IS OBVIOUS THEREFORE THAT SEA-BOXES ARE NECESSARY TO HOUSE THE ANODES, WHICH WOULD BE IMPOSSIBLE WITH THE CONVENTIONAL SHIPSIDE VALVES.

IN THESE SEA-BOXES ARE HOUSED THE MARINE GROWTH ANODES. THESE ARE DUAL ANODES OF DIFFERING MAJOR METALS CONTAINING "CATALYSTS" WHICH DESTROY SIMPLE MARINE ORGANISMS. THIS TERM SIMPLE MARINE ORGANISMS IS IMPORTANT BECAUSE, THE DESIGN OF THE "CATHELCO" SYSTEM FOR THIS, OR FOR THAT MATTER ANY NEWLY BUILT SHIP IS TO DESTROY THESE ORGANISMS RIGHT FROM THE START WHICH ONLY REQUIRES A SMALL ANODE TERMINAL CURRENT TO DO SO, (SEE PANEL OPERATION), BECAUSE IF INFESTATION DOES OCCUR AND THE INFESTATION EVOLVES WITHIN THE WATER SYSTEM, IT NOT ONLY TAKES A VERY HIGH CURRENT TO DISLODGE THEM, (WASTE OF ANODE MATERIAL), BUT SEVERE BLOCKAGE IN THE PIPING AND UNITS WOULD RESULT AS THEY BROKE AWAY FROM THE INNER SURFACES. IN ORDER TO BE FREE OF SUCH A CONDITION, THESE MARINE GROWTH ANODES IN THE SEA-BOXES ARE IMPRESSED WITH A CALCULATED ELECTRIC CURRENT TO REMAIN ON CONTINUOUSLY FOR THE LIFE OF THE ANODES.

A N O D E S - (CORROSION) DRAWING NO.

THESE PIECES OF EQUIPMENT VARY CONSIDERABLY BOTH IN WEIGHT, SHAPE, AND ALLOYS -- THE REASONS FOR THIS OF COURSE ARE:--

- (1) THE AREA OF METALS INVOLVED IN PROTECTION OF ANY GIVEN INSTALLATION (WEIGHT OF ANODE).
- (2) CONTOURS OF THE REACTION AREAS IN WHICH THE ANODES ARE HOUSED (SHAPE).
- (3) ALLOYS AND CATALYSTS, TO FUNCTION EFFICIENTLY FOR THE VARIED TYPES OF RAW WATER (ANALYSIS) BEING TREATED (A VESSEL SUCH AS A FERRY OR TUG OPERATING IN CLOSED WATERS WOULD BE EQUIPPED WITH DIFFERENT ALLOYED ANODES, THAN A DEEP SEA SHIP CLASSED AS A WORLD TRAVELLER PLYING THROUGH MANY DIFFERENT TYPES OF SEA WATER).

A N O D E S - (MARINE GROWTH) DRAWING NO.

THESE ANODES DO NOT PROVIDE ANY PROTECTION AGAINST CORROSION OF THE METALS -- THEY ARE DESIGNED AND ALLOYED PRECISELY FOR THE CONTROL OF MARINE ORGANISMS THROUGH THE MEDIA OF POISONS RELEASED BY AN IMPRESSED CURRENT OF ELECTRICITY. IN ADDITION TO THIS -- THESE ANODES ARE ESPECIALLY ALLOYED TO WORK IN CONJUNCTION WITH THE CORROSION ANODES IN ORDER TO PREVENT ANY OF THESE CORROSIVE "IONS" PLATING OUT ON THE METALS UNDER PROTECTION.

CONTROL PANELS

THE CONTROL PANELS NATURALLY VARY IN THEIR FABRICATION. IT IS BECAUSE OF THESE VARIATIONS IN "CATHELCO" EQUIPMENT IN EACH SPECIFIC INSTALLATION THAT ELECTROLYTIC MARINE CORROSION SERVICES LTD. MAINTAIN THE POLICY OF DESIGNING AND FABRICATING ALL THE EQUIPMENT IN THEIR OWN SHOPS -- THIS IMMEDIATELY CENTRALIZES ALL TROUBLE SHOOTING AND REPLACEMENTS.

BY STUDYING DRAWING -- PAGE 13 -- IT WILL BE NOTED IN THIS SCHEMATIC DIAGRAM THAT THE BASIC WIRING IS THE SAME EXCEPT FOR NUMBER OF OUTLETS REQUIRED FOR ANY SPECIFIC VESSEL, i.e. 115 AC 60 CYCLE SINGLE PHASE -- TO 5, 10, 15, 20, VOLTS D.C. THIS IS WHAT WE TERM ONE ELECTRICAL SUPPLY UNIT -- THE PURPOSE OF THIS IS THE LOAD IS LIGHT AND THEREFORE NATURALLY COOLED -- SOME LARGE CONTROL PANELS CONTAIN FOUR SUCH UNITS. -- i.e. SHOULD EIGHT UNITS BE REQUIRED ON ONE SHIP TWO SUCH CONTROL PANELS WOULD BE NECESSARY -- OR IF FIVE UNITS WERE NEEDED -- ONE LARGE AND ONE SINGLE UNIT PANEL WOULD BE SUPPLIED. THE ADDITIONAL VARIATION IN CONTROL PANEL CONSTRUCTION IS MANUAL OR AUTOMATION -- MANUAL CONTROL IS USUAL ON VESSELS THAT PLY THEIR SERVICE IN SIMILAR SEA WATER CONDITIONS -- AUTOMATION IS USED IN DEEP SEA SHIPS PLYING THEIR SERVICES IN THE VARIOUS SEA WATER CONDITIONS THE WORLD OVER. -- THE AUTOMATION IS GENERALLY GOVERNED BY

SEA TEMPERATURE AND SOMETIMES BY PRESSURE -- THESE STABILIZE THE CURRENT DENSITY REQUIRED FOR ANY GIVEN CONDITION OF RAW SEA WATER.

THE PHYSICAL FRONT OF THE PANEL.

THIS IS SELF EXPLANATORY. IT CAN BE SEEN THAT THE FRONT OF THE PANEL IS HINGED, AND CONTAINS THE NECESSARY METERS, TOGGLE SWITCHES, CUT OUT BREAKERS, SIGNAL LIGHTS AND THE CURRENT SETTINGS.

METERS

THERE ARE TWO METERS SHOWN ON THE PANEL FACE. THE VOLTMETER WITH A RANGE OF 0-5V GIVES THE INDIVIDUAL READING AT THE ANODE STATIONS, THE AMMETER WITH A RANGE OF 0-3A IS ENERGIZED WHEN THE VARIOUS TOGGLE SWITCHES ARE DEPRESSED. CARE SHOULD BE TAKEN TO MAINTAIN THE READINGS AS CLOSE AS POSSIBLE TO THE ONES THAT WERE SET AND MARKED WHEN THE SYSTEM IS INSTALLED. REMEMBER AT ALL TIMES THAT THE SEA WATER IS THE VARIABLE RESISTANCE IN THE CIRCUIT OF EACH ANODE. IT CAN BE READILY UNDERSTOOD THAT THE AMPERAGE READING WILL VARY IN ONE WAY OR ANOTHER IN A MEASUREMENT OF MILLIAMPS. THIS IS NORMAL AND SHOULD BE DISREGARDED.

SIGNAL LIGHTS

THERE ARE TWO SETS OF SIGNAL LIGHTS ON THE FRONT OF THE CONTROL PANEL. THE "GREEN" LAMPS ARE LIGHTED WHEN THE POWER IS TURNED ON. THE "RED" LIGHTS WILL LIGHT UP IF TROUBLE OCCURS. WHEN THIS HAPPENS YOU WILL FIND THAT ONE OF THE "BREAKER" SWITCHES IS IN THE "OFF" POSITION. FIRST TRY AND RESET THE BREAKER SWITCH. IF IT WILL NOT REMAIN IN POSITION, CHECK THE ANODE FOR A SHORT. IF TROUBLE CONTINUES, LEAVE BREAKER SWITCH IN THE "OFF" POSITION AND REPORT TROUBLE IN THE OPERATIONAL REPORT CARD SUPPLIED BY THE SYSTEM.

SPRING LOADED TOGGLE SWITCHES

THESE ARE POSITIVE ON-OFF SWITCHES THAT WILL ALLOW A READING TO BE TAKEN OF THE LOAD THAT IS BEING CARRIED ON THE ANODE. DUE TO THE SPRING LOADING THESE SWITCHES CAN NOT BE LEFT ON, THUS PROTECTING THE METERS AND LINES. BELOW EACH TOGGLE SWITCH YOU WILL NOTE A RED OR A BLOCK MARKER SHOWING WHETHER THE CONTROL IS FOR MARINE GROWTH OR CORROSION. YOU WILL ALSO NOTE THAT THE SUGGESTED AMPERAGE IS ALSO GIVEN, THIS SHOULD BE MAINTAINED AT ALL TIMES.

CARE OF SEA CHESTS

DURING THE FIRST YEAR OF OPERATION, THE CURRENT RATINGS ARE SET AT "MAXIMUM" -- THE PURPOSE OF THIS IS TO CONDITION THE RE-ACTION AREA AND TO DESTROY ANY MARINE GROWTH THAT MAY HAVE LODGED IN THE SYSTEM. A REASONABLY HEAVY COATING OF CALCAREOUS MATERIAL CAN ALSO BE EXPECTED IN THE SEA CHEST AREA. THIS COATING SHOULD BE CLOSELY EXAMINED AND ANY LOOSE COATING SHOULD BE REMOVED. IF COATING APPEARS EXCESSIVE, IT SHOULD BE CAREFULLY SCRAPED TO A SMOOTH SURFACE.

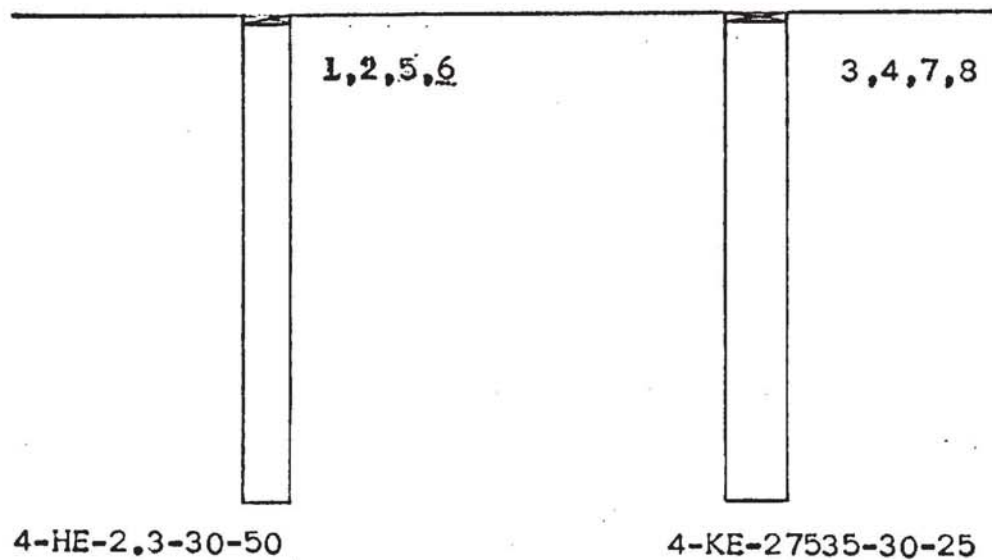
SUMMARY

LIKE ALL GOOD EQUIPMENT, REASONABLE CARE IS VERY NECESSARY TO MAINTAIN IT IN THE BEST OPERATIONAL CONDITION. YOUR "CATHELCO" SYSTEM IS NOT EXCEPTION ... THEREFORE WE ASK YOUR CO-OPERATION IN CHECKING THE "CATHELCO" PANELS EACH WATCH TO ENSURE THAT THE ANODES ARE OPERATING IN ACCORDANCE WITH THE CURRENT SETTINGS THAT WERE IMPRESSED BY OUR TECHNICIANS AT THE TIME OF PLACING THE SYSTEM IN OPERATION.

F. LEWIS CHAPPELL,
TECHNICAL DIRECTOR.

ELECTROLYTIC MARINE CORROSION SERVICES LTD.

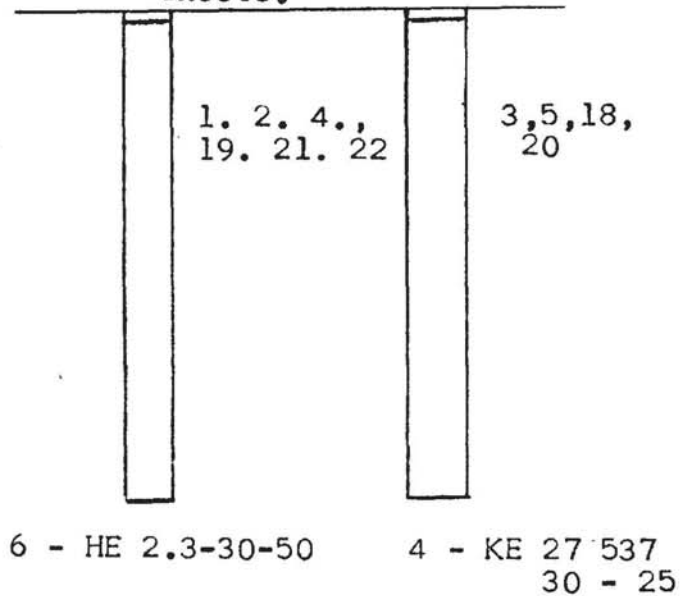
BOW THRUSTER -- Frames - 165 -- 176 -- PANEL " A "



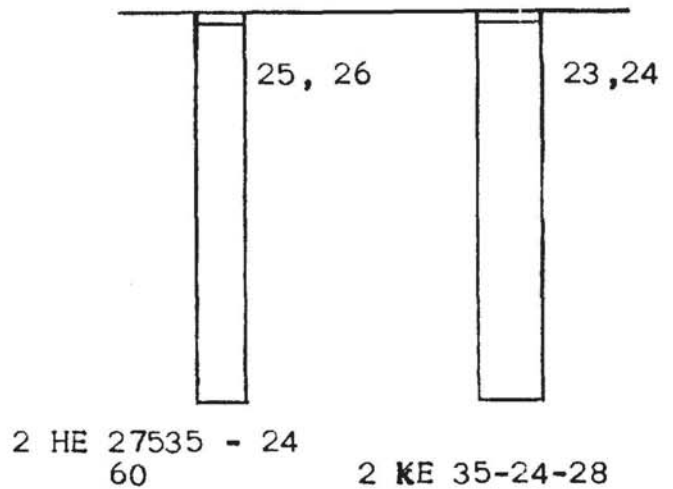
All the above Anodes have 5" Studs and 3/4" Insulators

FORWARD ENGINE ROOM -- Frs. 95 - 97 -- Panel " B ".

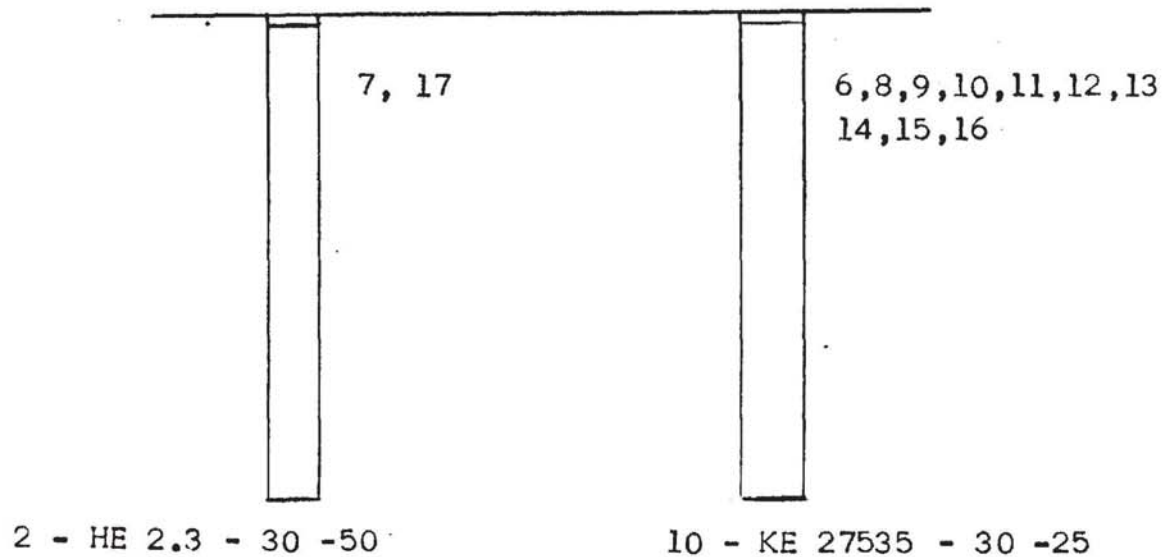
Port & Starboard Main Sea Chests.



STARB'D HIGH SEA CHEST



SEA WELL TREATMENT TANK.

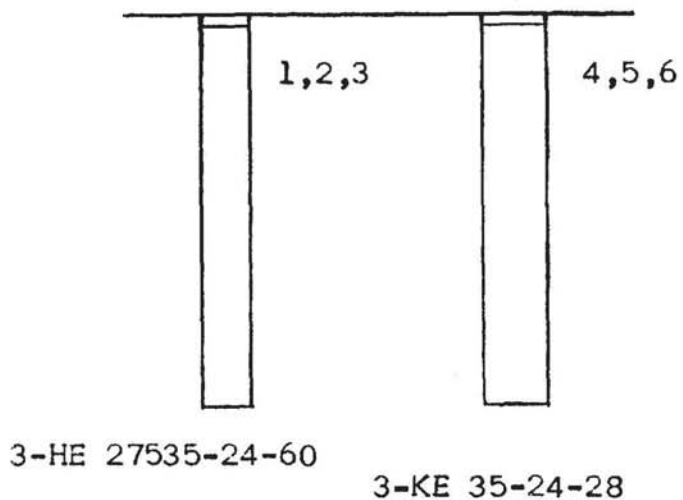
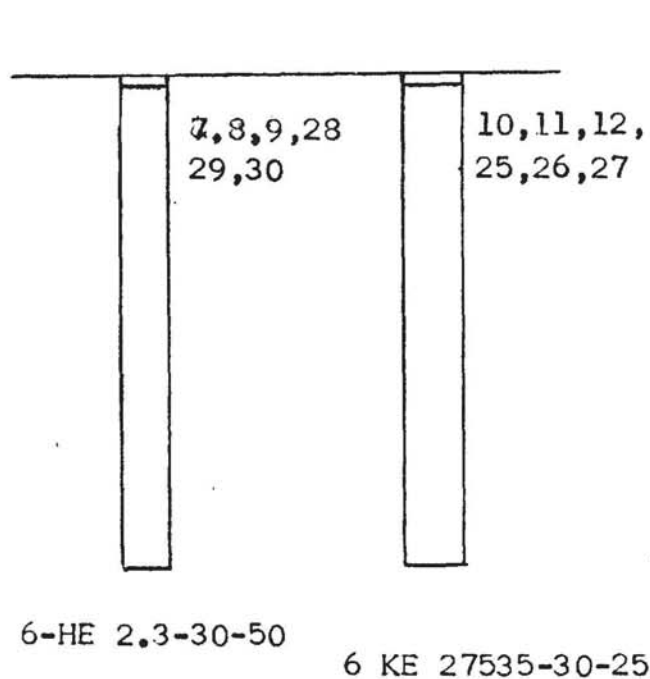


All the above Anodes have 5" Studs - 3/4" Insulators

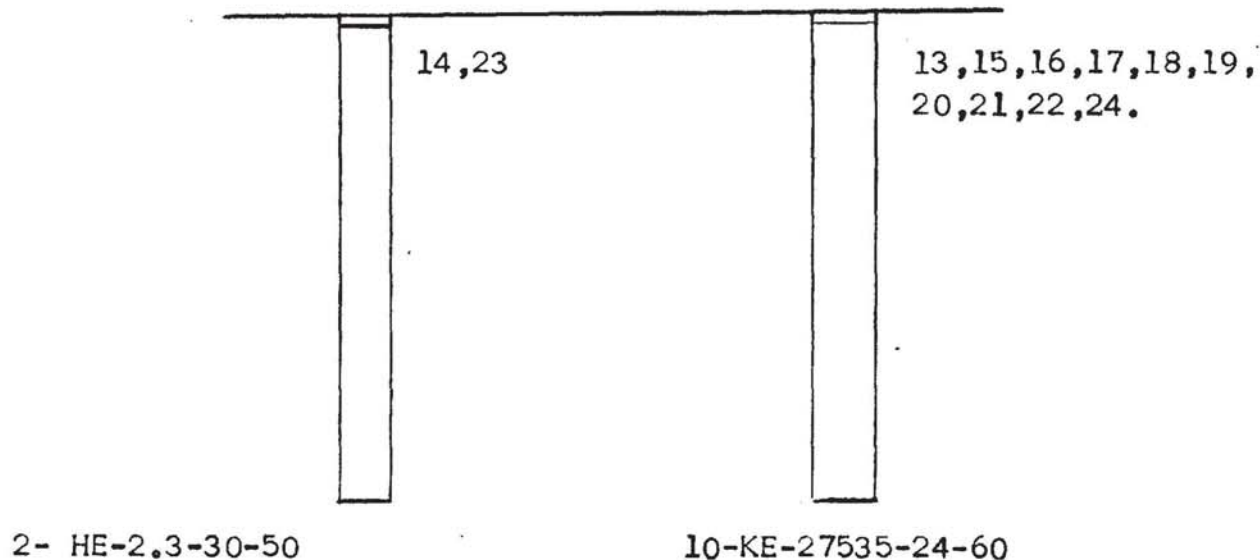
AFTER ENGINE ROOM -- FRAMES - 92 - 95 -- PANEL " C "

PORT & STARBOARD MAIN SEA CHESTS

PORT HIGH SEA CHEST



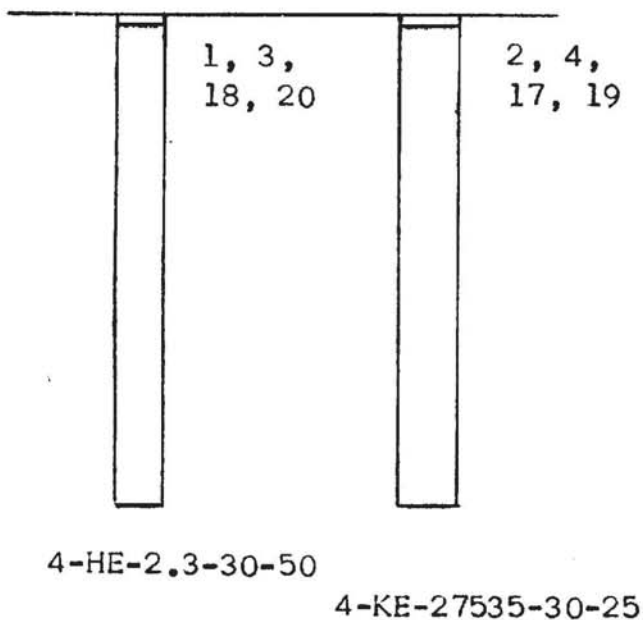
SEA WELL TREATMENT TANK



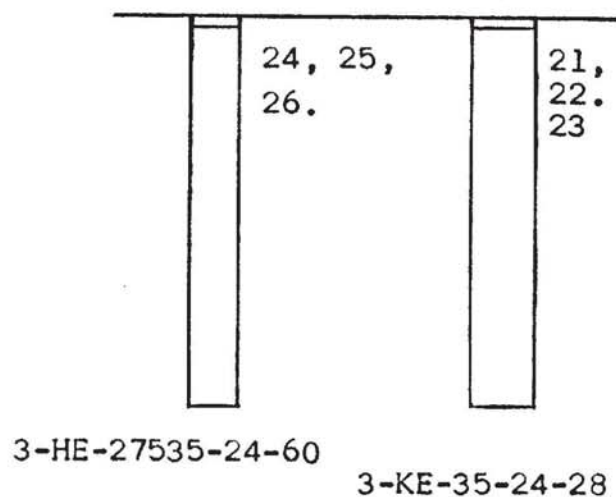
All the above Anodes have 5" Studs & 3/4" Insulators

PROPULSION ROOM -- Frames 55 - 61 -- PANEL " D "

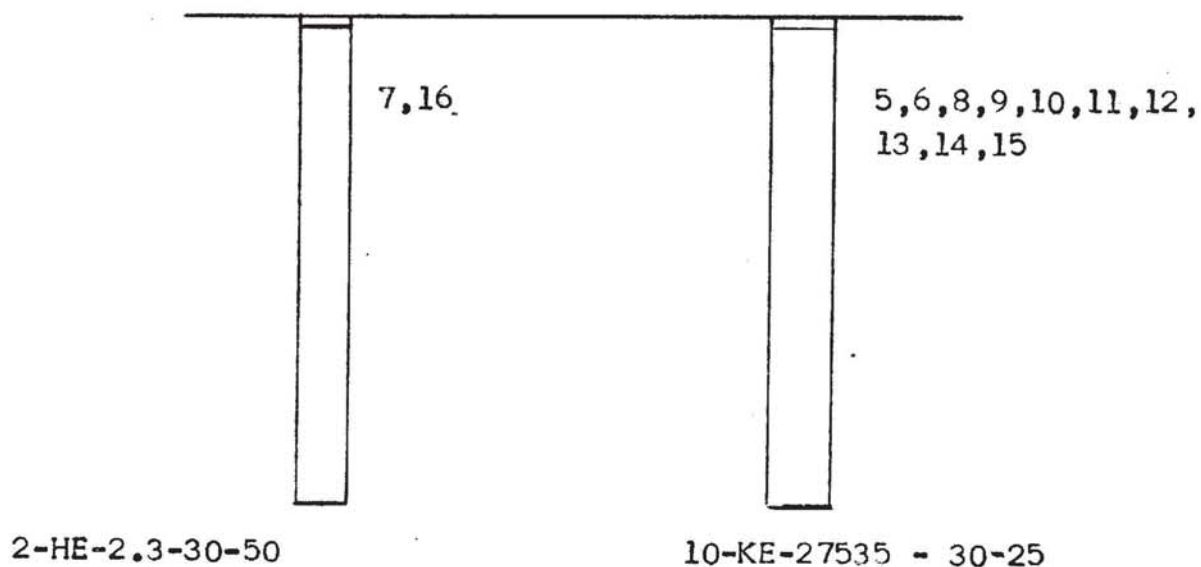
PORT & STARBOARD MAIN SEA CHESTS



STARBOARD HIGH SEA CHEST

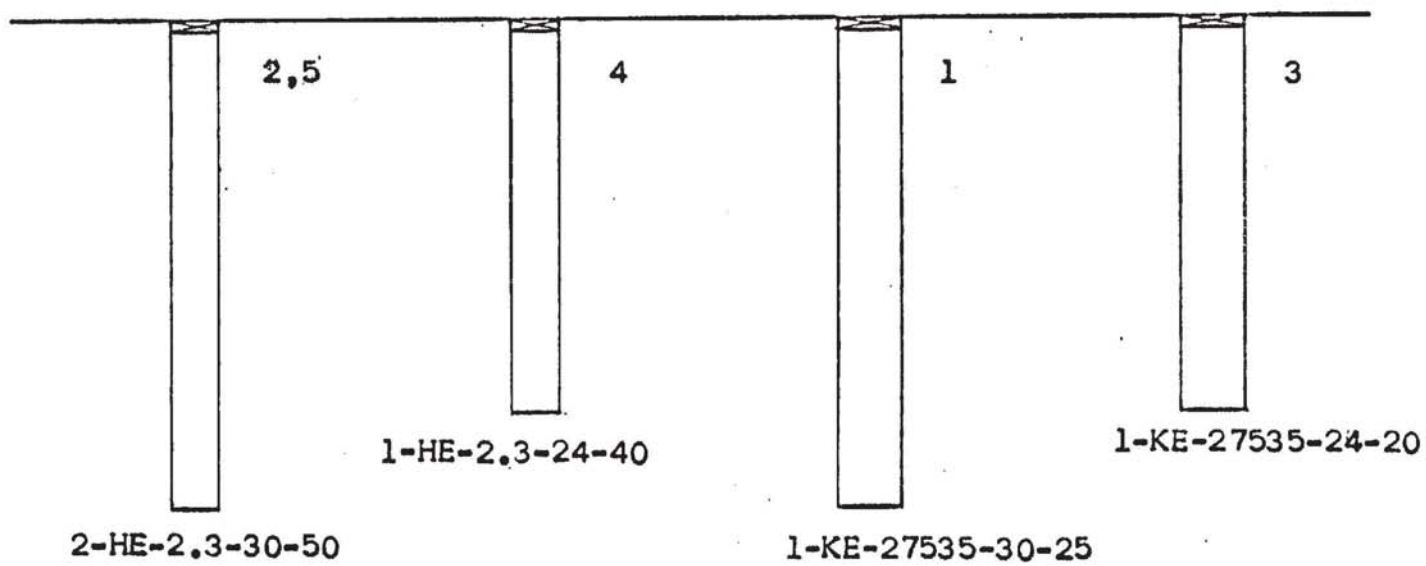


SEA WELL TREATMENT TANK



All the above Anodes have 5" studs and 3/4" Insulators
EXCEPT- Anodes # 9, 10, 12, 13,. These have 10" Studs
and 3/4" Insulators.

SPRINKLER PUMP SEA BOX -- Frame 30-31 -- PANEL " E "



BOW THRUSTER PANEL "A"

DATE: NOV. 28, 77 PANEL PARTS LIST. 8 OUTLETS.

No's.	PART	MAKE	STOCK NUMBER
1	PANEL 18x15x10 KEY	AD E 147	
1	A.C. BREAKER 10 AMPS	HEINMANN	J.A.2-A3-A
1	VARIAC ^{1/2} 0-250V 2.0A	OHMITRAN	UT4N
1	TRANSFORMER 300 VA	HAMMOND	52315
1	RECTIFIER	SYNTRON	25AB05W
11	TERMINAL BLOCKS	A. & B.	25 F
1	TERMINAL BLOCK ENDS	A. & B.	25 E
4	RHEOSTATS (20HM)	OHMITRAN	OI41
4	RHEOSTATS (6 OHM)	OHMITRAN	OI43
4	D.C. BREAKER 3 AMP	HEINMANN	JAI-B2-A
4	D.C. BREAKER 5 AMP	HEINMANN	JAI-B2-A
8	TEST TOGGLE SWITCHES	KULKA	ST50R
1	AMP. METER 0-3 AMPS	SIMPSON	1327
1	VOLT METER 0-5 VOLTS	SIMPSON	1327
2	LIGHT ASSEMBLIES 1-red jewels 1-green jewels	DRAKE	220A-AE
2	LAMPS 6-8 VOLTS	G. E.	#44
43	SCREWS-NUTS & WASHERS		
7	TYE WRAP- BOLT TYPE	PANDUIT	SSC 25
48	TYE WRAP- PLAIN TYPE	PANDUIT	SS T 25
98 ft	ASSORTED WIRE		
ft	SPIRAL BAND	PANDUIT	
8	RHEOSTAT KNOBS		
2	2 SCREW CONNECTORS		
4	DUPLEX CONNECTORS		

FORWARD ENGINE ROOM PANEL "B"

DATE: NOV. 28, 77 PANEL PARTS LIST. 26 OUTLETS.

No's.	PART	MAKE	STOCK NUMBER
1	PANEL 24x48x10 KEY	AVE 147	
3	A.C. BREAKER 10 AMPS	HEINMANN	J.A.2-A3-A
3	VARIAC ⁴⁰⁰ KNOB & DIAL	OHMITRAN	U54N
3	TRANSFORMER 300 VA	HAMMOND	52335
3	RECTIFIER	SYNTRON	25AB05W
29	TERMINAL BLOCKS	A. & B.	25T
3	TERMINAL BLOCK ENDS	A. & B.	25E
16	RHEOSTATS (20HM)	OHMITRAN	OI41
10	RHEOSTATS (6 OHM)	OHMITRAN	OI43
10	D.C. BREAKER 3 AMP	HEINMANN	JAI-B2-A
16	D.C. BREAKER 5 AMP	HEINMANN	JAI-B2-A
26	TEST TOGGLE SWITCHES	KULKA	ST50R
1	AMP. METER 0-3 AMPS	SIMPSON	1327
1	VOLT METER 0-5 VOLTS	SIMPSON	1327
6	LIGHT ASSEMBLIES 3-red jewels 3-green jewels	DRAKE	220A-AE
6	LAMPS 6-8 VOLTS	G. E.	244
133	SCREWS-NUTS & WASHERS		
22	TYE WRAP- BOLT TYPE	PANDUIT	55C25
120	TYE WRAP- PLAIN TYPE	PANDUIT	55T25
278ft	ASSORTED WIRE		
1 ft	SPIRAL BAND	PANDUIT	
1	TERMINAL BLOCK (DIV)	A + B	25A
26	RHEOSTAT KNOBS	ARMACO	TF912
2	2-SCREW CONNECTIONS	T + B	3302
13	DUPLEX CONNECTORS	T + B	291
1	SELECTOR SWITCH	MARLORY	1231L

AFT ENGINE ROOM

PANEL "C"

DATE: NOV 28, 77 PANEL PARTS LIST. 30 OUTLETS.

No's.	PART	MAKE	STOCK NUMBER
1	PANEL 24x48x10 KEY	HUE 147	
3	A.C. BREAKER 10 AMPS	HEINMANN	J.A.2-A3-A
3	VARIAC ⁴ / ₂ KNIGHT D.D.L	OHMITRAN	U.T.N
3	TRANSFORMER 3000 VA	HAMMOND	52335
3	RECTIFIER	SYNTRON	25AB05W
33	TERMINAL BLOCKS	A. & B.	257
3	TERMINAL BLOCK ENDS	A. & B.	25E
19	RHEOSTATS (20HM)	OHMITRAN	OI41
11	RHEOSTATS (6 OHM)	OHMITRAN	OI43
11	D.C. BREAKER 3 AMP	HEINMANN	JAI-B2-A
19	D.C. BREAKER 5 AMP	HEINMANN	JAI-B2-A
30	TEST TOGGLE SWITCHES	KULKA	ST50R
1	AMP. METER 0-3 AMPS	SIMPSON	1327
1	VOLT METER 0-5 VOLTS	SIMPSON	1327
6	3 red jewels LIGHT ASSEMBLIES 3 green jewels	DRAKE	220A-AE
6	LAMPS 6-8 VOLTS	G. E.	744
133	SCREWS-NUTS & WASHERS		
30	TYE WRAP- BOLT TYPE	PANDUIT	55C25
128	TYE WRAP- PLAIN TYPE	PANDUIT	53125
350ft	ASSORTED WIRE		
- ft	SPIRAL BAND	PANDUIT	—
1	TERMINAL BLOCK (DIV)	A & B	25A
30	RHEOSTAT KNCS	ARMACCO	TF912
2	2 SCREW CONNECTORS	T & B	3302
15	DUPLEX CONNECTORS	T & B	291
1	SELECTOR SWITCH	MALLOY	1231L

PROPULSION ROOM

PANEL "D"

DATE: NOV. 28, 77 PANEL PARTS LIST. 26 OUTLETS.

No's.	PART	MAKE	STOCK NUMBER
1	PANEL 24148110 KEY	AUE 147	
3	A.C. BREAKER 10 AMPS	HEINMANN	J.A.2-A3-A
3	VARIAC ^{4W} KNOB & DIAL	OHMITRAN	UT4N
3	TRANSFORMER 300 VA	HAMMOND	52 335
3	RECTIFIER	SYNTRON	25AB05W
29	TERMINAL BLOCKS	A. & B.	25 T
3	TERMINAL BLOCK ENDS	A. & B.	25 E
17	RHEOSTATS (20HM)	OHMITRAN	OI4J
9	RHEOSTATS (6 OHM)	OHMITRAN	OI43
9	D.C. BREAKER 3 AMP	HEINMANN	JAI-B2-A
17	D.C. BREAKER 5 AMP	HEINMANN	JAI-B2-A
26	TEST TOGGLE SWITCHES	KULKA	ST50R
1	AMP. METER 0-3 AMPS	SIMPSON	1327
1	VOLT METER 0-5 VOLTS	SIMPSON	1327
6.	LIGHT ASSEMBLIES 3 red jewels 3 green jewels	DRAKE	220A-AE
6	LAMPS 6-8 VOLTS	G. E.	#44
133	SCREWS-NUTS & WASHERS		
22	TYE WRAP- BOLT TYPE	PANDUIT	55 C 25
120	TYE WRAP- PLAIN TYPE	PANDUIT	55 T 25
278 ft	ASSORTED WIRE		
ft	SPIRAL BAND	PANDUIT	
1	TERMINAL BLOCK (DIE)	A & B	25 A
26	RHEOSTAT KNOBS	ARMALCO	TF912
2	2-SCREW CONNECTORS	T & B	3302
13	DUPLEX CONNECTORS	T & B	291
1	SELECTOR SWITCH	MALLORY	12312

BOW THRUSTER CONTROL PANEL

PANEL " A "

Power Light

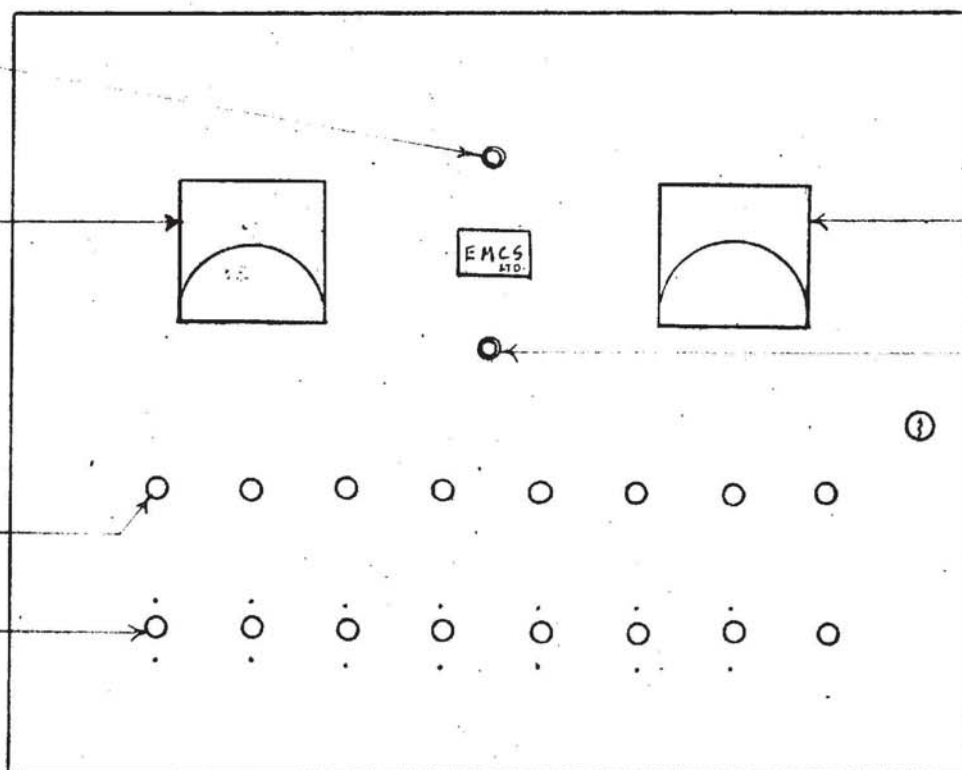
Amp. Meter
0 - 3 A.

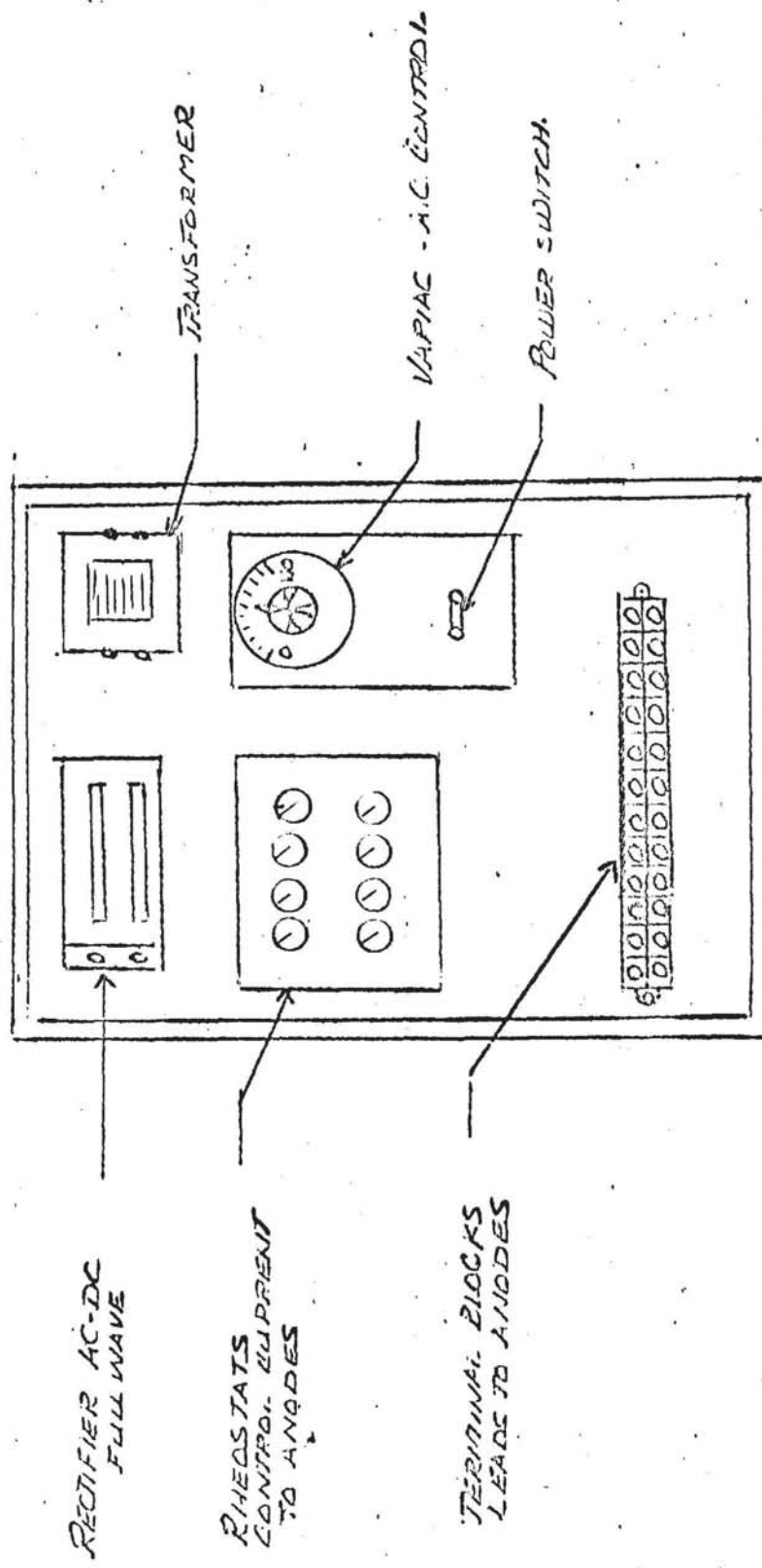
Volt
Meter
0-5 V

Breaker
Light
①
Lock

Toggle
Switches

Breaker
Switches



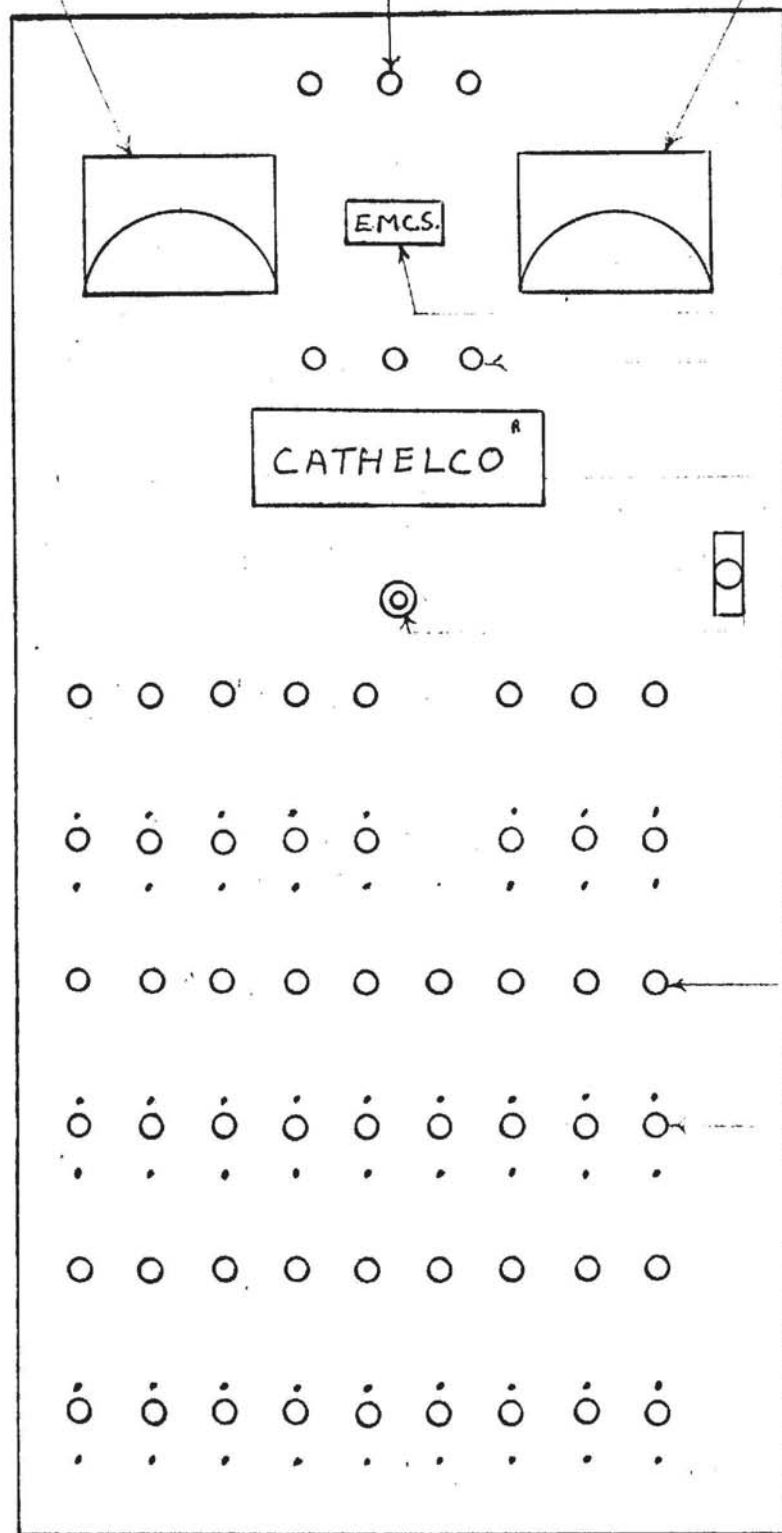


Bow Thruster Control Panel -- Inside of Panel.

0 - 3 A.
Amp. Meter

Power Light
Green

0-5 V
Volt Meter



E. M. C. S.
Name Plate

Breaker Lights
Red

Name Plate and
Registered Trade
Mark

Lock
Selector Switch

Toggle Switches

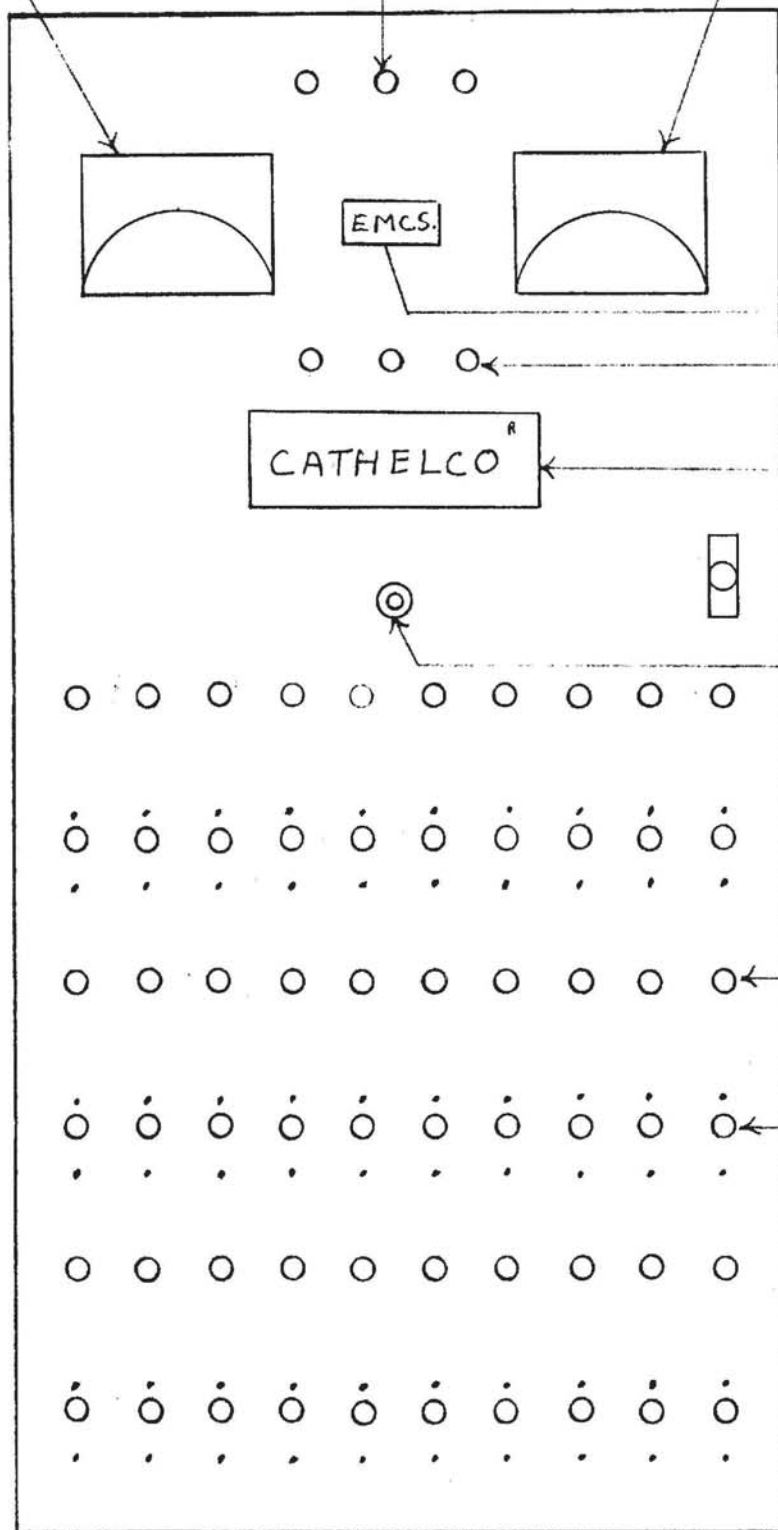
Breaker Switches

PANEL "B" - Forward Engine Room

0 - 3 A
Amp. Meter

Power Light
Green

0 - 5 V.
Volt Meter



E. M. C. S.
Name Plate

Breaker Lights
Red

Name Plate and
Registered Trade
Mark

Lock

Selector Switch

Toggle Switches

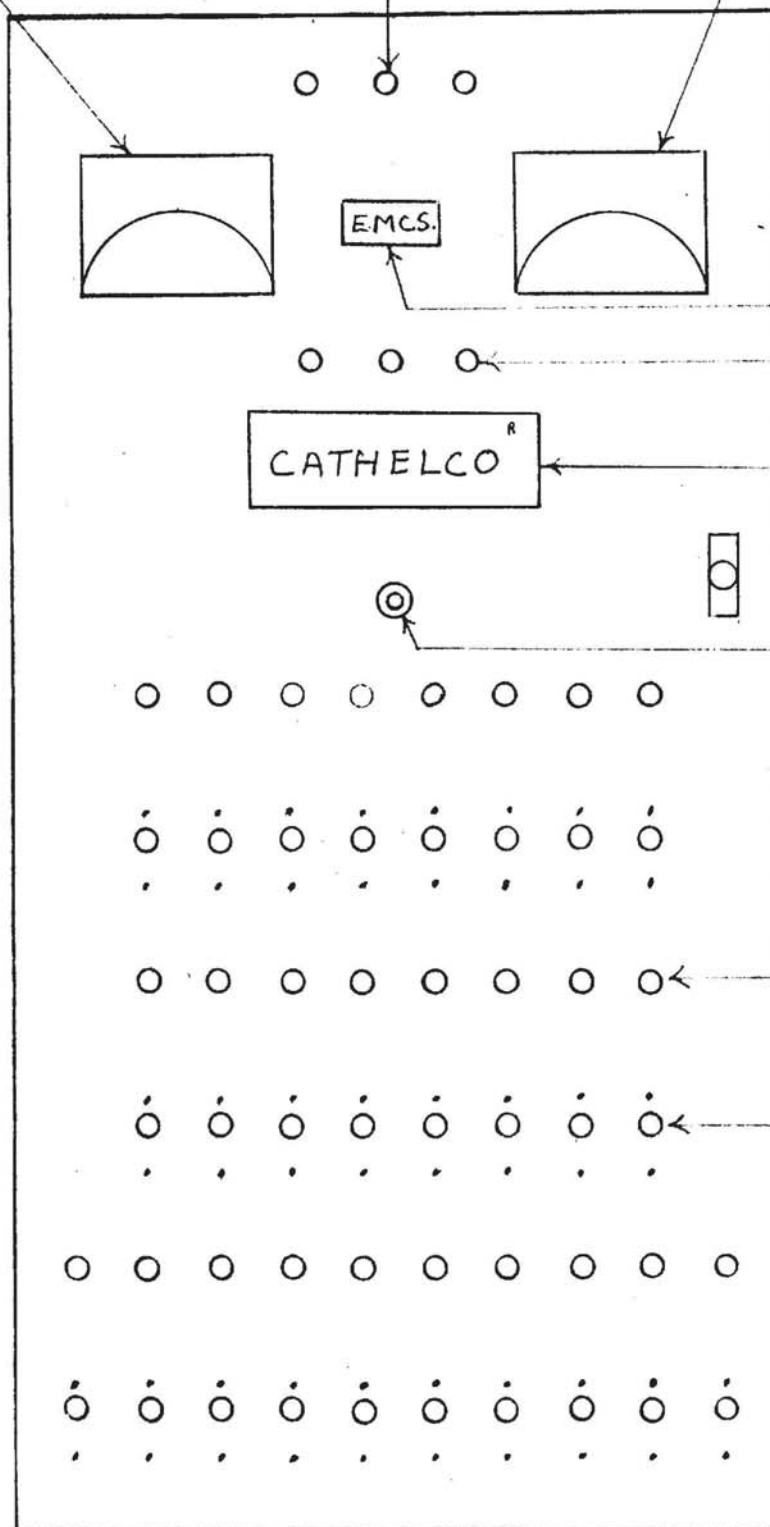
Breaker Switches

PANEL "C" After Engine Room

0 - 3 A
Amp. Meter

Power Light
Green

0 - 5 V
Volt Meter



E. M. C. S.
Name Plate

Breaker Lights
Red

Name Plate and
Registered Trade
Mark

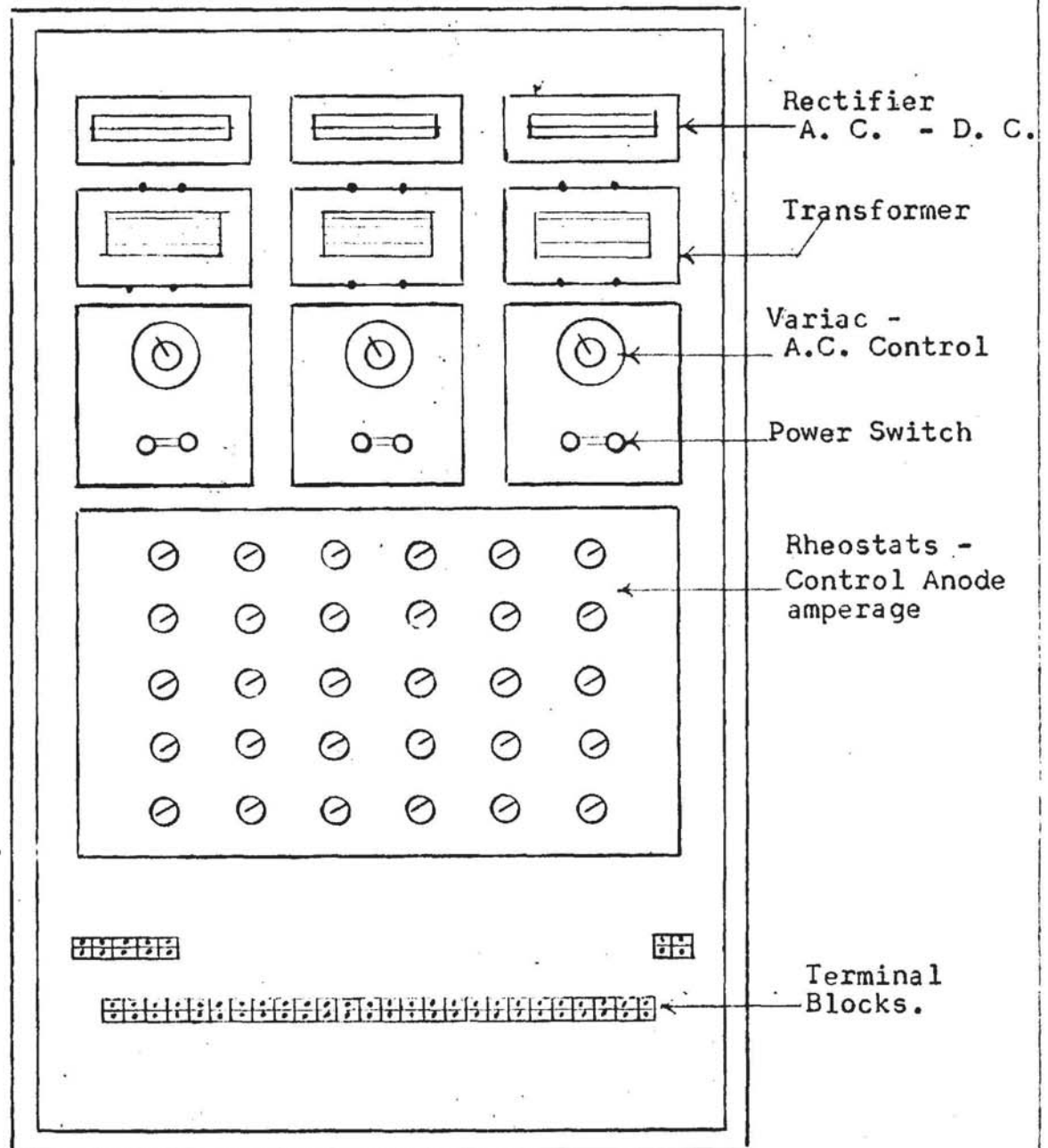
Lock

Selector Switch

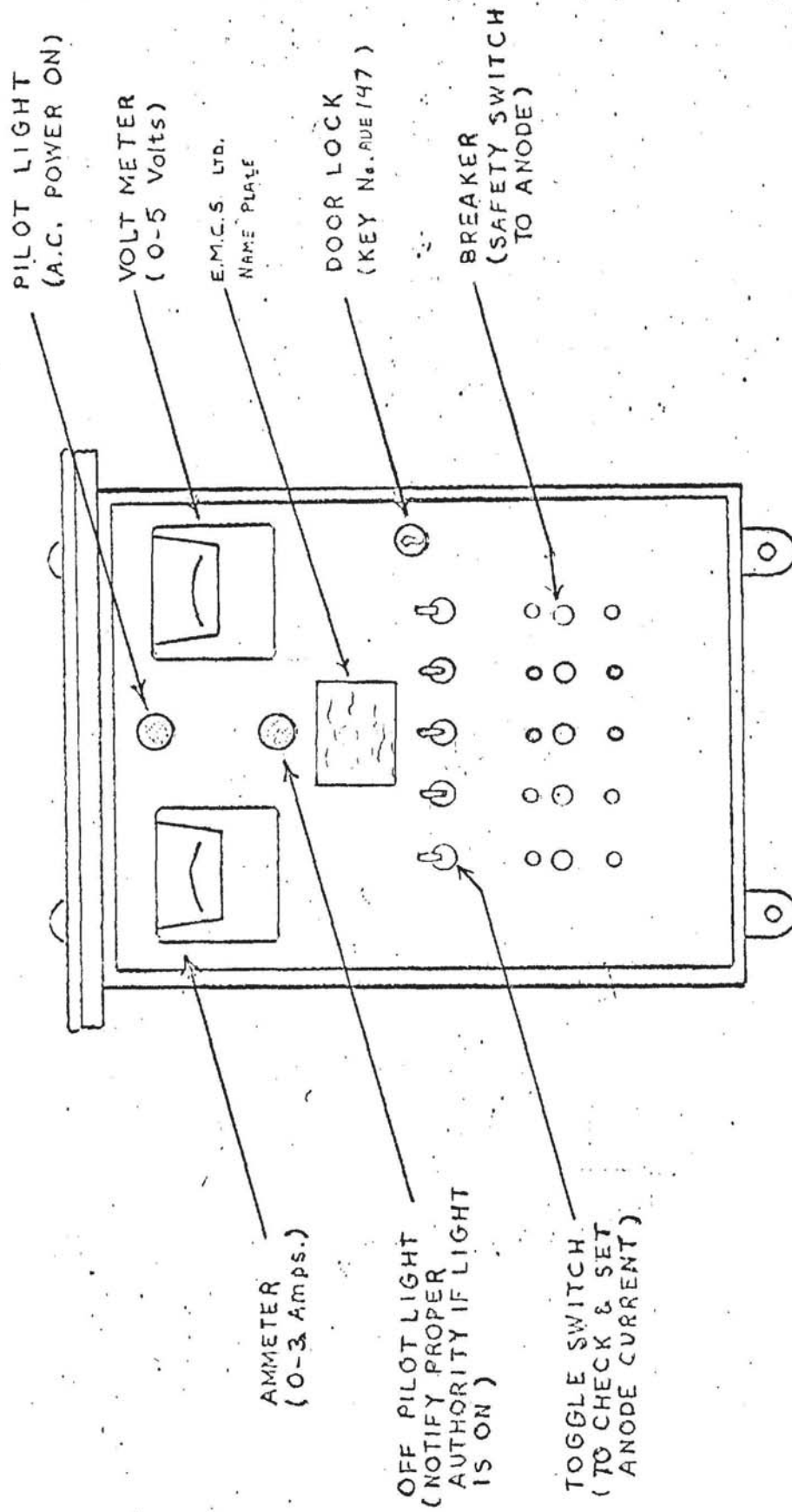
Toggle Switches

Breaker Switches

Panel " D " Propulsion Room



TYPICAL CONTROL PANEL

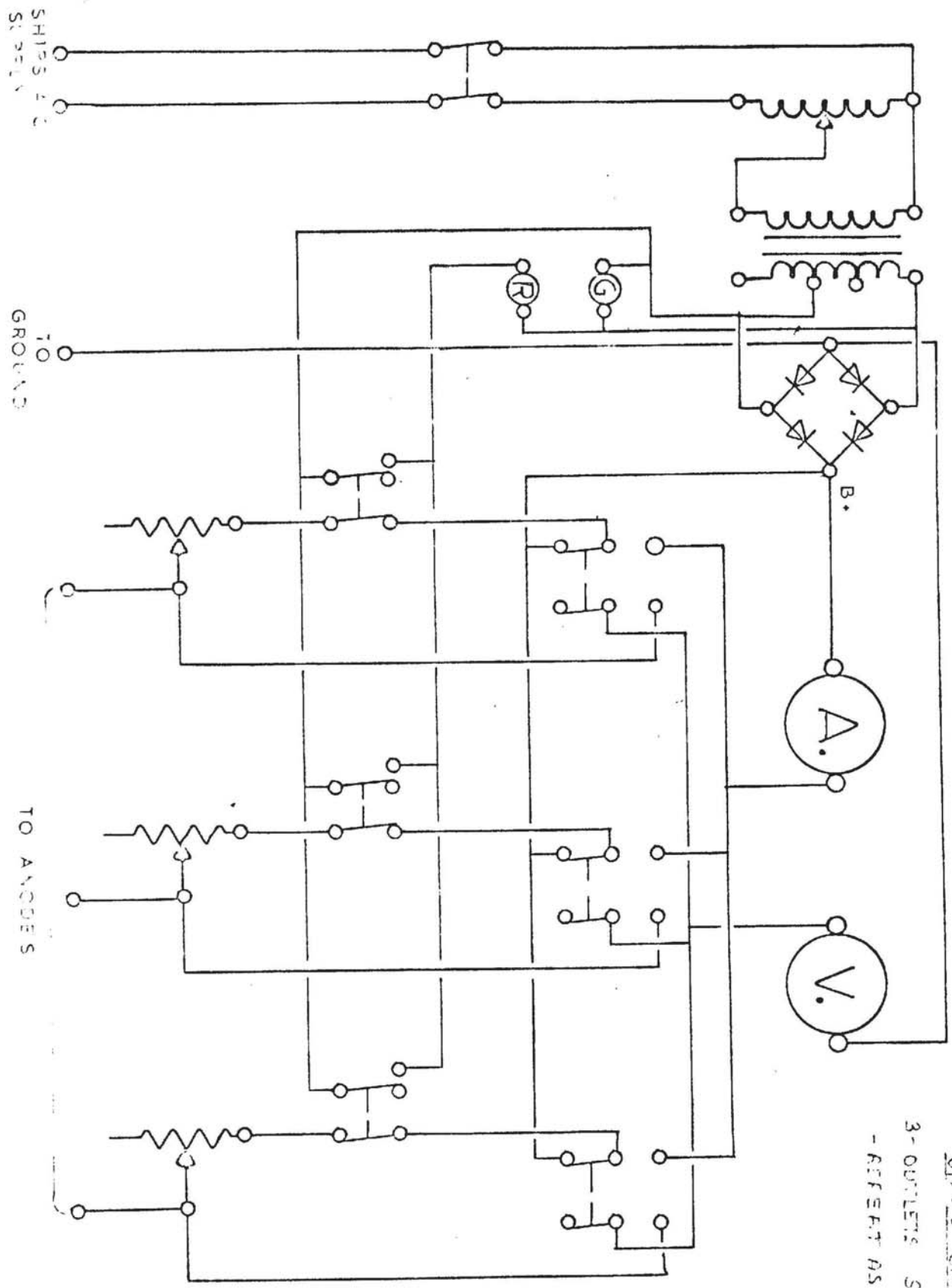


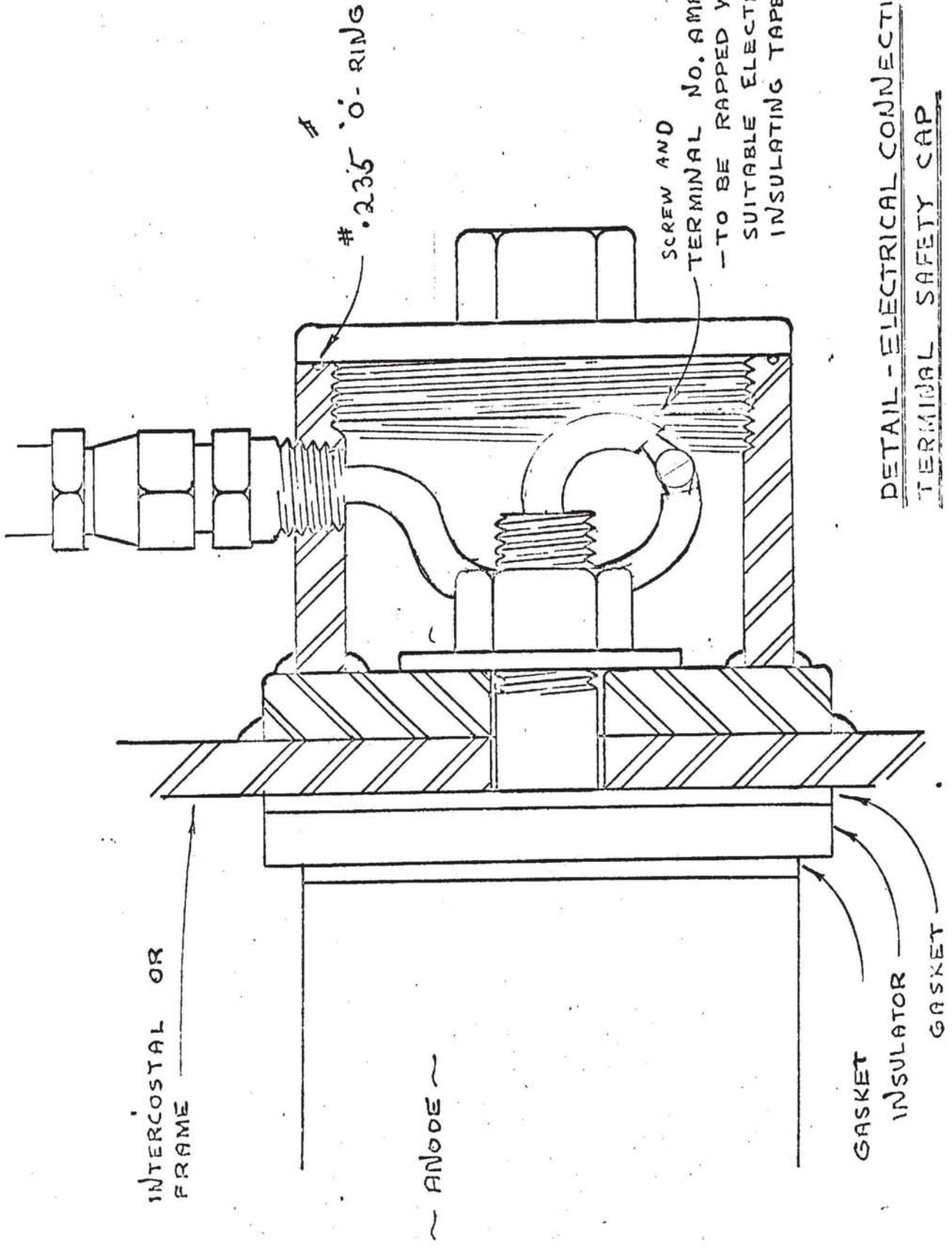
PANEL FRONT

PANEL " E " Sprinkler Pump Sea Suction

1.

3-OUTLETS SHOWN
- EFFECT AS REQUIRED





5.

DETAIL - ELECTRICAL CONNECTION
TERMINAL SAFETY CAP