Construction of the west coast deperming unit

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LABORATORIES

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THE NATIONAL RESEARCH COUNCIL OF CANADA

ELECTRICAL ENGINEERING AND RADIO BRANCH

CONSTRUCTION OF

THE WEST COAST DEPERMING UNIT

OTTAWA

APRIL, 1947

Report no. ERB - 171

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Electrical Engineering and Radio Branch

CONSTRUCTION OF THE WEST COAST DEPERMING UNIT

by

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Head: Electrical Engineering Section.

Introductory pages - 4
Numbered pages of text - 8
Appendices A to F - 18
Illustrations (see page iv)

Ottawa, April, 1947.

ABSTRACT

Provision of a mobile deperming station on Canada's west coast became desirable when the shipbuilding program there approached its peak. Design and procurement of the electrical equipment was entrusted to the Electrical Engineering Section of the National Research Laboratories. The Naval Service undertook to provide a suitable ship to convert for deperming use, and, after a search, suggested the Motor-Vessel "Gryme". She was surveyed to assure her suitability. Sketches were then prepared in the Electrical Engineering Section which showed the proposed arrangement of equipment, together with the necessary additions and modifications to the ship. These were approved by the Naval Service. The derpeming equipment was installed by Naval personnel under the supervision of the National Research Laboratories' engineers. The first deperming operation with the unit was successfully completed in September, 1943.

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CONSTRUCTION OF THE WEST COAST DEPERMING UNIT

Unclassified

1. INTRODUCTION

Soon after the start of hostilities in September, 1939, confirmation was obtained of the use by the Germans of non-contact mines, actuated by changing magnetic fields. Since every piece of iron or steel, even though unmagnetized, modifies the magnetic field of the earth in its immediate vicinity, such a device offered a serious threat to all engine-driven ships, whether or not the hulls were of steel.

The first Allied reaction was the fitting of degaussing equipment to all major ships to reduce as far as practicable the magnetic disturbance associated with each. It was soon found that all ships have some permanent magnetization which complicated the problem of degaussing and which, in the case of small ships, contributed a major part of the disturbance. The necessity of reducing this permanent magnetic component led to the development of deperming.

Deperming is the name given to the process of reducing the permanent magnetization of ships by stepped reversals, (i.e., by applying to the ship being depermed, pulses of magnetomotive force, whose direction is reversed with each application, and whose magnitude is reduced in such a manner that the final residual field is small). This necessitated winding a solenoid about the ship and passing currents of controlled magnitude, direction and duration through this solenoid. The aggregation of equipment needed to perform this operation is known as a deperming unit.

In the late summer of 1941 when ship losses were very severe, a deperming unit was constructed at Halifax, following the general arrangement developed by the Royal Navy. Experience with the construction and use of this unit was the basis for design work which was started late in the summer of 1942 on a second unit, to be stationed at Vancouver. This unit was intended to treat newly-constructed ships then being built in quantity on the west coast, limited numbers of ships on Far Eastern runs, and Naval vessels operating out of Esquimalt.

2. PRELIMINARY DESIGN

Pressure on shipbuilding facilities was so great that it was impossible to obtain a vessel specially constructed for deperming use. Consequently, a survey was made of existing ships which could be released for conversion. The most suitable of these was the motor-vessel "Gryme", then carrying cement to various defense developments around the southern coastline of British Columbia. She was, however, not available until the winter of 1942.

The Gryme was a small, wooden, cargo carrier of 92-foot length, 18-foot beam, and 10-foot depth. She had been practically rebuilt in 1940 and was in good condition. In coastal operation she carried a crew of four,

though accommodation for seven existed. For deperming use, accommodation for two officers, for at least two petty officers and for as many seamen as possible was desired.

A careful check of the space available against that required for deperming equipment showed that it would be feasible to enlarge the forecastle sufficiently to provide for four additional seamen, bringing the total accommodation for seamen to six. In addition, a deckhouse could be built over the after part of the cargo hatch. This deckhouse would provide an officers' wardroom, with sleeping accommodation for one, and an officers' lavatory. Suitable accommodation for the other officer was already available in the cabin adjoining the wheelhouse. Existing accommodation aft was suitable for three petty officers.

The proposed alterations and allocation of space are shown on Electrical Engineering Laboratories sketches number 1 1521 to 1525, (See Appendix C), copies of which were submitted to the naval authorities for their consideration. During the interval while naval approval was awaited the Engineer Superintendents' drafting office at Esquimalt made detailed plans and specifications of the alterations and additions required, following the arrangement indicated in the National Research Laboratories' preliminary sketches.

Approval and authorization to proceed were granted in April, 1943. The Electrical Engineering section of the National Research Laboratories was instructed to provide the electrical equipment and to supervise the alterations and installation which were to be carried out at Esquimalt by naval personnel.

In the meantime space suitable for a berth for the "Gryme" was found at the National Harbours Board's "Lapoint Pier" at Vancouver, and sufficient space was requested in the pier shed for a spare equipment storage room, and for locker and shower rooms for the rigging party (1 or 2 petty officers and 16 seamen, who could not be permanently accommodated aboard).

3. DETAILED DESIGN

The allocation of space and the arrangement of equipment suggested in the preliminary sketches and adopted in the more detailed form developed in the Engineer Superintendent's plans are shown in figures 1 and 2 (H.M.C. Dockyard drawings 974 and 975). Descriptions of the major items involved in the conversion of the ship for deperming use are given in appendices A to F. A general discussion of the modifications and installed equipment is included in the following paragraphs.

The cargo space was divided into four sections by bulkheads designated "C", "D", and "E". "C" and "D" were existing cargo separation bulkheads which were reinforced and made gas-tight to contain the battery compartment. "E" was a new, sound insulating bulkhead to separate the diesel-generator and contactor from the control room. The existing forward hold bulkhead, designated "B", was pierced for access to the accommodation space which was added to the

forecastle. In bulkhead "F" at the forward end of the engine room the opening (required for main engine disassembly) was enlarged and fitted with a water-tight steel door to be used as the main access to the deperming installation.

False raised decks were fitted in the hold to increase the width of flat. The cargo hatchway was decked over and the proposed wardroom deckhouse was erected over the after part of this deck. Semi-permanent sections were provided in the deck and deck-head of the entrance-way to the wardroom which could easily be removed if major equipment items were required to be added to, or removed from, the deperming installation below.

The ship's 32-volt lighting system was completely removed and replaced with a 110-volt system providing substantially improved illumination. This new system was arranged for connection either to the diesel-generator set, any one of the three banks of deperming batteries, or the 110-volt shore supply. As existing electrical facilities at Lapointe pier were overloaded, except on the 550-volt conveyer power circuit, a 550/110 volt 5 KVA dry-type transformer was ordered to provide a shore power connection. This relieved the battery and diesel generator set of the lighting and heating loads while the Gryme was at her berth.

An upper bridge was built atop the wheelhouse. A standard 10-inch signal projector and a flag locker were mounted thereon. Signal halyards were rigged from the existing spar to the upper bridge.

The engine room, galley, and accommodation spaces were renovated, lockers and racks being fitted where necessary. Adhering to naval tradition, several coats of paint were applied inside and out.

4. DEPERMING INSTALLATION

To accomplish its purpose, a deperming unit must have a source of large direct currents, a method of controlling these currents, and a supply of heavy cable to conduct the currents to the points at which their magnetic effect is required. In addition, it is also necessary to have instruments for the measurement of magnetic field strength.

In this unit, lead-acid batteries were used as the source of the heavy currents. A contactor, liquid rheostat and selector panel, with the necessary meters, were the control elements. Six thousand feet of 400 MCM and six thousand feet of 600 MCM flexible rubber covered cable, in convenient lengths, was provided as the heavy current conductor. Permalloy magnetometers, of the United States Naval Ordnance Laboratories' type, were used to determine the effect of each deperming operation.

Previous experience indicated that with standard automotive type lead-acid batteries reasonable life and satisfactory operation would be obtained if the maximum current drawn from the batteries was approximately four amperes per ampere-hour of battery rating. The normal deperming procedure requires maximum currents approaching four thousand amperes. It

was desirable, therefore, to have one thousand ampere-hour battery capacity. The largest batteries then in quantity production in Canada were of one hundred seventy-five ampere-hours rating. These were available in three-cell, six-volt units approximately seven inches by sixteen inches by nine inches high, and weighing about ninety pounds. Terminal connections were the standard 'Society of Automotive Engineers' post type. Grouping these batteries in six parallel circuits provided the required ampere-hour capacity.

In the Halifax unit, a battery bank voltage of ninety was adopted, following the Royal Navy precedent. Experience indicated that a small increase would produce a large imrpovement in operating efficiency by permitting more general use of the smaller of the two deperming solenoid cables. It was decided, therefore, to adopt a bank voltage of one hundred eight, an increase of twenty per cent above the Halifax installation. This voltage also provided for efficient operation of standard one hundred ten volt lamps and appliances. Eighteen six-volt battery units, connected in series, were used in each bank.

The final battery consisted of three hundred twenty-four six-volt, one hundred seventy-five ampere-hour units arranged in three banks of six parallel, eighteen series with multiple connection. These three banks, each of one hundred eight volts, one thousand fifty ampere-hours, were permanently connected in series, but the intermediate points were brought out to a selector switch panel. This permitted the use of one hundred eight, two hundred sixteen, or three hundred twenty-four volts, as desired, applied to the solenoid circuit.

The permanent series connection of the three banks of batteries permitted the substitution of two single-pole, double-throw switches for the three double-pole, double-throw switches used in the British units and in the first Canadian unit. A double-pole double-throw switch, connected for reversing the circuit polarity, and two single-pole, single-throw switches, for short circuiting the liquid rheostat and the ballast resistors, completed the selector switch equipment. Each of these switches had a continuous rating of two thousand amperes, at six hundred volts. The short circuiting switch for the liquid rheostat was provided with a latch and padlock to prevent accidental mis-operation. The short circuit switch for the ballast resistor which also short-circuited the low range ammeter shunt, carried auxiliary contacts which energized lights to indicate the ammeter that was operable.

The liquid rheostat was modeled after the East Coast rheostat. However, an attempt was made to improve its performance in several respects in which its predecessor had proved not entirely satisfactory. The plate area and tank capacity were increased approximately fifty per cent. The plate shape was modified to obtain a more uniform resistance scale. The clearance between the liquid surface and the shaft was increased. The steel tank lining, tried as an innovation and found so satisfactory at Halifax, was repeated. The reduction gear between the control wheel and the rheostat was changed from one-to-three, to one-to-five. The position indicator was made more positive by driving it with sprockets and chain, instead of pulleys and cord. Construction generally was simplified. In addition a panel was added, mounted on the face of the rheostat, which carried the control wheel, the position indicator, the high and low range ammeters and their indicating lamps, a clock and the master circuit switch.

As shown on the circuit diagram (Appendix F), a ballast resistor was provided, which consisted of two cast grid units each of seventy-five ten-thousandths ohm, connected in parallel. It was connected permanently in series with the liquid rheostat to give better control at low current settings and to prevent the accidental passage of large currents through the low range ammeter shunt. A short-circuiting switch, (previously mentioned), permitted by-passing both the resistors and shunt when larger currents were required.

Magentically-operated contactors, of the type used for roll motor control in steel mills, were provided for making and breaking the heavy current circuit. These contactors were rated for continuous duty at two thousand five hundred amperes, seven hundred fifty volts, and had adequate capacity to interrupt the maximum short-circuit current of the battery. Associated over-current relays, adjustable from fifteen hundred to six thousand amperes, were connected to protect the equipment. A foot switch, for remote operation of the contactors, was set in a recess under the liquid rheostat, where it was protected from accidental operation, but where it was readily accessible to the operator at the control panel.

The deperming solenoid is essentially a huge inductance with the ship as its iron core. The energy stored in it is appreciable, and if uncontrolled on sudden interruption of the circuit, is easily capable of causing severe damage. To prevent this, a discharge circuit must be available whose resistance is sufficiently low to carry the maximum solenoid current without an undue rise of voltage. For this purpose a large copper oxide rectifier was used, connected so that it presented its high inverse resistance as a shunt across the deperming solenoid when the contactors were closed, and its low forward resistance as a discharge path when the contactors were opened. Measurements during normal operation showed no wasted power while the contactors were closed and no rise of voltage as the contactors were opened.

Two ammeters, each with a shunt, were provided. These were seven-inch, half of one per cent accuracy, fan shape, moving coil instruments. The scales were four thousand-zero-four thousand and eight hundred-zero-eight hundred amperes. The short circuiting switch for the ballast resistor also short-circuited the eight hundred ampere shunt. Indicating lights above ammeters, and energized from auxiliary contacts on the short circuiting switch, showed which meter was to be used. An engine room type clock (Seth Thomas) with a sweep seconds hand, mounted on the control panel above and between the ammeters provided accurate and convenient timing of the deperming operations.

Terminals for the connection of the solenoid to the power supply were provided in a splash proof housing on the foredeck. Provision was made for attachment of two cables to each terminal, in case paralleling of the deperming solenoid should be necessary. All internal connections in the heavy current circuit were made with million circular mil flexible stranded conductor. Circuits, in all cases were installed with parallel runs as close together as possible to minimize spurious magnetic effects. Battery connections were arranged for optimum compensation when complete neutralization was not feasible.

To charge the battery a thirty kilowatt diesel-generator set was installed. The generator characteristic was specified such that the rate of charge fell as the battery voltage rose with charge. Approximately fifteen per cent regulation was required to bring the output current down to the finishing rate of the battery, when the generator was adjusted for rated current in re-charging a half-discharged bank. The generator was used as a motor, supplied with power from the battery, to crank the diesel in starting the set.

On the dead front control cabinet of the charging set were mounted two circuit breakers, an ammeter, a voltmeter, a voltmeter transfer switch, a balance indicator push button, the diesel start push button and the controls of the two double-pole double-throw switches which selected the bank to be charged. Both circuit breakers had overload trip-outs for protection of the generator, and both were capable of interrupting the maximum fault current that could flow either from the generator or from the battery. Under-voltage and reverse current relays on one breaker prevented paralleling an inoperative generator with the battery, and protected the set in the event of engine failure. A magnetically-operated contactor with a current-limiting resistor by-passed the reverse current and under-voltage relays to supply power to crank the diesel when the start push-button was pressed. To facilitate paralleling, a push-button switch transferred the voltmeter connections so that the difference voltage between the battery and the generator was indicated. A standard rotary voltmeter switch permitted connection of the voltmeter to any battery bank, the charging bus or the generator terminals. Electrical interlocks insured the correct sequence of operations when the set was started or stopped.

For the deperming solenoids two sizes of rubber-insulated, rubber-jacketed, tough rubber-sheathed cable were supplied. The smaller was four hundred thousand circular mils and the larger was six hundred thousand circular mils cross section. Both were finely stranded of the "rope lay" type of construction for extra flexibility; both were supplied in convenient lengths (detailed in Appendix E) fitted with two-bolt lugs at each end. The drillings in the lugs were made identical to permit inter-connection of the two sizes of cable. Tough rubber sleeves were supplied which could be slipped over the joints to prevent accidental contact of the lugs with metal parts near them. Everdur bolts and appropriate box wrenches for the cable joints were also supplied.

On the East Coast unit, the cable had been stored for ready use by laying it out in troughs on the deck. The "Gryme", however, was much smaller and no deck space was available, except that built over the forward part of the cargo hatchway. This was thirteen feet ten inches fore and aft, by nine feet eleven inches athwartships. Preliminary calculations indicated that reels could be built to occupy this space and to carry the bulk of the cable. It was desirable to have separate spools for each size and length of cable, and to have reversible power drive to the individual spools. A tentative design was made and discussed with a manufacturer. At the suggestion of his chief engineer, the designs of the bases of the reels were changed to make them structurally more rigid, and to utilize steel shapes in stock in Vancouver. The manufacturer then accepted responsibility for their production. Details of the design of these reels are included in this report as Appendix E. Basically, they consisted of two sets of four spools, each

spool carried on trunions, and supporting, concentrically, the drive shaft which could be clutched to the spool in use. Power was supplied from a two horsepower electric motor with reversing two step control, through a seventy-seven-to-one reduction gear directly to one drive shaft, and from that through sprockets and a roller chain to the other drive shaft. A ballast resistor was included to limit the starting current and the stalled torque of the motor. Roller fairleads were fitted on the gunwhales opposite each spool, to guide the cable onto it. In the final design, storage capacity was available for all the deperming cable except seven hundred fifty feet of the larger cable. (This was the least used size, and its omission from the reel, and storage below facilitated trimming the ship and contributed to the ship's stability. This amount of cable weighed two thousand pounds). The first length of cable on each spool was attached to a hook on the spool flange. Subsequent lengths were added by coupling them to the preceding cable end with a C-link. A maximum speed of twenty-three revolutions per minute for the spools with the smaller cable and of nineteen revolutions per minute for the spools with the larger cable was provided.

An innovation, later adopted also on the East Coast, was the placing of the magnetometer instrument box permanently in the deperming unit control room, and the connecting to it of the two detector units by long extension cables. The magnetometers used were the permalloy detector, null type, developed by the United States Naval Ordnance Laboratories. Canadian Army field telephones, type D Mark V, also with long extension cables, were used to maintain communication between the Unit Officer in the control room and the parties at the detector units.

5. FIRE PROTECTION

In the operation of heavy current electrical equipment by inexperienced seamen there is always some danger of fire. In a wooden ship this is especially true. For this reason, extra precaution in circuit protection was exercised and adequate fire-extinguishing equipment was installed. Sufficient volume of carbon-dioxide was provided to smother immediately any fire in the battery room, control room or generator-contactor room. Carbon-dioxide was provided to protect the main engine room. Foam type extinguishers were provided for all accommodation spaces. In addition normal fire-fighting equipment was installed.

Another danger in an installation of this sort is an accumulation of hydrogen as a result of improper ventilation of the battery compartment during and for some time after battery charging. To guard against this, a ventilating fan was installed to provide positive circulation of air in the battery room. The capacity exceeded that required to keep the hydrogen concentration below the minimum explosive ratio. It also was sufficient to prevent any undue rise of temperature due to battery and cable resistance losses during charging. A ventilating fan was installed in the diesel-generator compartment to remove the air heated by radiation from the diesel and from the generator, and to maintain circulation of air in the control room when the charging set was shut down.

6. CONCLUSION

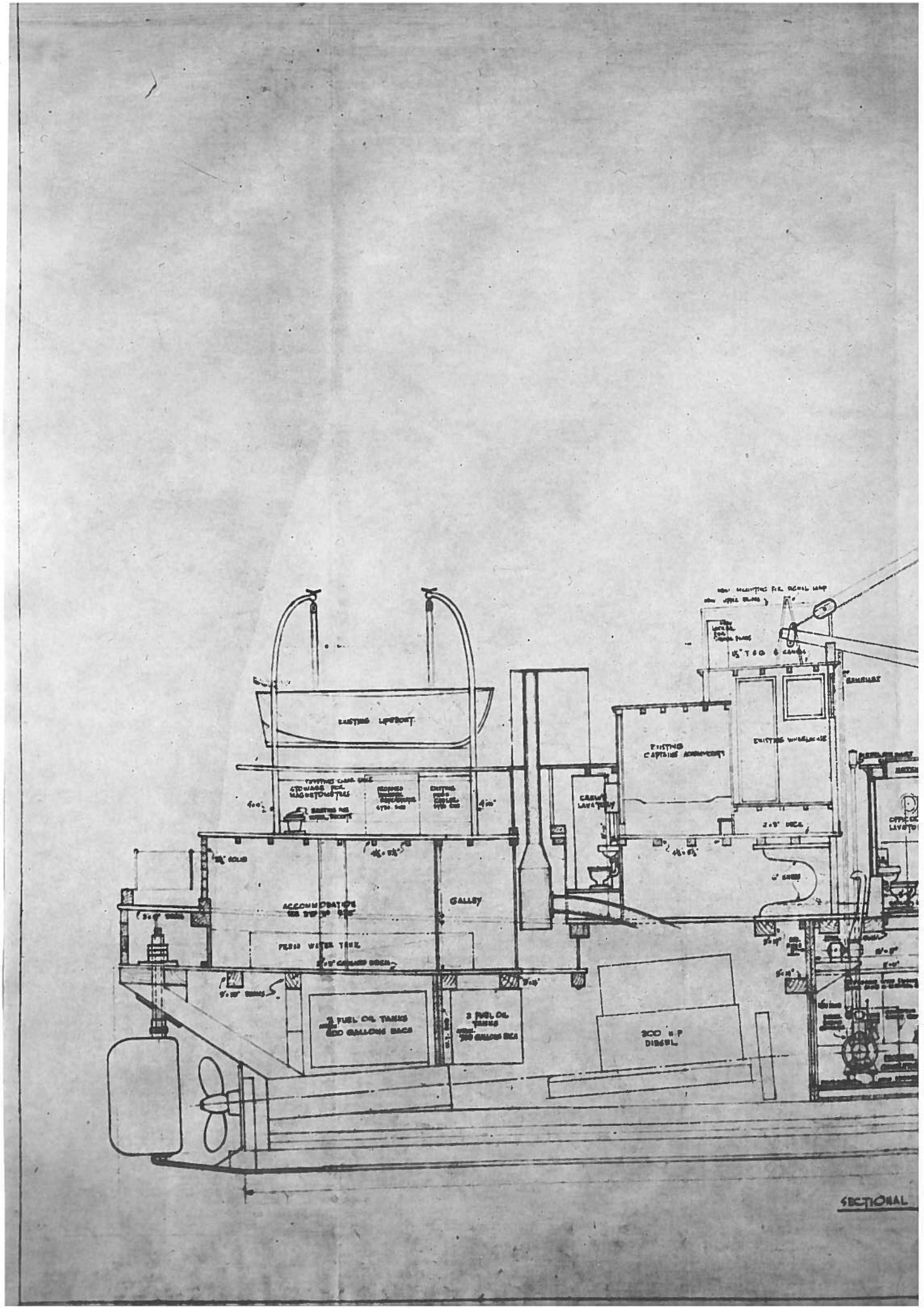
Completion of the deperming installation was delayed by failure of several suppliers to meet delivery promises, but as each section was finished it

was given complete tests culminating in the initial deperming operation in the first week of September, 1943. The operation was completely successful, and was completed with a new, and for the most part, inexperienced, crew, in less than two hours.

7. ACKNOWLEDGEMENT

The author wishes to acknowledge assistance received from Mr. B.G. Ballard, in the electrical design and in procurement of materials, from Lt/Cdr. MacHardy, RCNVR, in naval architecture, and from the Ross and Howard Iron Works in the design of the cable storage reels.

Acknowledgement is also due for the co-operation and advice received from Dr. H.J. MacLeod of the National Research Council and the University of British Columbia, from Cdr. T.H. Evans, RCN, Engineer Sup't. of HMC Dockyard at Esquimalt, from Lt/Cdr. R.E. Smythies, RCNVR, and from Lt. J. Thornton, RCNVR.


EXISTING LIFEBOAT
EXISTING CAPTAINS ACCOMMODATION
EXISTING WHEELHOUSE
CREW LAVATORY
ACCOMMODATION
GALLEY
FRESH WATER TANK
2 FUEL OIL TANKS
300 GALLONS EACH
2 FUEL OIL TANKS
300 GALLONS EACH
300 H.P DIESEL
SECTIONAL

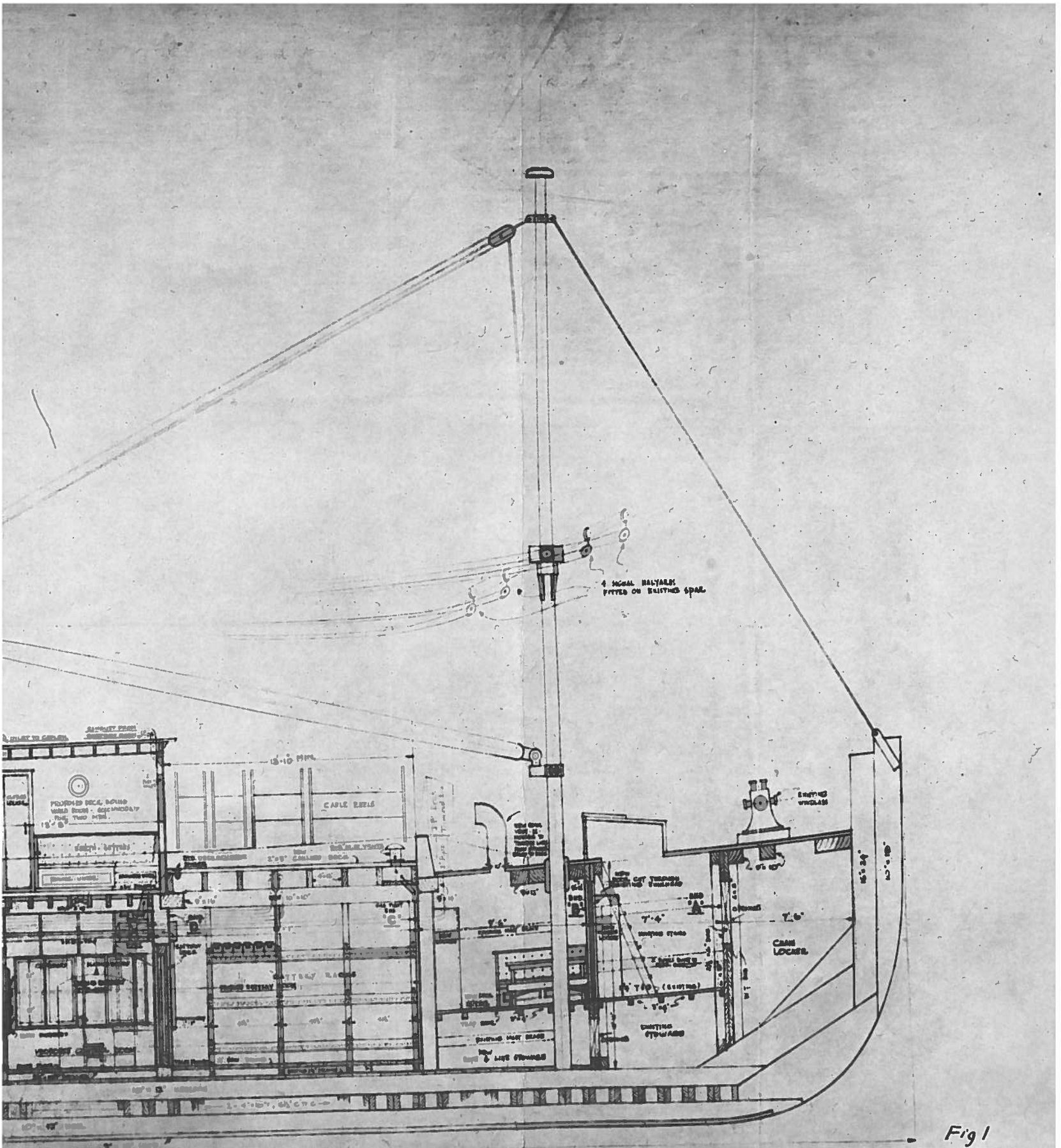


Fig 1

TION SHOWING MACHINERY & EQUIPMENT.

REFERENCE DRAWINGS :-
PLAN - SEE DWG. No 975
DETAILS OF BULKHEADS & DECKHOUSE - SEE DWG. No 976

H. M. C. DOCKYARD
ESQUIMALT, B. C.
"H/V GRYME"
ALTERATIONS AND ADDITIONS TO ACCOMMODATION UNIT - WEST COAST

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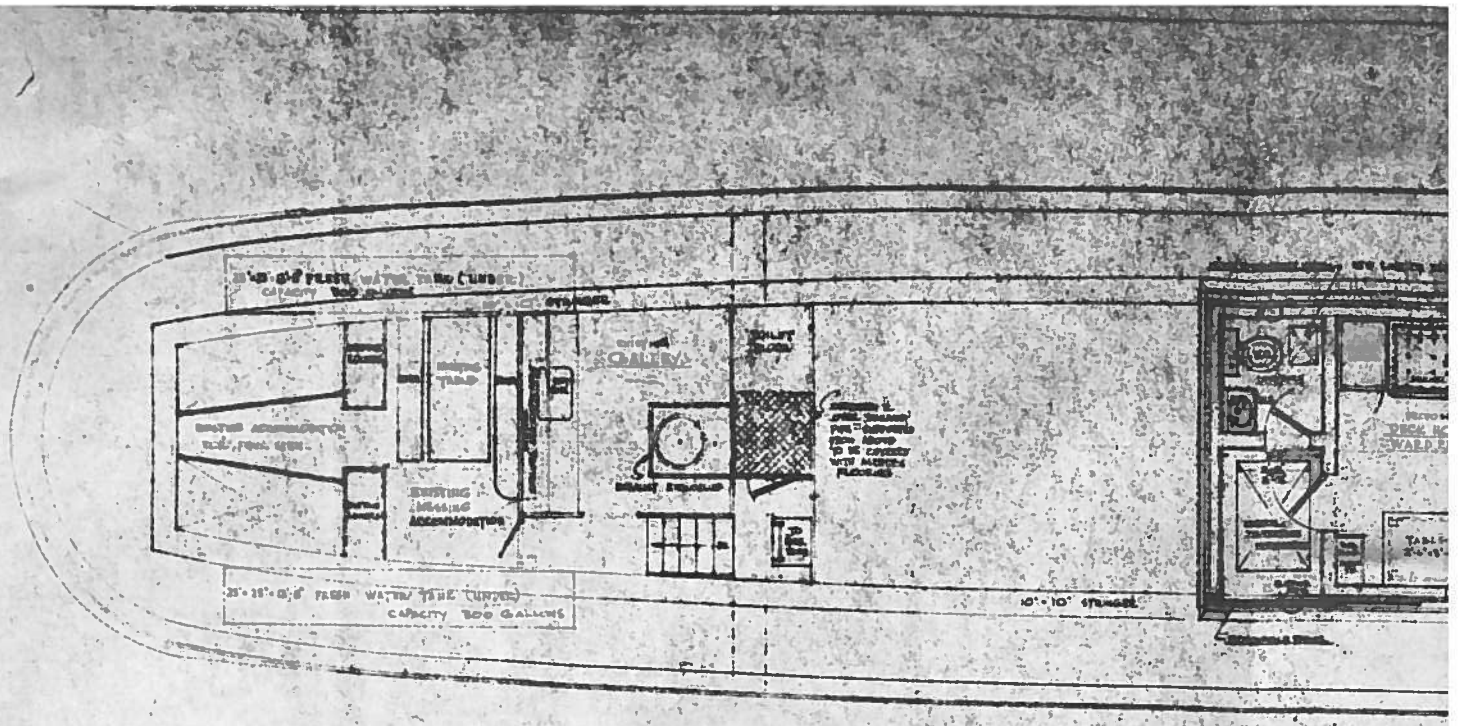
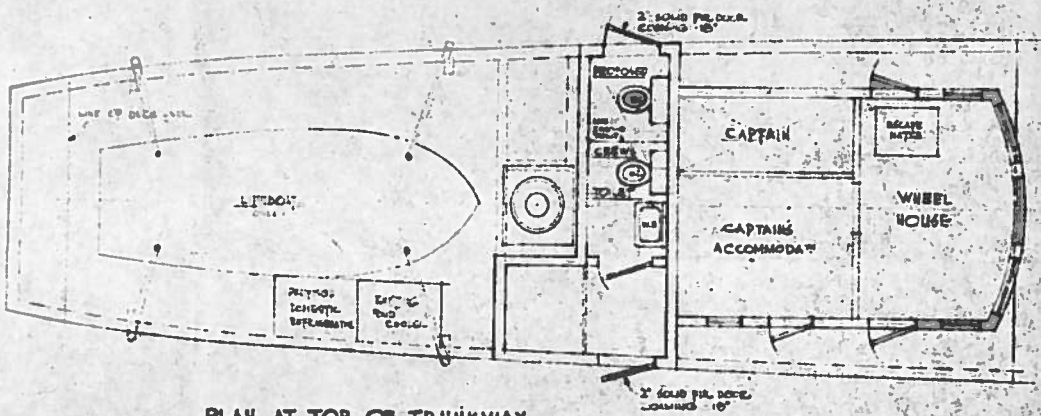
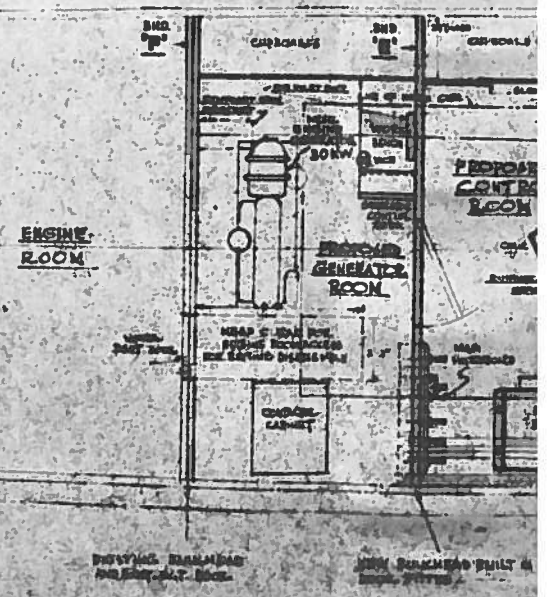
DATE - 10/1/43	TRACED BY	974
APPROVED -	CHECKED	



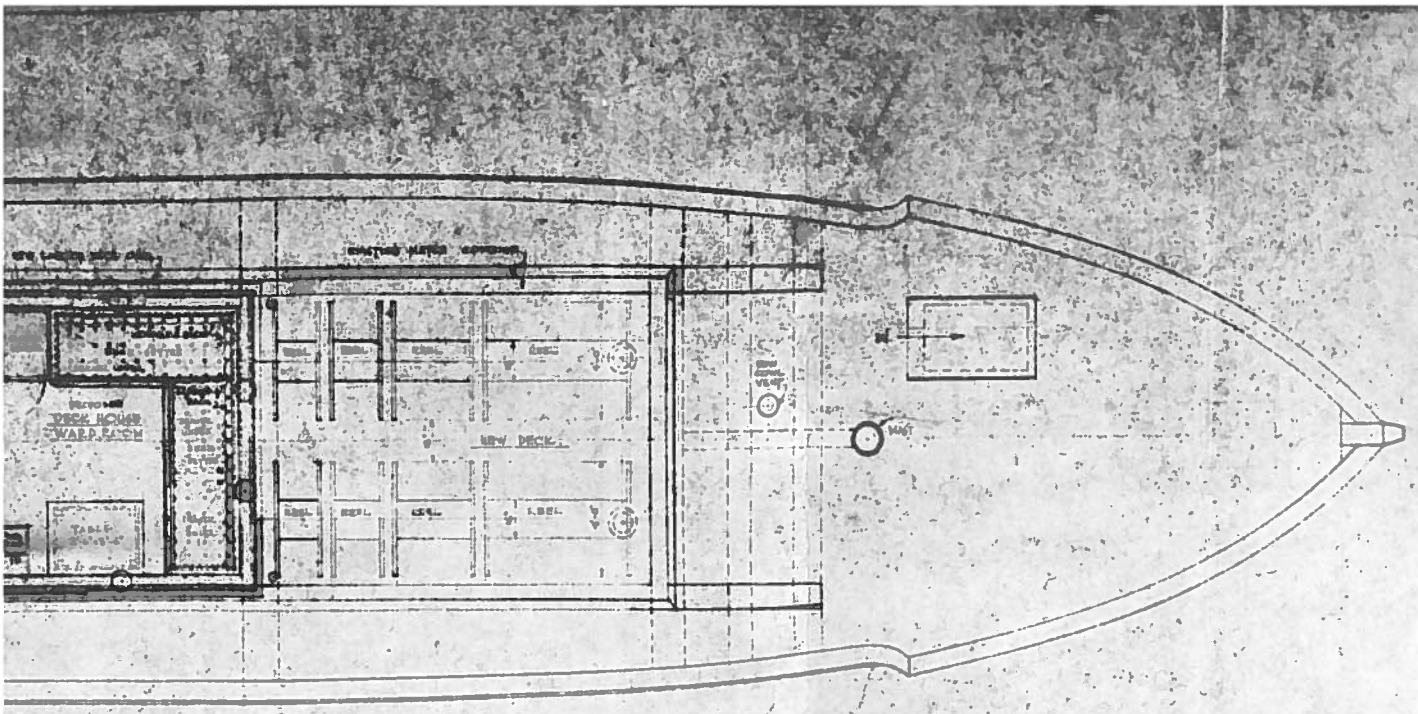
MAIN DECK

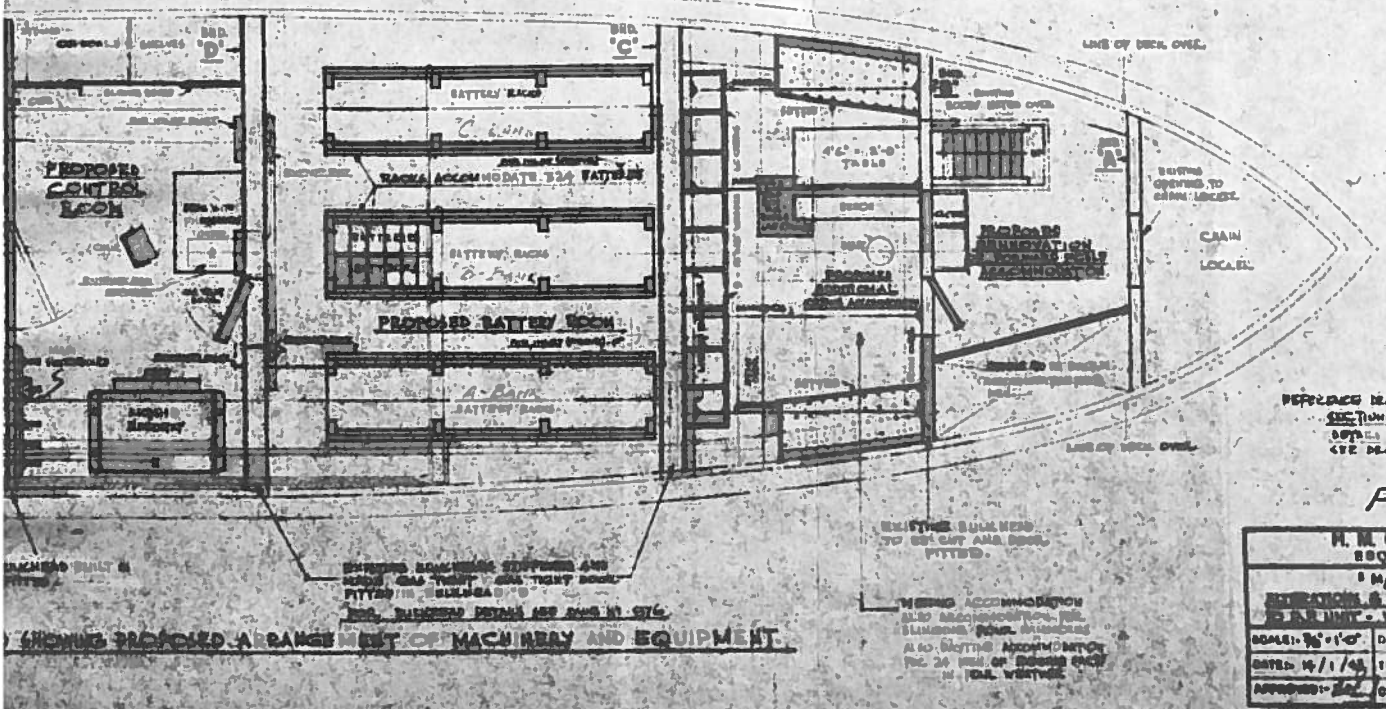


PLAN AT TOP OF TRUNKWAY



PLAN OF HOLD





REFERENCE DRAWINGS:-
SECTIONAL ELEVATION - SEE DWG. NO. 974
DETAILS OF BULKHEADS AND DECK HOUSE
SEE DRAWING NO. 976

SHOWING PROPOSED ARRANGEMENT OF MACHINERY AND EQUIPMENT.

Fig 2

H. M. C. DOCKYARD EQUIMALT, B. C.		
"M/V GRYME"		
ALTERATIONS & ADDITIONS TO CONVERT TO R.N. UNIT - WEST COAST - PLAN		
SCALE: 1/8" = 1'-0"	DRAWN BY	DRAWING No.
DATE: 14/1/43	TRACED BY	975
APPROVED:	CHECKED	

APPENDIX A - BATTERY AND CHARGING GENERATOR

The battery consists of three banks. Each bank contains 108 six-volt units (Exide XH-25) of 175 ampere-hour capacity. These are arranged as shown in figure 1A, in six parallel circuits, each with 18 units in series, producing a nominal bank voltage of 108, and an ampere-hour capacity of 1050.

The three banks are permanently connected in series and the four terminals resulting from this connection are brought out to the selector switch panel, and to the charging control panel.

Figure 2A shows the construction of the battery racks and the way in which they fit into the hold.

Electric power for charging the batteries is obtained from a diesel-generator set of 30 kw capacity. (Cummins diesel 50 hp 1400 rpm, Westinghouse generator 30 kw, 125 volts, 240 amperes, direct-connected.) The load characteristic of the set was chosen to suit the charging characteristic of the battery. (As the battery is charged, its voltage rises. As the battery voltage rises, the generator output falls.) This matching of characteristics reduces greatly the attention required from the attendant, and the danger of serious overheating or overcharging of the battery.

Figure 3A shows the saturation curve and the load characteristic for the charging generator set.

Figure 4A is the connection diagram for the charging control panel. This panel includes main circuit breakers with overload, under-voltage and reverse current relays, selector switches for connecting the generator to any one of the three battery banks, ammeter for indicating generator current, voltmeter and switches for indicating battery bank voltages, generator voltage, or unbalance voltage when paralleling the generator with a battery bank preparatory to charging, field rheostat for controlling generator output, starting contactor and ballast resistor permitting the use of the generator as a motor for cranking the diesel.

Figures 5A and 6A show structural details of the charging control panel, and figure 7A shows a front view of the completed panel.

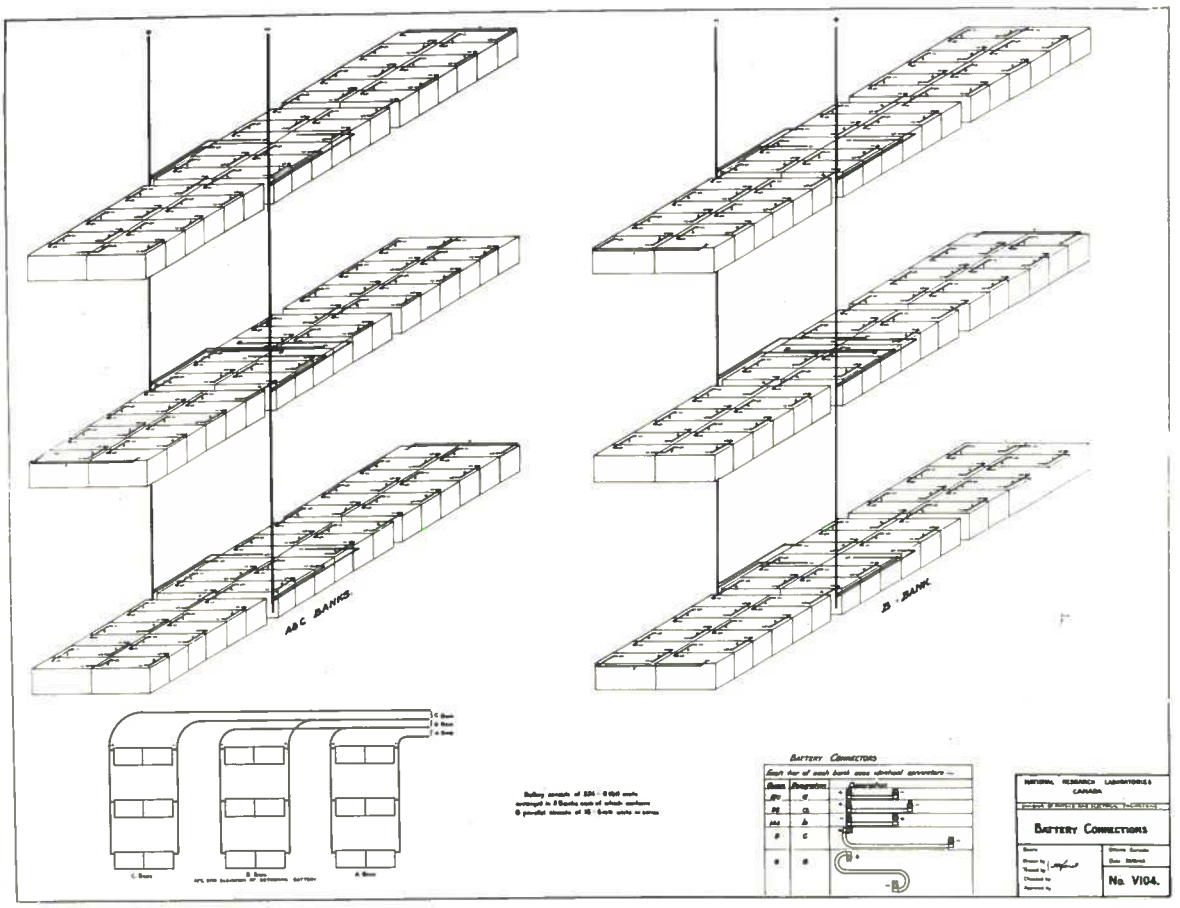

A B C BANKS
D BANK
BATTERY CONNECTIONS
BATTERY CONNECTIONS
No. V104.

FIG. 1A.

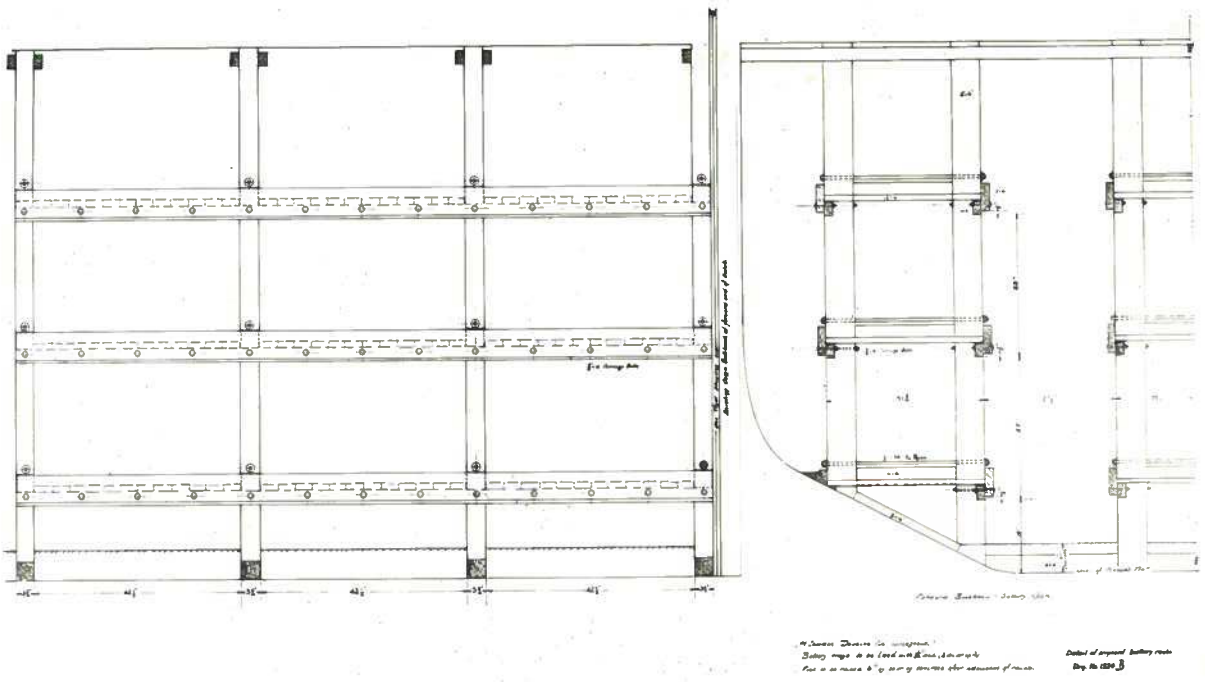


FIG. 2A.

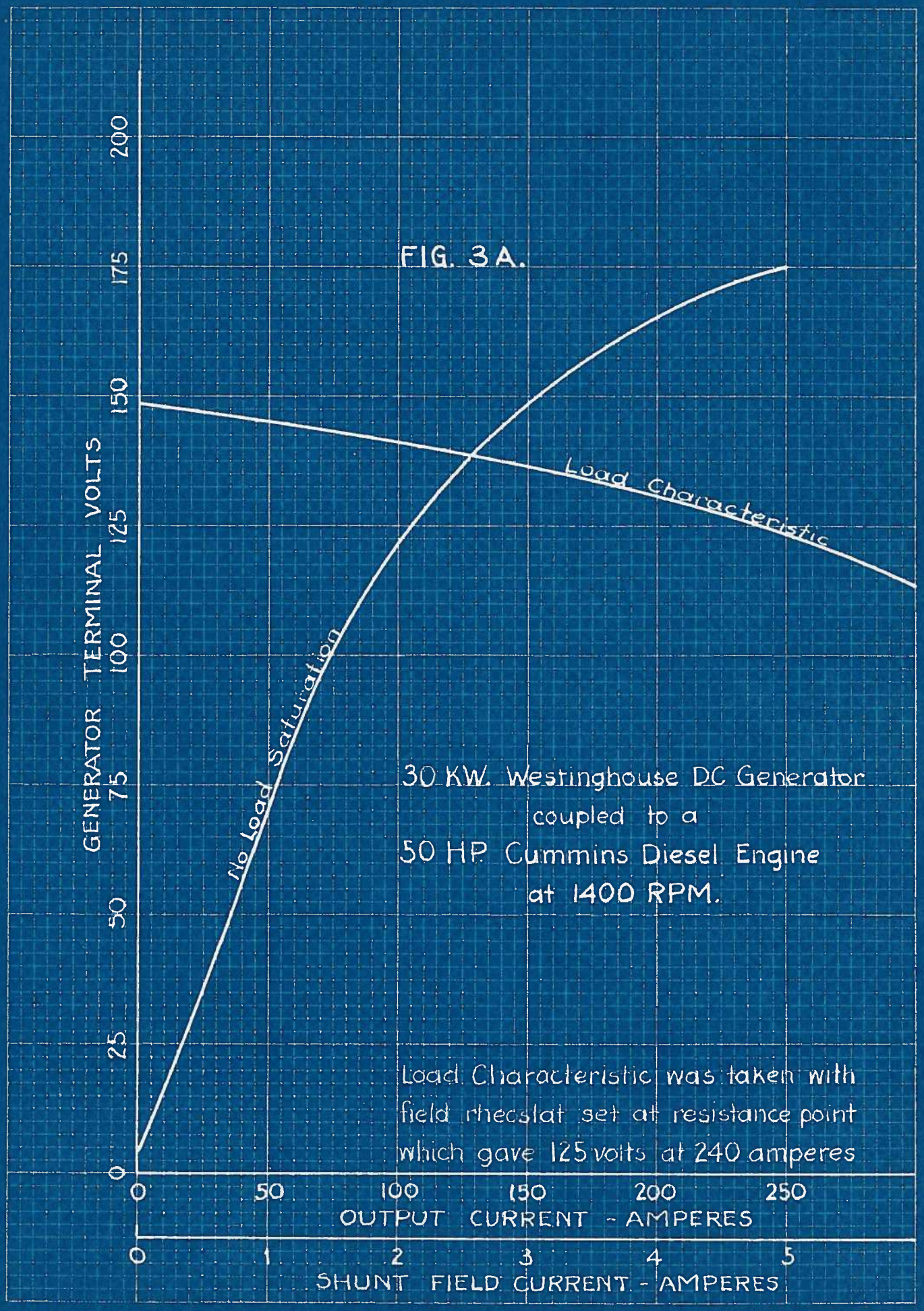


FIG. 3A.
GENERATOR TERMINAL VOLTS
0
25
50
75
100
125
150
175
200
No Load Saturation
Load Characteristic
30 KW. Westinghouse DC Generator
coupled to a
50 HP Cummins Diesel Engine
at 1400 RPM.
Load Characteristic was taken with
field rheostat set at resistance point
which gave 125 volts at 240 amperes
0
50
100
150
200
250
OUTPUT CURRENT - AMPERES
0
1
2
3
4
5
SHUNT FIELD CURRENT - AMPERES

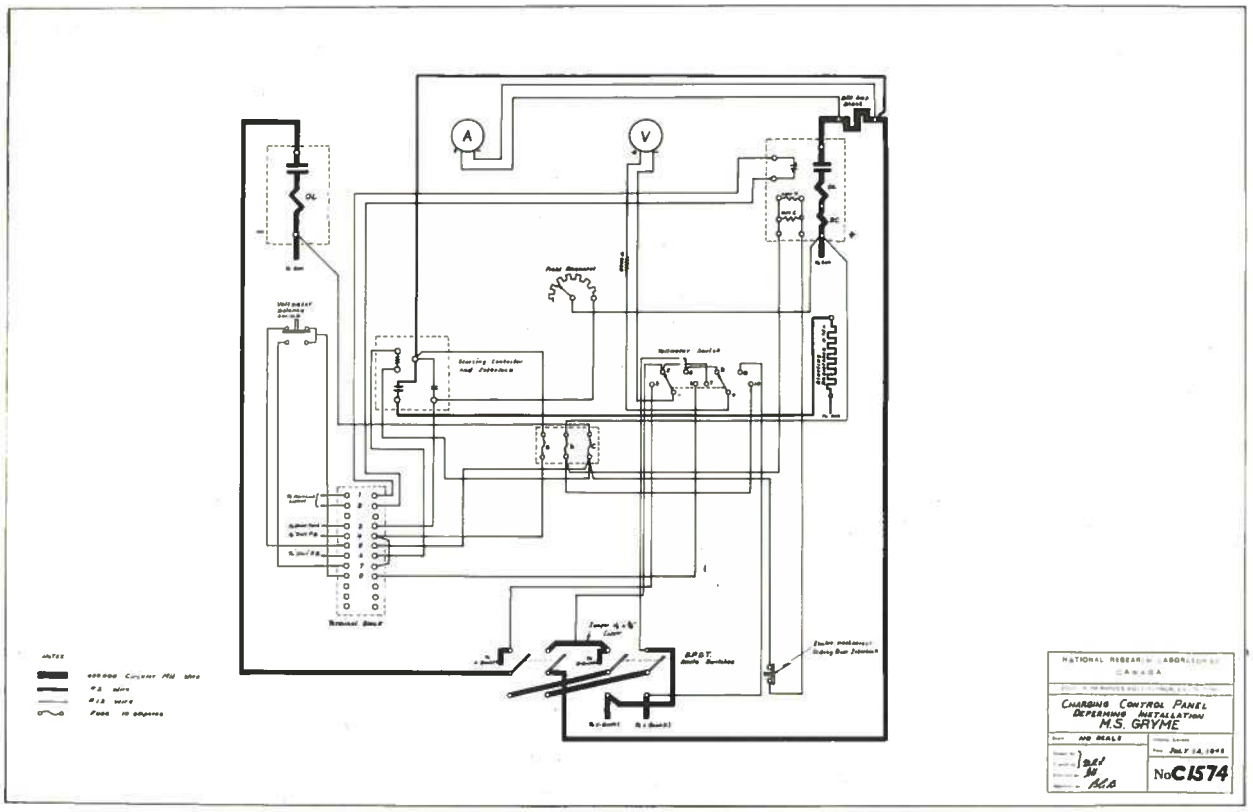

A
V
CHARGING CONTROL PANEL
DEPERMING INSTALLATION
M.S. GRYME
No C1574

FIG. 4A.

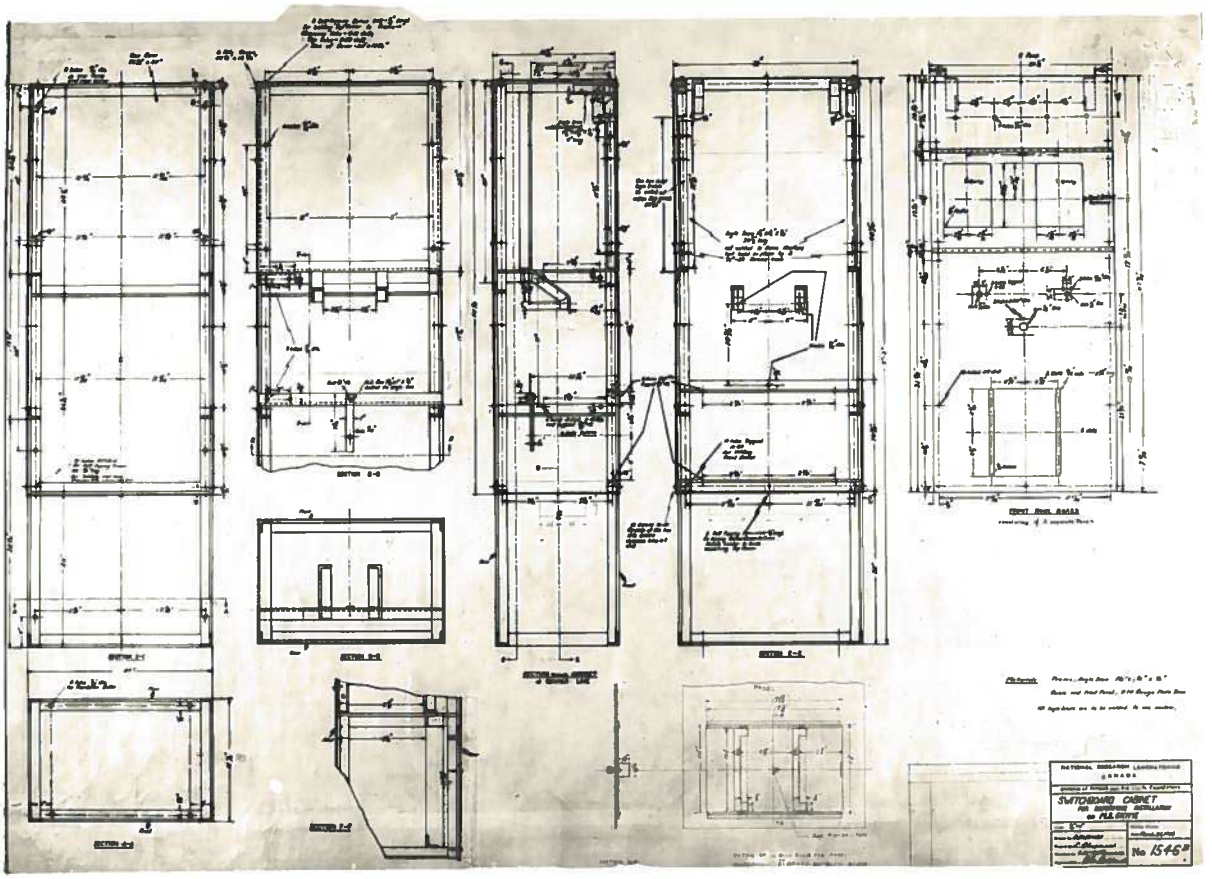

SWITCHBOARD CABINET
No 1546

FIG. 5A.

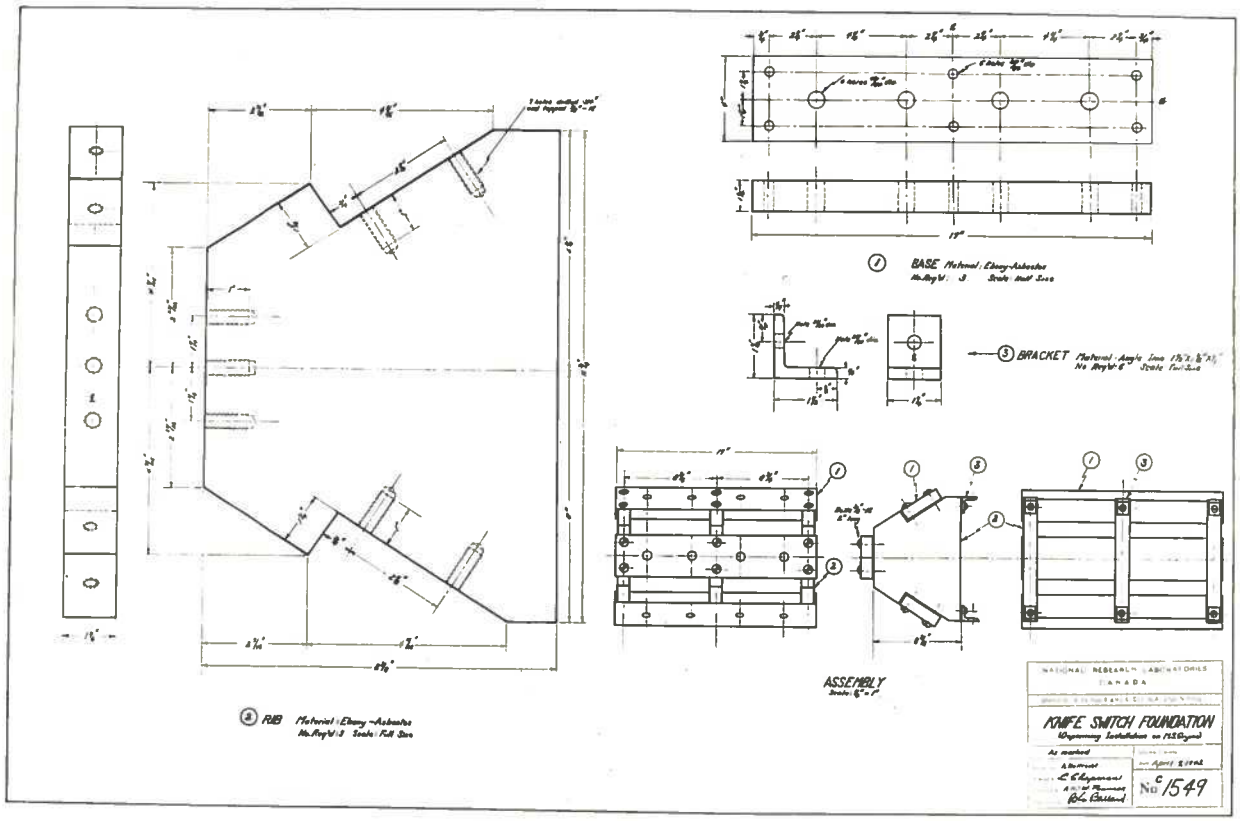

① BASE
② RIB
③ BRACKET
ASSEMBLY
KNIFE SWITCH FOUNDATION
No. C/1549

FIG.6A.

FIG. 7A.

APPENDIX B - LIQUID RHEOSTAT

Control of the magnitude of the current drawn from the battery is accomplished by the liquid rheostat. Its design follows that of the rheostat installed in the East Coast deperming unit, which in turn was fabricated at Halifax from Admiralty drawings.

Some modifications were made, however, as a result of experience with the East Coast rheostat. The tank was enlarged, and provided with a steel lining. The number of plates was increased and the separation between plates was decreased. The height of the shaft above the liquid level was increased. The contour at the starting point of the movable plates was altered to improve the control over the minimum current range. The drive-gear ratio was altered from 1:3 to 1:5, to improve control. The terminal arrangement was modified to simplify the cable connections.

In addition, a panel was added to the face of the liquid rheostat, with indicating lights, high and low range ammeters, clock and master switch, thus making control a one-man operation. Figure 1B shows this panel before the addition of the clock. Figures 2B to 11B, inclusive, are details of assembly and parts of the rheostat.

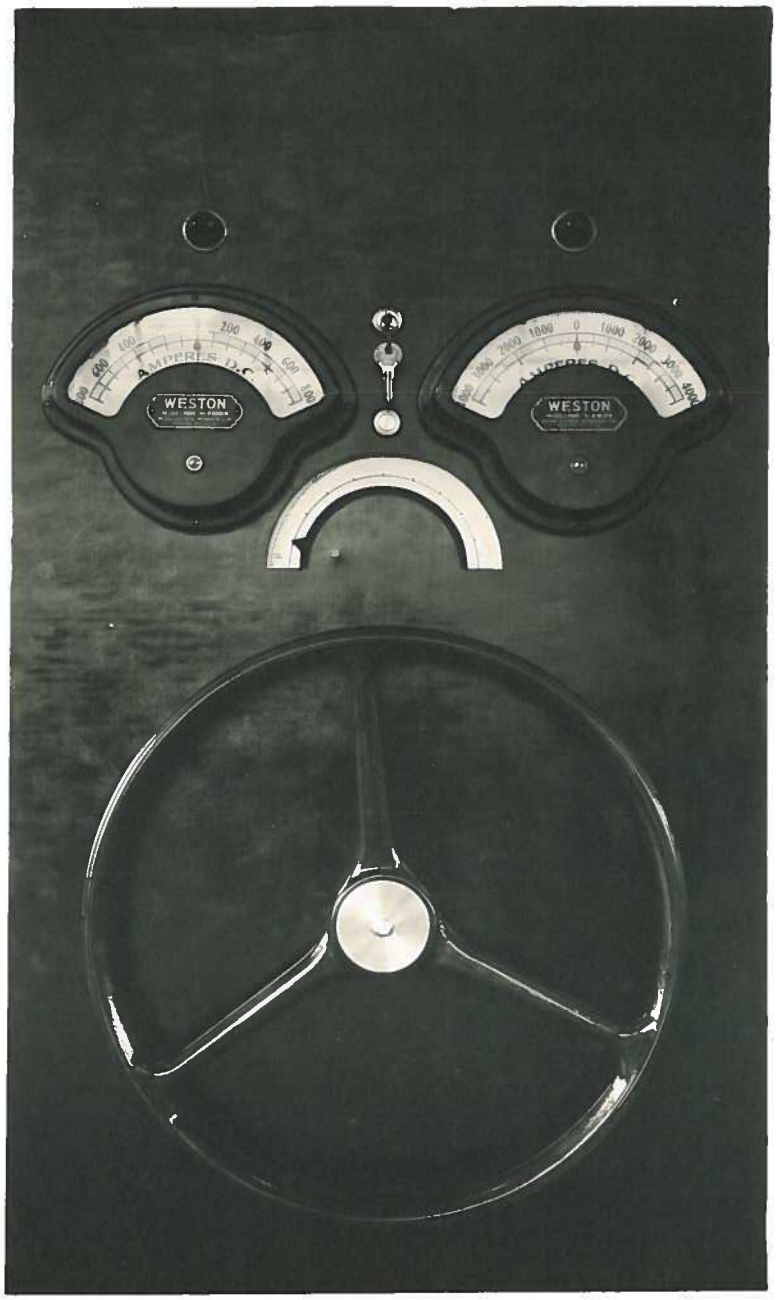


FIG. 1B.

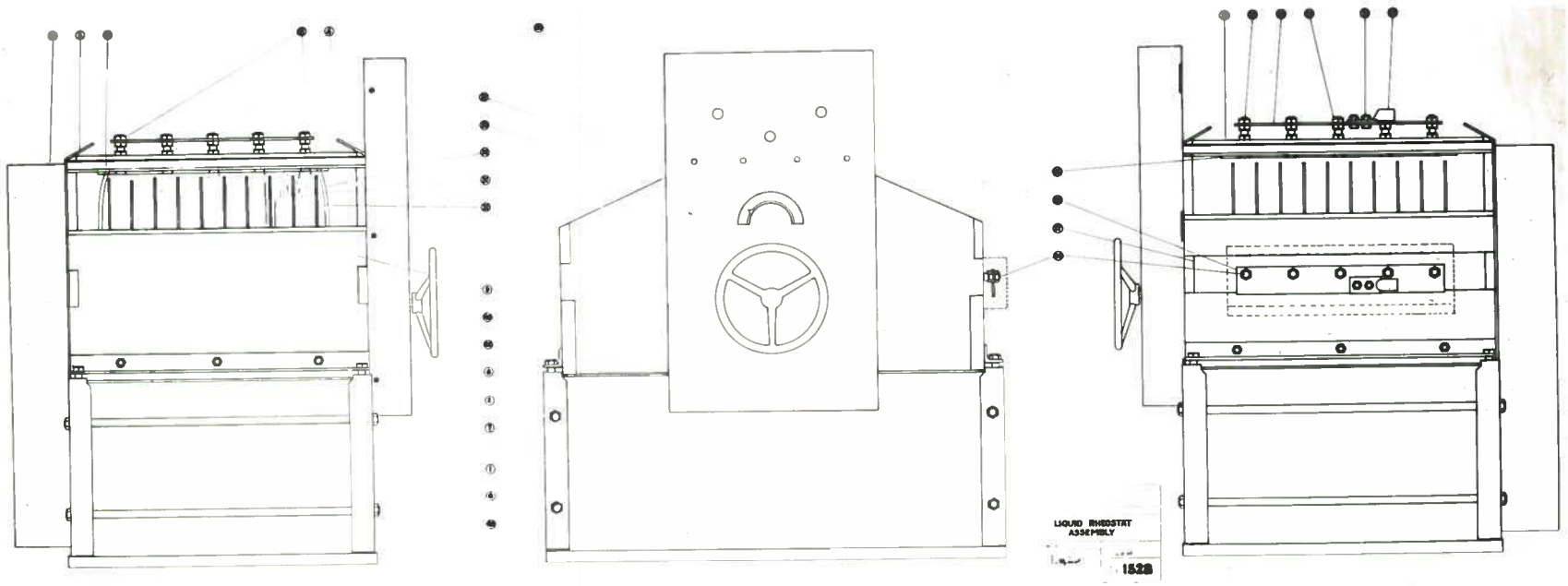


FIG. 2B (above)

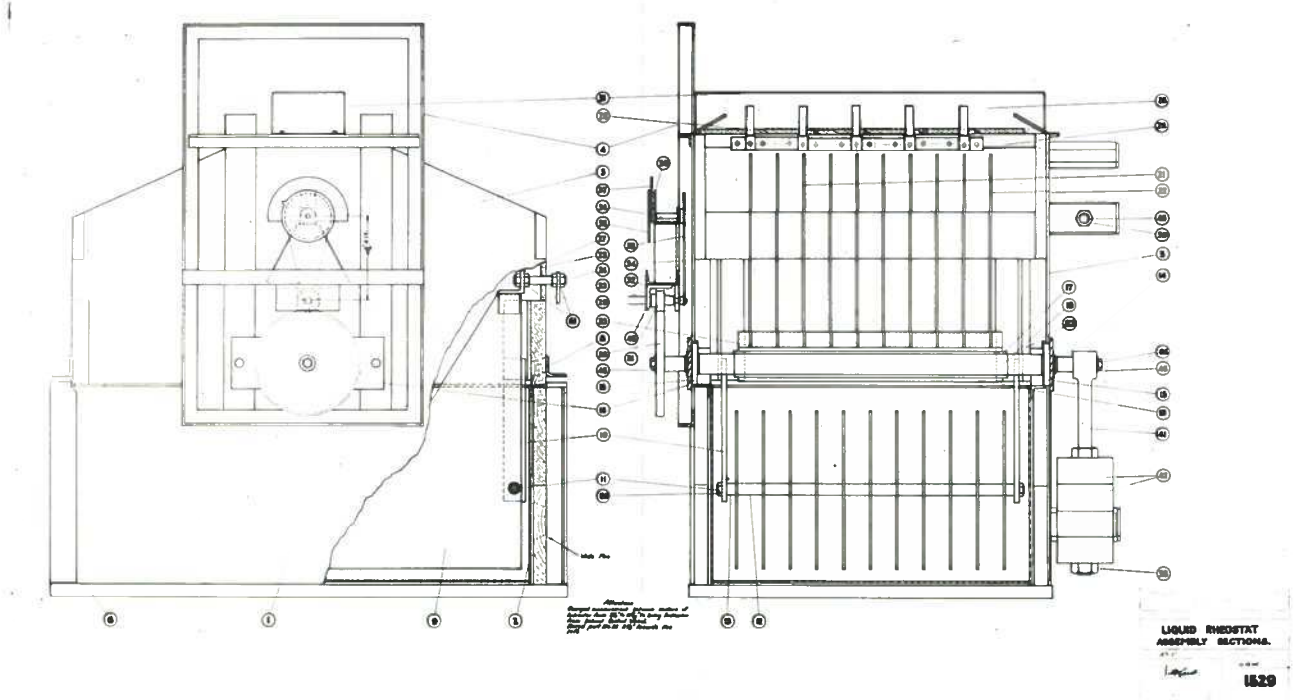


FIG. 3B (left)

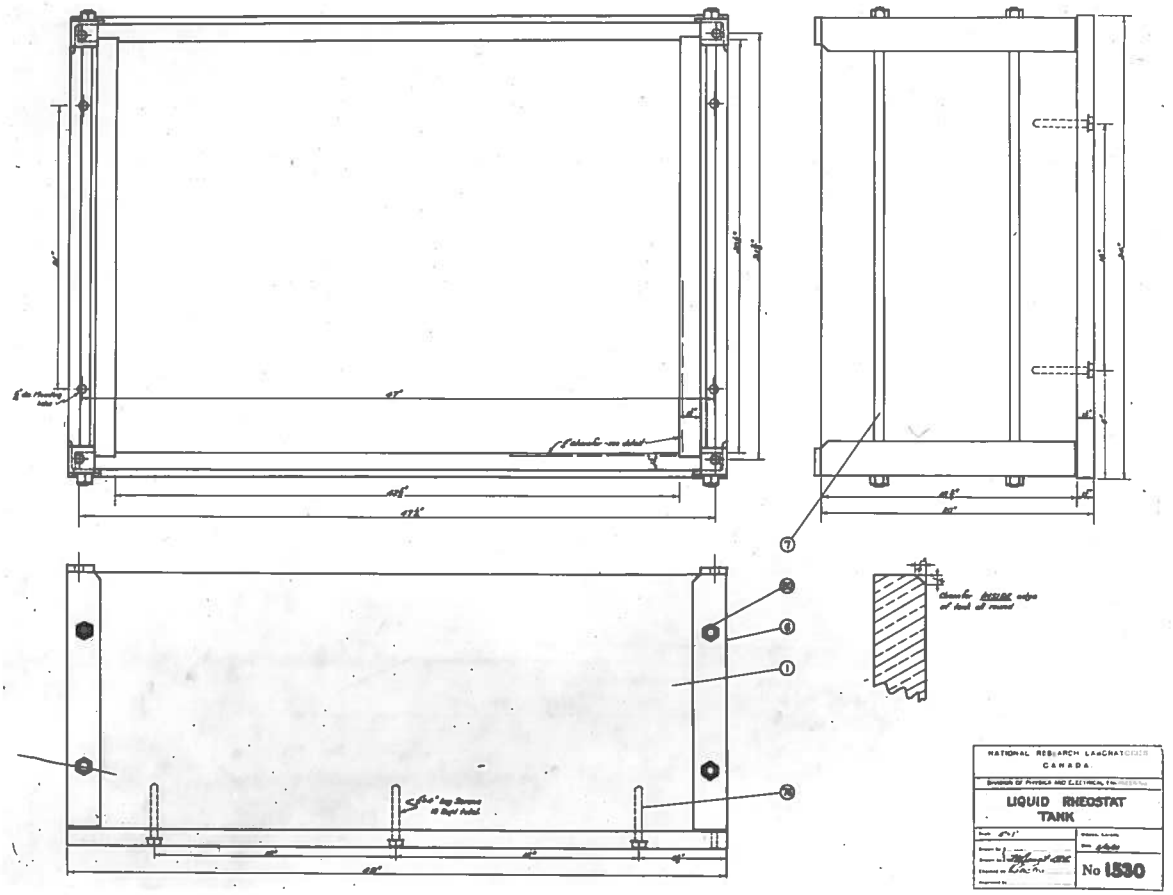

NATIONAL RESEARCH LABORATORIES
CANADA.
LIQUID RHEOSTAT
TANK
No 1530

FIG. 4B

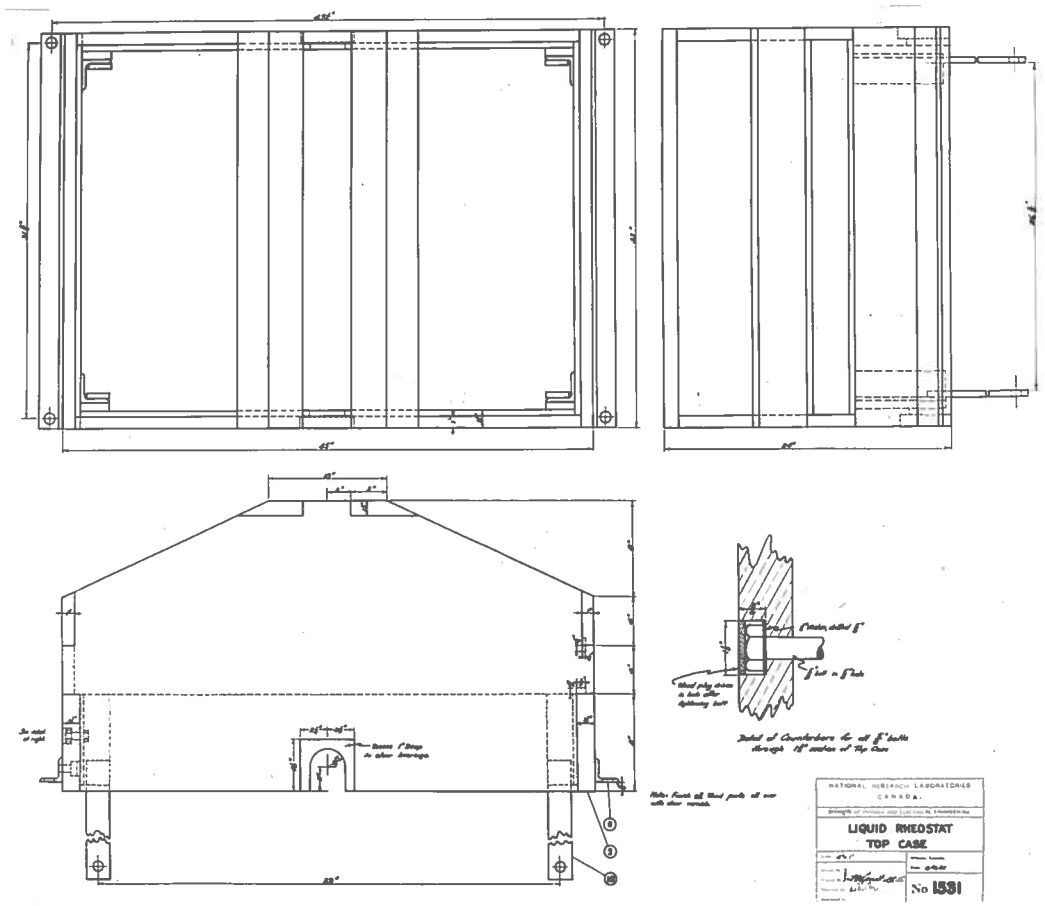

NATIONAL RESEARCH LABORATORIES
CANADA.
LIQUID RHEOSTAT
TOP CASE
No 1531

FIG 5B

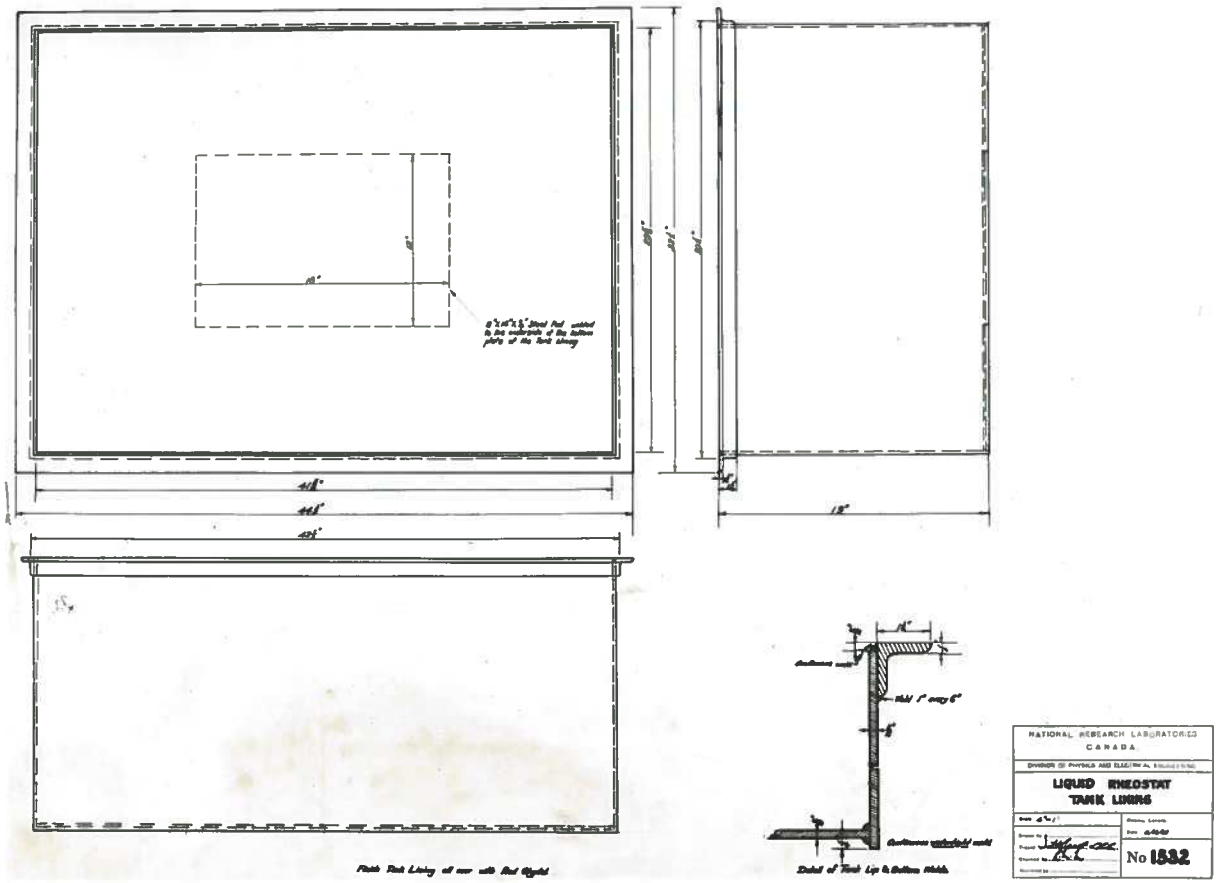

NATIONAL RESEARCH LABORATORIES
CANADA
LIQUID RHEOSTAT
TANK LINING
No 1532

FIG.6B

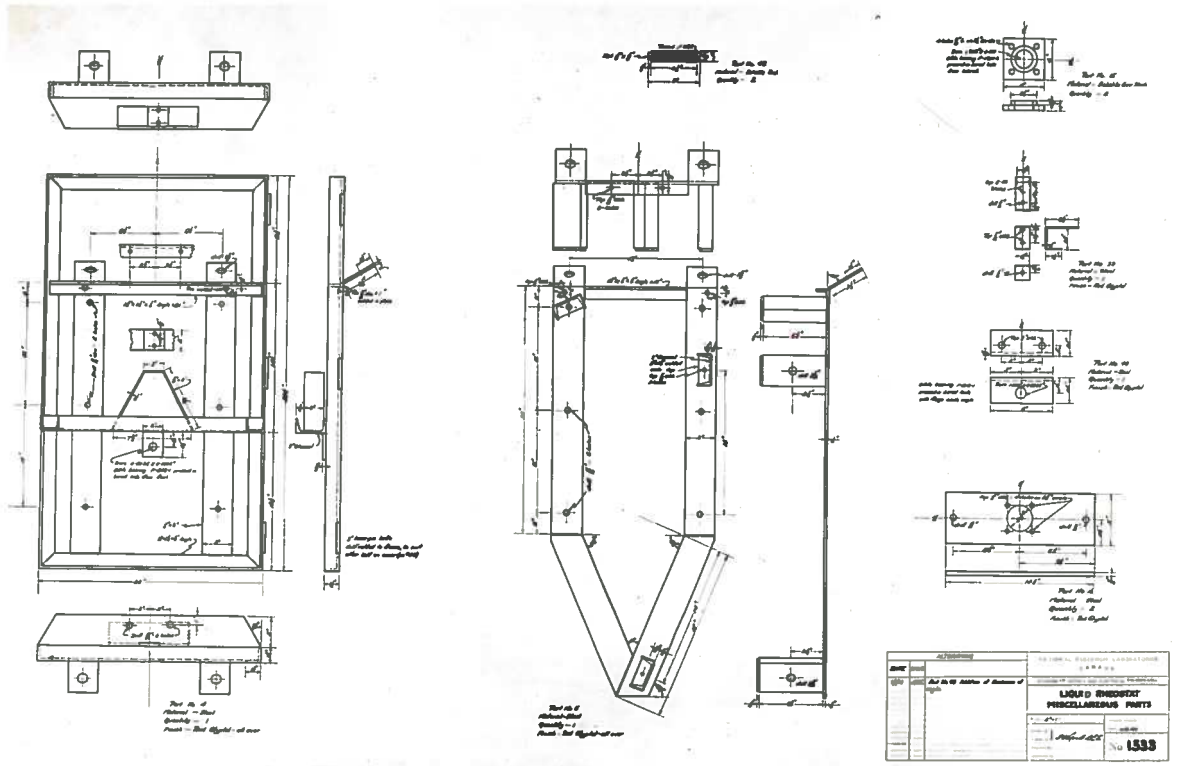

LIQUID RHEOSTAT
MISCELLANEOUS PARTS
No 1533

FIG. 7B.

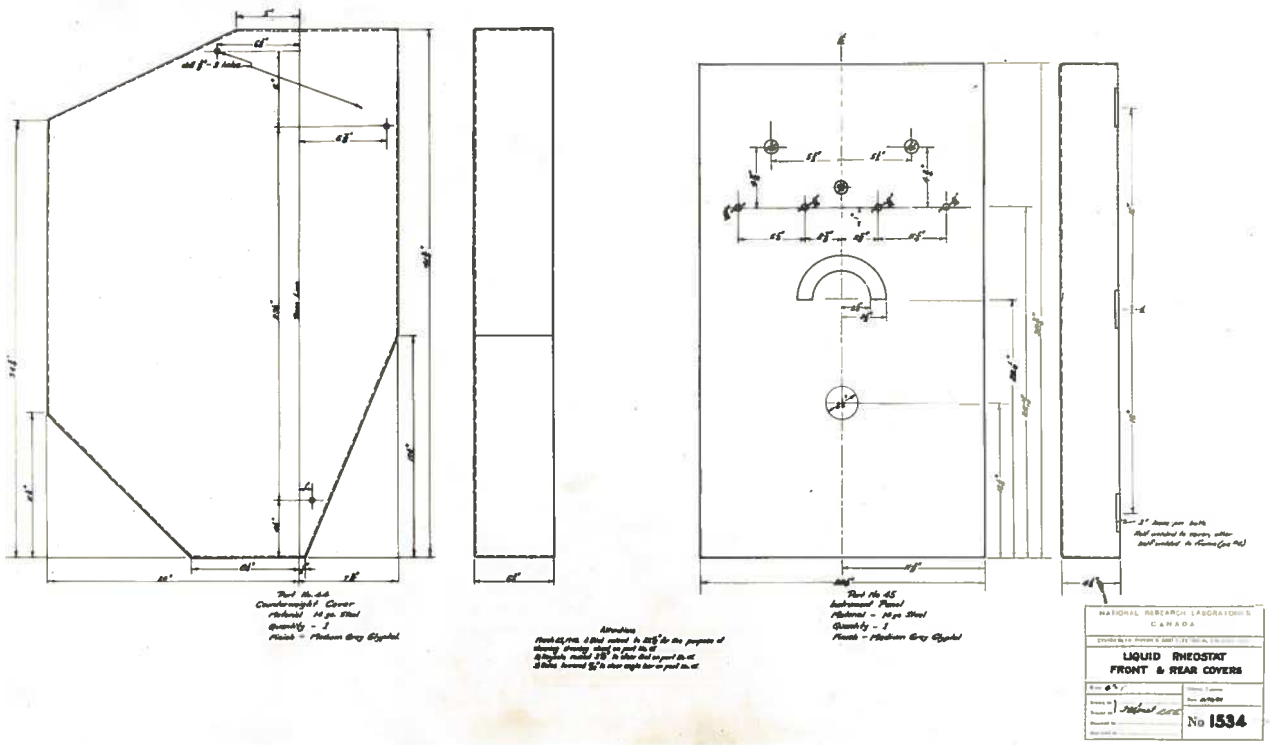

LIQUID RHEOSTAT
FRONT & REAR COVERS
No 1534

FIG.8B.

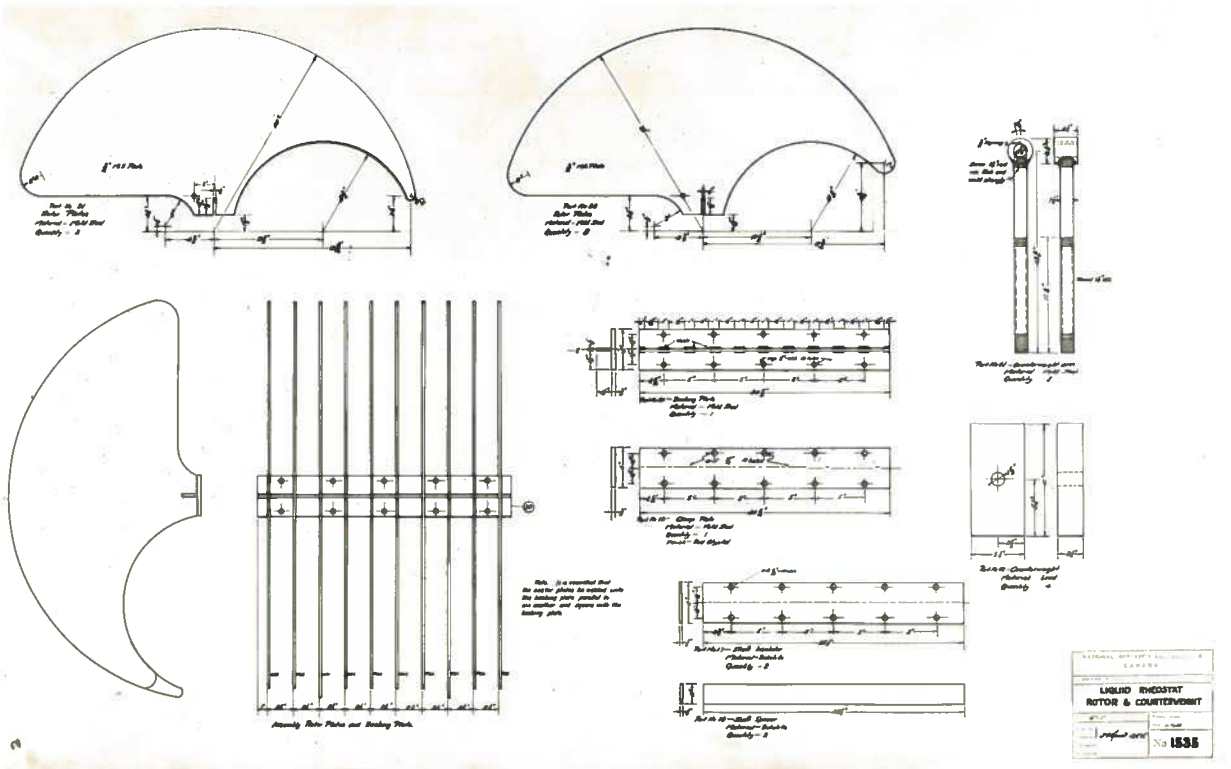

LIQUID RHEOSTAT
ROTOR & COUNTERWEIGHT
No 1535

FIG.9B.

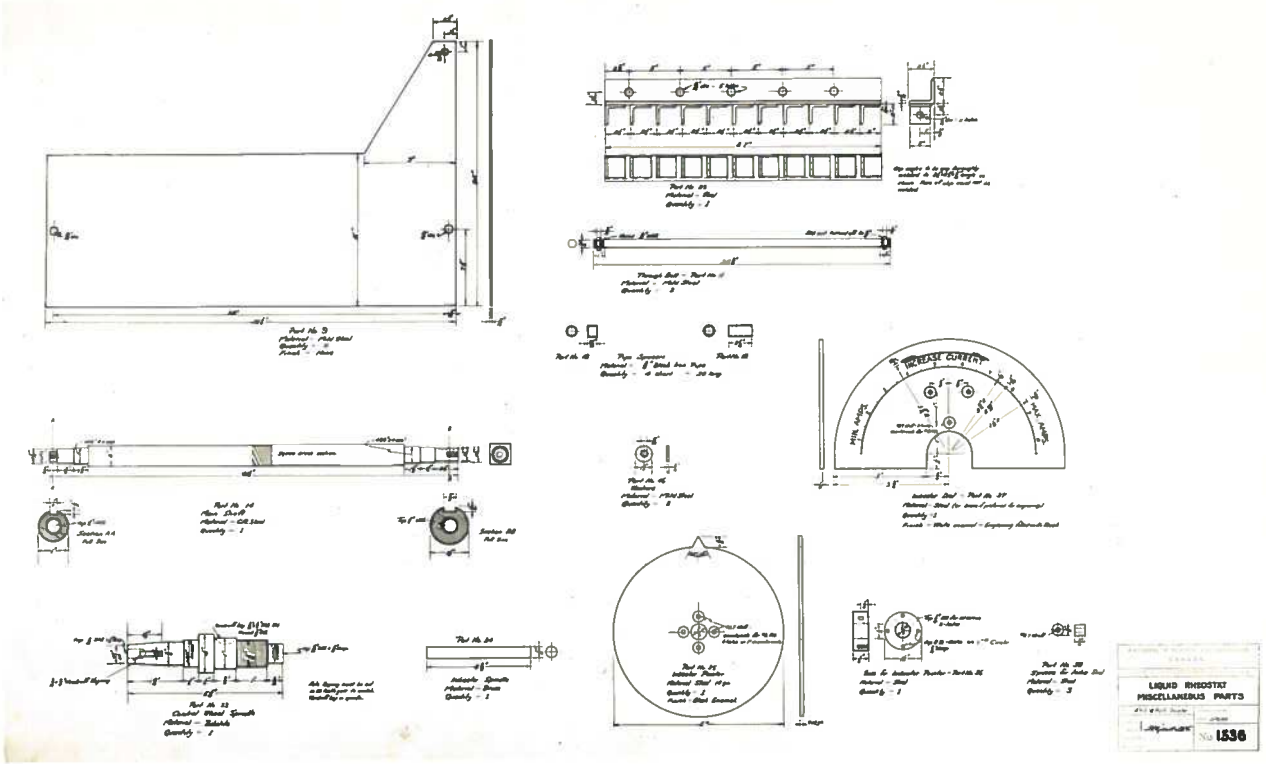


FIG.10B.

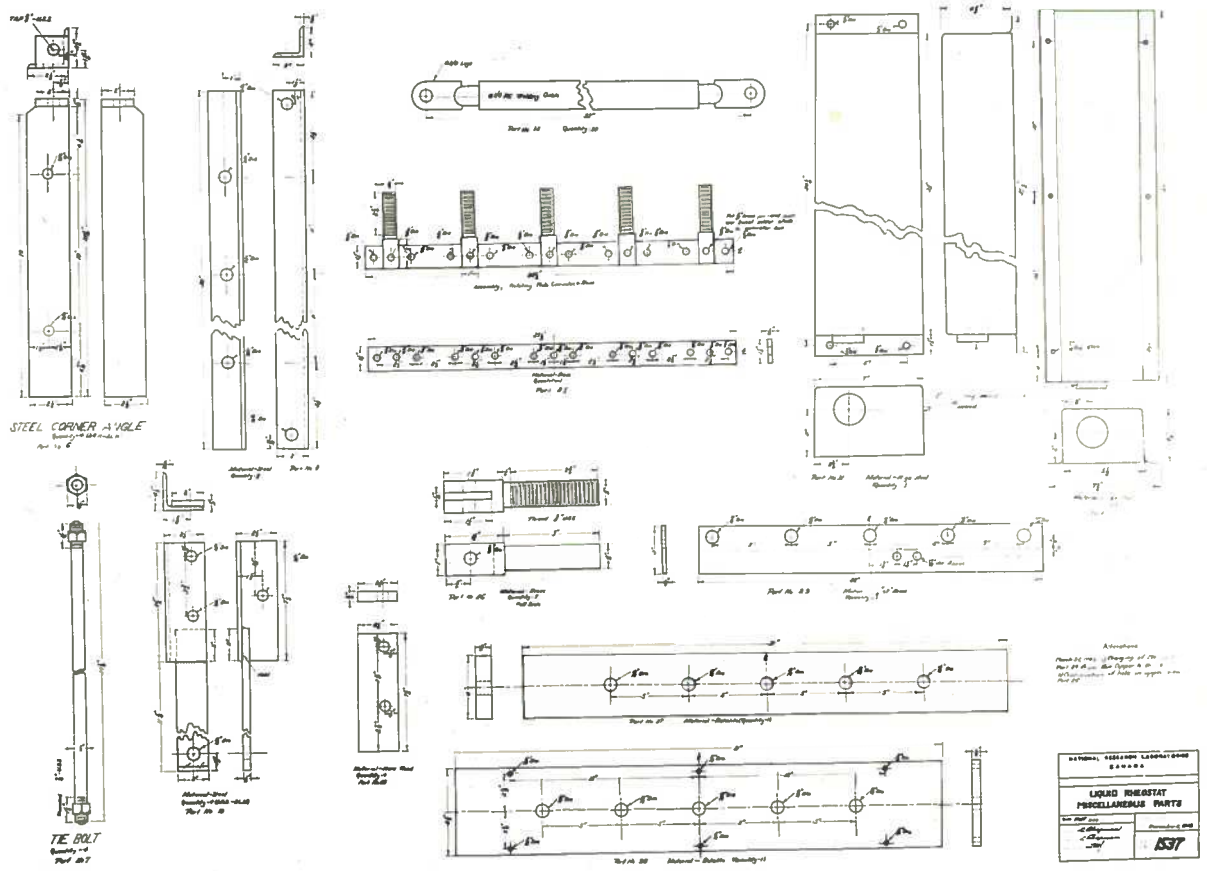


FIG.11B.

APPENDIX C - PRELIMINARY MODIFICATION PLANS

When the Motorship "Gryme" was first proposed for use as a deperming ship, no details of her construction were available. It was necessary, therefore, to prepare dimensioned sketches before making preliminary space allocation and equipment layouts.

Scale plans were then made of the spaces usable for equipment and additional quarters for the crew. From these it was evident that, with some crowding, the essential equipment and personnel could be accommodated. On this basis, sketches of the required alterations and additions were made and submitted to the Naval Board for approval.

The proposal involved sub-dividing the cargo hold into four compartments, decking over the hatchway, and erecting a deckhouse in the after half of the hatchway. Numbered from the forward end, the compartments were: first, additional quarters for seamen; second, battery room; third, control room; and fourth, generator room. These are shown in figure 1C. Water-tight and gas-tight bulkheads were specified for the fore and aft ends of the battery room. A partition only would be required to separate the control and generator rooms. It would support certain of the control equipment. This partition is shown in figure 2C.

The necessary deperming plant was then superimposed on the sketches, resulting in the arrangement shown in figure 3C. Lighting and ventilating fixtures for the installation were next located on the sketches, as shown in figure 4C.

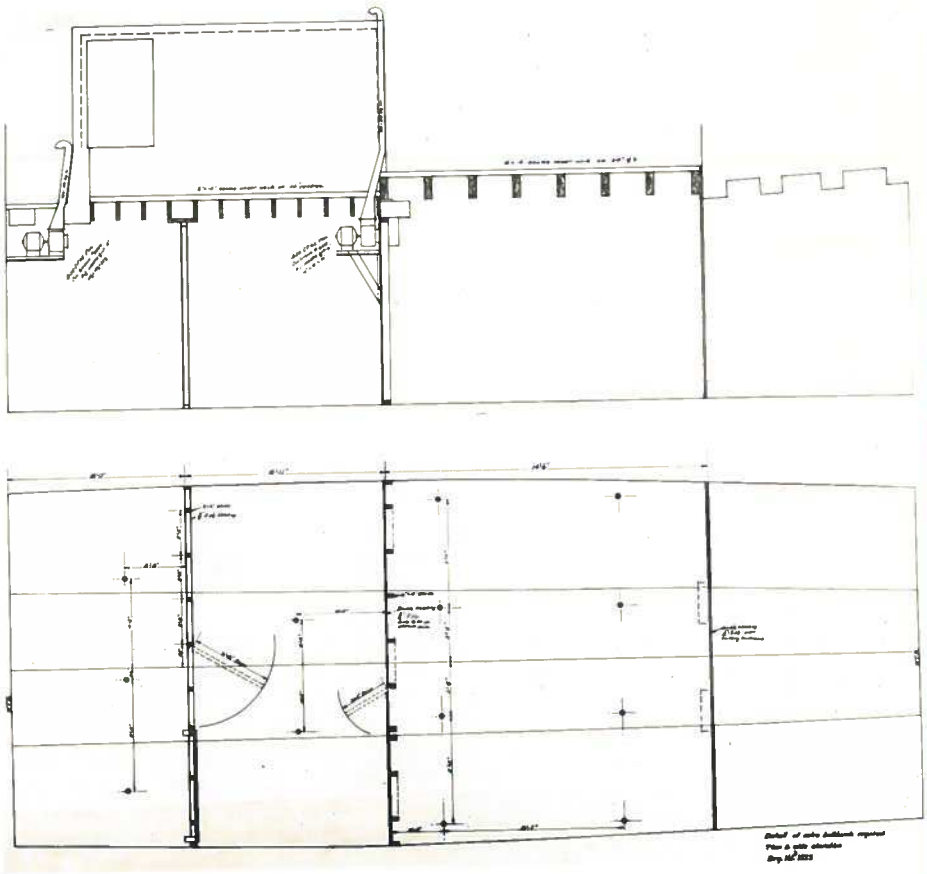


FIG.IC.

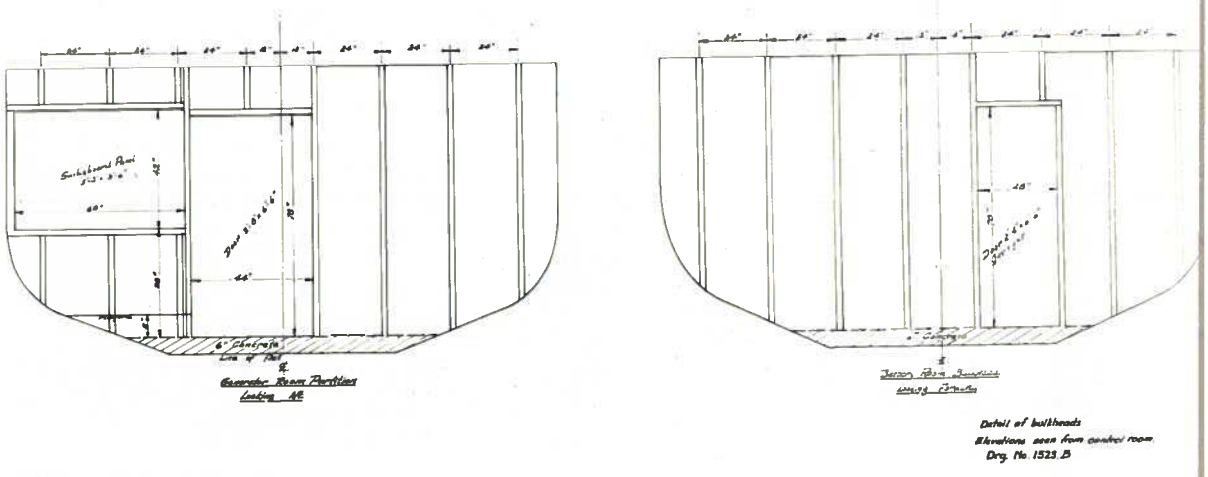


FIG.2 C.

FIG.3C.

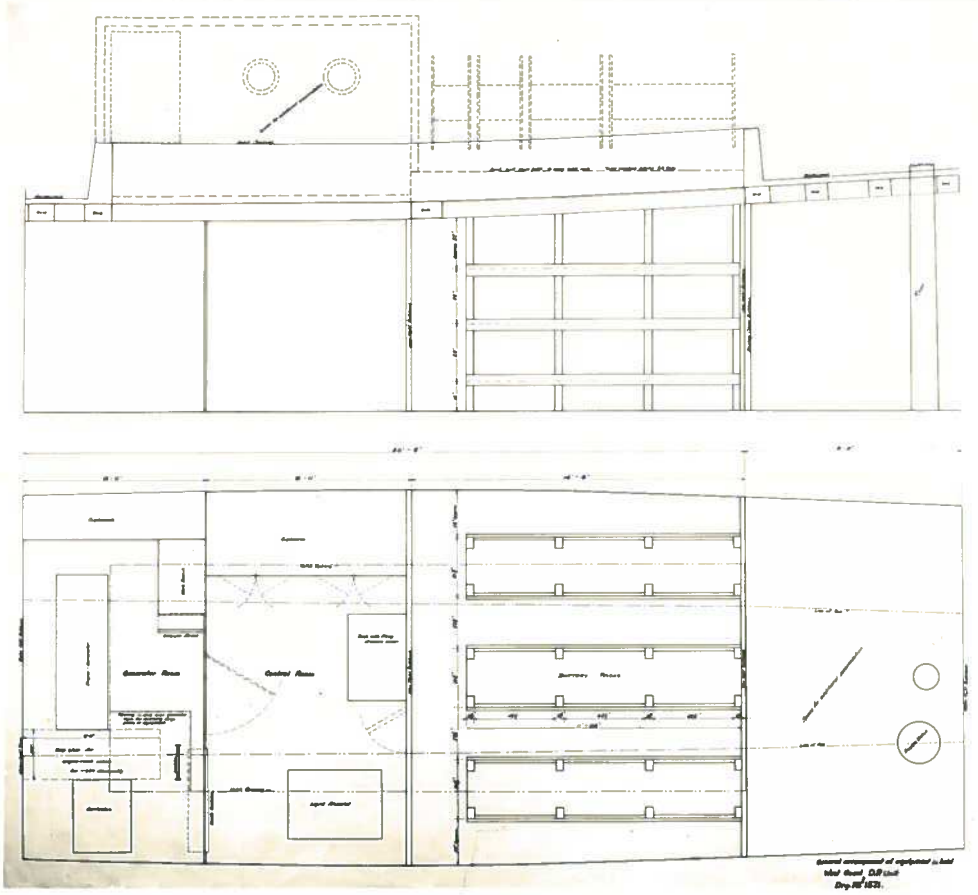
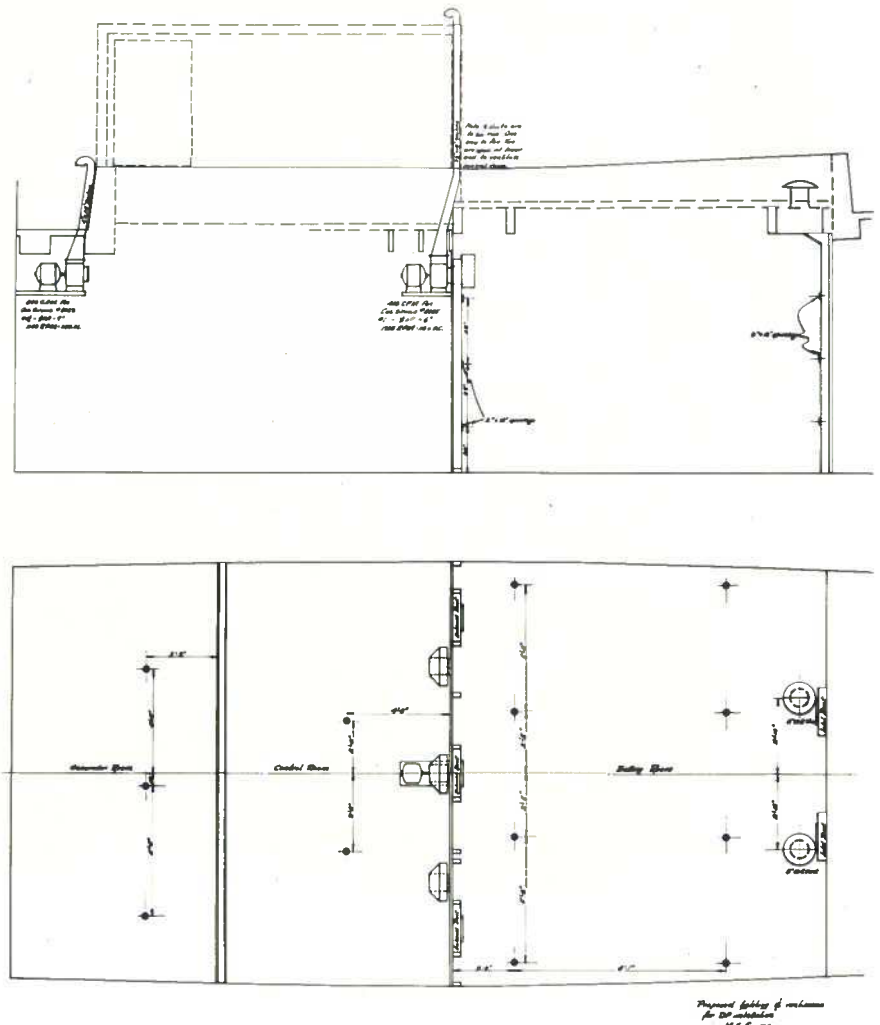


FIG.4C.



APPENDIX D - SPECIFICATIONS OF ALTERATIONS AND MODIFICATIONS

"M/V GRYME"

(Prepared by Engineer Superintendent - H.M.C. Dockyard, Esquimalt)
9th January, 1943.

1. GENERAL DESCRIPTION

The dimensions of the vessel are:-

Length B.P.	92'	- 0"
Beam	18'	- 0"
Depth Moulded	11'	- 3"

The above vessel is to be converted to a Mobile D.P. Unit, (West Coast). The hold will be divided into three compartments comprising a total length of 31' - 7" forward of the Forward Engine Room water-tight bulkhead. The Compartments from the Engine Room W.T.B. forward are, Generator Room, Control Room and Battery Room, as shown on the accompanying sketch. On the weatherdeck, in the way of the hatchway, are two cable real units, one located on the Port Side and the other on the Starboard Side.

A wood cabin or deck house to be built over the after-portion of hatch Coaming, for the D.P. Officer's messing and living accommodation.

A sub-division in after-portion of deck house, as shown on drawing, is to be made so as to provide a lavatory with toilet and wash-basin. Living accommodation for the crew in the Forecastle and the existing accommodation aft of the galley is to be renovated.

Proper lavatory and toilet facilities to be provided for the crew.

All electrical installation, lighting and fixtures to be provided for by H.M.C. Dockyard, Esquimalt, B.C.

All timber used in construction on this vessel is to be sound and properly seasoned.

General and detailed drawings showing alterations and modifications will be made by H.M.C. Dockyard, Esquimalt, B.C.

Any drawings which may be prepared by a contractor are to be approved by the Department.

NOTE:-

Where the word "Department" is used in this specification it shall mean the Department of National Defence (Naval Service).

It is the intent and spirit of this specification that the contractor shall complete in all respects any items mentioned in this specification but not shown in the drawings, or vice versa, or omitted from both, but obviously necessary for the proper completion of the vessel are to be carried out as though fully treated in both.

With working drawings being supplied for guidance, it is to be clearly understood that the contractor is to check all scantling sizes etc. and satisfy himself as to their suitability.

The cost of such changes, if any, for minor additions required for local stiffening during construction, shall be considered as having been provided for in the contract.

2. GENERATOR ROOM EQUIPMENT

Diesel Generator and Appurtenances

(a) A 30 Kw Diesel Eng. Generator will be located athwart-ship, in position shown on drawing. The side of the base to be approximately 18" from the Engine Room W.T. Bulkhead and the general disposition of the unit to straddle the center line as shown on drawing.

The seating for the above unit will be bolted rigidly to the Port and Starboard bottom stringers and also bolted to the sister keelsons by 3/4" diameter galvanized lag screws.

The 8" I beams attached to the Engine base are to be cut and fitted where found necessary, also I beams to be tied together at each end by welding a distance piece as shown on Drawing.

The approximate weight of the complete 30 Kw Diesel generator unit is 5,000 lbs. This unit will be supplied by the Department. All electrical connections, wiring and conduits will be done by H.M.C. Dockyard, Esquimalt.

(b) Cooling System

The cooling system shall include the necessary piping and fittings, pumping unit and heat exchanger.

A seacock shall be located at some convenient place in the generator room for the supply of seawater to the heat exchanger.

The discharge overboard from the pumping unit to be located above the water line, and located in a suitable place in the generator room.

An expansion tank for fresh water to the Diesel engine jacket to be supplied, together with the necessary piping and fittings to connect up the inlet and outlet connections on engine.

(c) Fuel Oil

Fuel oil piping and fittings to be supplied and connections made to the existing fuel oil day tank in the engine room.

(d) Intake Air

Intake air supply piping for the diesel engine shall be about 8 feet above deck and equipped with a standard air filter, and located in a suitable position aft of the deckhouse. Air intake to be fitted with a W.T. cover.

(e) Exhaust Gases

The exhaust gas piping and fittings, together with a silencer for a 30 kw diesel engine to be supplied. The exhaust piping connections must be made gas tight and the exhaust piping led to, and secured firmly to the existing exhaust stack, or some other suitable location.

(f) Contactor Cabinet

The contactor cabinet will be mounted and secured rigidly to a suitable seat and fastened at the top by galvanized fastenings as shown on drawing. The approximate weight of the unit is 1,200 lbs. This unit will be supplied by the Department. All electrical connections, wiring and conduits will be done by H.M.C. Dockyard, Esquimalt, B.C.

(g) Ventilation

An exhaust fan and motor will be mounted rigidly on the forward side of the engine room bulkhead. The discharge duct shall be located outside, just aft of the deckhouse, as shown on drawing. W.T. covers to be fitted where necessary. The capacity of the fan is 800 C.F.M.

This unit will be supplied by the Department.

Provision is to be made also for fresh air supply to generator room. Electrical wiring and connections will be done by H.M.C. Dockyard, Esquimalt, B.C.

(h) Generator Control Panel

The generator control panel will be located on the port side adjacent to work bench as shown on drawing. The base channel will be held firmly by suitable fastenings to the flooring. The top of panel will be

held in place by some suitable stiffening from bulkhead.

The generator control panel will be supplied by the Department.

(i) Workbench

A suitable workbench approximately 2 feet wide and 3 feet long, made from 1 5/8" finished fir and fitted with a 4" bench vise and drawers. Suitable rigid fastenings to ceiling and flooring is to be provided.

(j) Cupboards

Locked cupboards with shelve lockers and drawers to be provided on port side as shown on drawing. The cupboards to extend in height to under side of deck. Cupboards to be made from fir. Sliding dorrs to be provided for.

(k) Ladder

The ladder from the generator room to the hatchway, as shown on the drawing, is to be provided and is to be openwork steel tread, type 16" wide, and to connect to hatchway in lobby to officers' accommodation.

This ladder is to be removable.

(l) Flooring

A false floor 1 5/8" thick suitably supported is to be provided. This flooring is to extend to the inboard edge of the lower stringer and to be level with same, as shown on drawing.

(m) New Bulkhead

Bulkhead "E", as shown on drawing, is to be constructed from 2" x 4" studding and sheathed on either side with 5 plywood. This bulkhead separates the generator room from the control room. A door is to be built into this bulkhead, (clear opening 6'-6" high and 3'-8" wide). The main switchboard will also be built into this bulkhead. Suitable stiffening is to be provided in way of doorway and switchboard. The location of door and switchboard is shown on drawing.

3. CONTROL ROOM EQUIPMENT

Liquid Rheostat

(a) The liquid rheostat to be installed will be held rigidly in place with suitable fastenings on the Starb'd side, as shown on drawing.

This piece of equipment will be supplied by the Department.

The electrical connections will be done by H.M.C. Dockyard, Esquimalt.

(b) Main Switchboard

The switchboard will be mounted on the Starb'd side of bulkhead "E" with knife switches looking forward. The necessary supports and fastenings to be provided for same.

All electrical wiring and connections will be done by H.M.C. Dockyard, Esquimalt. The switchboard and knife switches will be supplied by the Department.

(c) Desk

A desk with chair and filing drawers to be supplied, as shown on drawing. The desk will be approximately 3'-9" long and 2'-6" wide and will be made from fir and finished all over. Drawers to be fitted with suitable locks.

(d) Cupboards

Cupboards with sliding doors and the necessary shelves and drawer space to be provided. Doors and drawers to be provided with suitable locks.

The cupboards to be made from fir and to extend in height to under side of deck.

(e) Existing Bulkhead "D"

Bulkhead "D" subdivides control room and battery room. This bulkhead will have to be made gas tight. All seams, cracks and openings by caulking and by the use of Irish Tarred Felt. Studding to be used where necessary on both sides of the bulkhead so that 5 plywood sheeting can be installed and made flush. This bulkhead has to be made to build bulkhead up with 2 1/2" thick by 10" wide planking, after which the necessary caulking and fitting will be done, the same to be covered with 5 plywood sheeting and made gas tight. A door 6'-6" high by 2'-0" wide is to be located in the bulkhead, as shown on drawing. This door is to be provided with W.T. clips and to be made gas tight.

(f) Flooring

A false floor 1 5/8" thick suitably supported is to be provided. This flooring is to extend to the inboard edge of the lower stringer and to be level with same as shown on drawing.

(g) Exhaust Fan

An exhaust fan and motor will be mounted on a suitable bracket or base on aft side of bulkhead "D" for exhausting gases from battery room, as shown on drawing. Provision has to be made for the suction duct to go through the bulkhead. This duct to protrude through bulkhead, to allow for a suitable connection to be made to fan inlet. The opening provided for the duct must be made gas tight after fitting has been completed.

The discharge duct from the fan will be provided with a flexible connection to eliminate vibration.

About seven feet of this duct run will be housed inside the forward wall of the deckhouse, as shown on drawing.

Two natural draft ventilating ducts one on the port side and one on starb'd side on aft side of bulkhead "D" are also to be housed inside the forward wall of the deckhouse.

The fan capacity is 400 cfm and the complete unit fan and motor will be supplied by the Department.

4. BATTERY ROOM EQUIPMENT

(a) Battery racks to be made from #1 Common Douglas fir and to be approximately 11'-10 1/2" long by 32" wide, three tiers high and three rows wide, as shown on drawing. Lead lined trays to be fitted under the batteries to protect the wood racks. The batteries will be supplied by the Department. Frame work to be held together with steel tie rods and bolts. Battery racks shall be painted all over with acid resisting paint.

(b) Ventilation

Special ventilation arrangements coupled to a power exhaust fan on aft side of bulkhead "D" and suction mouths over the batteries are to be provided for as shown on the drawing. On aft side of bulkhead "C" two ventilating ducts connecting two 8" MR vents on deck for the supply of fresh air to the battery room are to be provided, as shown on drawing.

(c) Existing Bulkhead "C"

Bulkhead "C" subdivides the battery room from the crews accommodation forward. This bulkhead will have to be made gas-tight. All seams, cracks and openings by caulking and by the use of Irish Tarred Felt. Studding to be used where necessary on both sides of the bulkhead so as 5 plywood sheetings can be installed and made flush.

(d) Flooring

A false floor 1 5/8" thick suitably supported is to be provided. This flooring is to be painted with an approved acid resisting paint and is to extend to the inboard edge of the lower stringer and to be level with same as shown on drawing.

5. CABLE REELS

The cable reels will be located in the way of the hatchway over the battery room between bulkheads "C" and "D" and to be kept as low as possible. There will be one set of cable reels for the port side and one set for the starb'd side.

Each set of reels and cables weighs 12 tons. Provision is to be made for supporting this load, as shown on guidance drawing. Cable reels together with cable, electric motor, and operating mechanism will be supplied by the Department.

A water-tight deck is to be provided in way of existing hatchway over the battery room.

6. DECK HOUSE FOR OFFICERS' MESSING, ETC.

A deck house to be built as shown on plan in way of hatchway from bulkhead "D" to after end of hatch coaming and to be well secured to hatch coaming by lag screws, and to be of the following construction. Studs and plates to be 2" x 4" fir. Outside to be of double sheathing T and G flush finish. Inside finish to be 3/4" T and G "V" jointed. Roof beams to be 2" x 6" B.C. fir and spaced as shown with a camber of about 5".

Top decking of house to be 1" cedar T and G covered with 12 oz. canvas, and to be painted. Canvas to be brought over ends and sides, and to be trimmed with 1/2 round of cedar.

Entrance to deck house is from weather deck through a doorway 5'-0" high x 2'-0" wide on starb'd side only. The door is to be of the standard sliding type, also a removable panel aft of doorway to be fitted for removal of equipment.

Galvanized steel rungs to be fitted in hatch coaming in front of doorway, together with galvanized hand rails fastened to side of deck house for access through doorway.

Port holes to be fitted on port and starb'd side and in forward end of deck house, as shown on drawing. Deck planking to be edge-grained fir in long lengths 2-1/4" x 3-1/2" and to be secured to each beam. Floors to be covered with battleship linoleum.

The elevation of deck planking as shown on drawing.

(b) Deck House

The deck house is subdivided: provision to be made for officers' accommodation, toilet cabinet, and passage way, all as shown on guidance drawing. All doors to be made from B.C. fir and to be of suitable construction, and to be provided with locks.

The officers' accommodation is to be fitted with settee berths, finished with suitable cushions upholstered in leather cloth on the seats, and with padded backs. Also a wardrobe, mirror, drawers, waterbottle rack, chair, small sideboard and table, etc. All drawers and cupboards to be provided with suitable locks. A glass fronted key case with hooks and labels, to hold ship's keys.

(c) Flooring

The flooring is to be of double thickness 1" x 8" shiplap covered with 1" x 4" No. 1 fir, flooring to be laid on 2" x 6" beam spaced about 14" apart.

The beams to be supported on ends by a notched shelf piece, (3" x 8" x 14' approx.) as shown on drawing.

7. LAVATORIES

(a) Officers' Lavatory

The officers' lavatory is housed in the aft part of the deck house as shown on the drawing. The lavatory is to consist of a toilet, flushed from a float-tank, also a wash basin. Water tanks to be housed on ceiling or some suitable location for main supply to float-tank and basin.

The necessary hand-pumping unit, piping, and fittings and fixtures to be provided. Storm valves are also to be supplied and fitted. This compartment to be painted with an approved paint.

(b) Crews' Lavatory

Crews' lavatory to be provided with a new toilet, flushed from a float-tank. A wash basin is also to be provided. Main water supply to come from tanks suitably located. The necessary hand pumping unit, piping, and fittings and fixtures to be provided. This compartment is to be thoroughly cleaned and painted with an approved paint.

(c) Fresh and Salt Water Supply

Gravity tanks suitably located, one for salt water and one for fresh water, will be provided. These tanks will be vented and coated with cement inside.

The necessary pipe connections and cleaning hand holes to be provided.

The approximate capacity of the tanks should be about 50 gallons each.

The fresh water day tank will be supplied with fresh water from the main existing tanks, which are located aft under the deck, one on starb'd side, and one on port side as shown on drawing. These tanks hold approximately 300 gallons each.

(d) Existing Fresh Water Tanks

Provision should be made for cleaning the existing main fresh water tanks, and, if necessary, a coating of cement should be applied.

All water tanks to be galvanized and to be tested to a pressure of 60 lbs. per sq. inch. All piping and fittings to be galvanized.

8. FORECASTLE

To be fitted with 2 berths, springs, and mattresses, with drawers below. Two clothes lockers are to be fitted as shown. Floors are to be covered with battleship linoleum. A doorway approximately 6'-6" high x 2' wide is to be cut in bulkhead "B" as shown on drawing, and a door fitted.

9. MESS SPACE FOR CREW, FORWARD

The existing hold forward between bulkhead "B" and "C" to be renovated, and made livable.

Flooring to be laid as in forecastle and covered with battleship linoleum.

Table, lockers, settees and hammocks to be provided as shown on drawing. Settees to be supplied with cushions covered with "Fabrikoid".

Suitable ventilation is to be provided. A two-foot-square hatch is to be fitted in floor for access to space below flooring. This space to be used for stowage.

The mess room to be cleaned and painted with an approved paint.

10. MESS SPACE FOR CREW, AFT

The existing mess space to be renovated and battleship linoleum to be laid on floor. This compartment to be painted with an approved paint.

11. CREW'S ACCOMMODATION, AFT

(a) Crew's existing accommodation aft to be renovated. Flooring to be covered with battleship linoleum.

This compartment to be thoroughly cleaned and painted with an approved paint.

(b) Galley

The woodwork around the galley to be lagged and covered with galvanized sheet metal. The galley is to be fitted with all the necessary shelves, cupboards and racks, etc.

A hand pump in galley is to be able to pump from the fresh water tank. Also a hand pump is to be located for pumping salt water to the salt water tanks.

12. FIRE FIGHTING EQUIPMENT

Suitable fire fighting equipment is to be provided throughout the ship. Carbon dioxide equipment should be fitted in generator room, control room, battery room, and crew's accommodation, forward.

13. SEA COCKS OR VALVES

Sea cocks to be of bronze with hull fittings to be supplied with spiggoted flanges and reinforced rings and to be carefully fitted and bedded in position. Strainers are to be fitted over all intake fittings.

14. PAINTING

Interior of hull below flats to be coated with 2 coats of bitumastic solution. Fore and after peak 2 coats of bitumastic solution.

Fore and aft after crew spaces - sides and fittings varnished, overhead 2 coats of white paint.

Officers' quarters - sides and fittings varnished, overhead 3 coats of white paint with glossy finish, washplace and galley - 2 coats of stone coloured paint. Toilets 2 coats of stone colour paint. Wheelhouse sides and fittings varnished, 2 coats of white paint overhead.

15. OUTSIDE PAINTING

Bottom 2 coats of black bitumastic solution and 1 coat of an approved anti-fouling composition (black).

Above water, superstructure sides, inside bulwarks, masts and spars and deck fittings. 3 coats of battleship grey lead paint.

16. ELECTRIC LIGHTING FIXTURES, CONNECTIONS, ETC.

All electrical work will be done by H.M.C. Dockyard, Esquimalt.

The whole electric system will be supplied from the 324 batteries in the battery room.

17. It is to be clearly understood that the contractor will supply all necessary material for the alterations to the ship, as well as the necessary cleaning and renovating, other than specifically mentioned as being supplied by the Department.

APPENDIX E - CABLE REEL DESIGN

The forward part of the deck over the cargo hatch was made sufficiently strong to support the concentrated load of the deperming cable. Motor-driven storage reels were designed for mounting on this deck space. The arrangement of these reels is shown in figure 1-E.

GENERAL REQUIREMENTS

Storage of 6,000 ft. of each of two sizes of cable 400 MCM, 1.424" O.D. & 600 MCM, 1.600" O.D. Each size of cable to be separately spooled in lots by lengths.

Spool diameters Overall - 48" - determined by limitation of space, 9' - 11" being available for 2 reels and alley-way between.

Barrel - 14" - determined by mechanical limitations, by minimum bending radius of cable and by torque ratio of full and empty spools.

Mean circumference $\frac{(48 + 14)}{2} \pi = 8.12$ feet.

Maximum possible number of layers at 1.42" dia. $= \frac{48 - 14}{2\ (1.42)} = 12$

at 1.60" dia. $= \frac{48 - 14}{2\ (1.60)} = 10$

The axial lengths of the spools then should be as follows:

400 MCM Cable			1.424" O.D.		2.0 #/ft.		
					Spool Length		
Length	No. of Pcs.	Total ft.	Total Turns	Turns per Layer	Min.	Actual	Est.Wgt.
50 ft.	14	700	86	8	12"	15 1/2"	1400#
100	10	1000	123	11	16"	20 3/8"	2000
150	12	1800	222	19	27"	37 7/8"	3600
250	10	2500	308	26	38"	48"	5000

600 MCM Cable			1.600" O.D.		2.7#/ft.		
					Spool Length		
Length	No. of Pcs.	Total ft.	Total Turns	Turns per Layer	Min.	Actual	Est. Wgt.
50	7	350	43	5	8"	11"	945
100	10	1000	123	13	21"	23"	2700
150	11	1650	203	21	34"	36"	4460
250	12	3000	370	37	60"	60"	8100

Due to space limitation and trim requirements, some of the less frequently used 250 ft. lengths of 600 MCM cable should be stowed elsewhere. In this case the 60" dimension could be, and was reduced to approximately 45" and 8100# estimated weight to 6000#.

Working tensile strength of cable = 500#
Test tensile strength of cable = 1000#
Max. radius of full spool = 24"
Max. allowable torque, full spool = 24000#"
Min. radius of empty spool = 7" + radius of cable - say 8"
Max. Working torque empty spool = 4000#"
Max. allowable torque empty spool = 8000#"
At 4000#" torque - RPM per HP = $\frac{33000\ (12)}{4000\ (2)} = 15.8$

for 20 RPM (estimated optimum speed)

Horsepower = $\frac{20}{15.8} = 1.27$

Allowing for 25% overload for short time, and friction loss of 50%.

Horsepower required = $\frac{1.27}{1.25\ (0.5)} = 2$ H.P.

As load is intermittent and never on for more than one minute for each minute off, nor on for more than 60 minutes accumulated operating time per deperm and then full load for only a fraction of the running time, it was considered safe to assume an accelerating torque of 200 lb.-in. average,

corresponding to 3 ohms armature circuit resistance to start, switching to minimum armature circuit resistance, at approximately 1000 RPM motor speed. (Minimum circuit resistance estimated 1.5 ohms).

Assuming 50% of this torque is available at the reel for acceleration of spools and cable and recovery of cable. Then net torque is 100 lbs. ins. referred to motor shaft. (Or 7700 lb. ins. referred to reel shaft through 77:1 reduction gear unit.)

DETAILS

Before determining actual spool lengths, the design of clutches for individual spool drives, and the design of bearings had to be undertaken, since the length required for clutches and bearings had to be deducted from the limited overall length. After the actual spool lengths were decided, detailed designs of all parts were made and drawings were prepared in sufficient detail to be used directly in the machine and fabricating shops of the builder. (Ross and Howard Iron Works undertook the construction on this condition as their design and draughting departments were working at maximum capacity on cargo ship construction). Further details of the cable storage reel parts are shown in figures 2E to 8E.

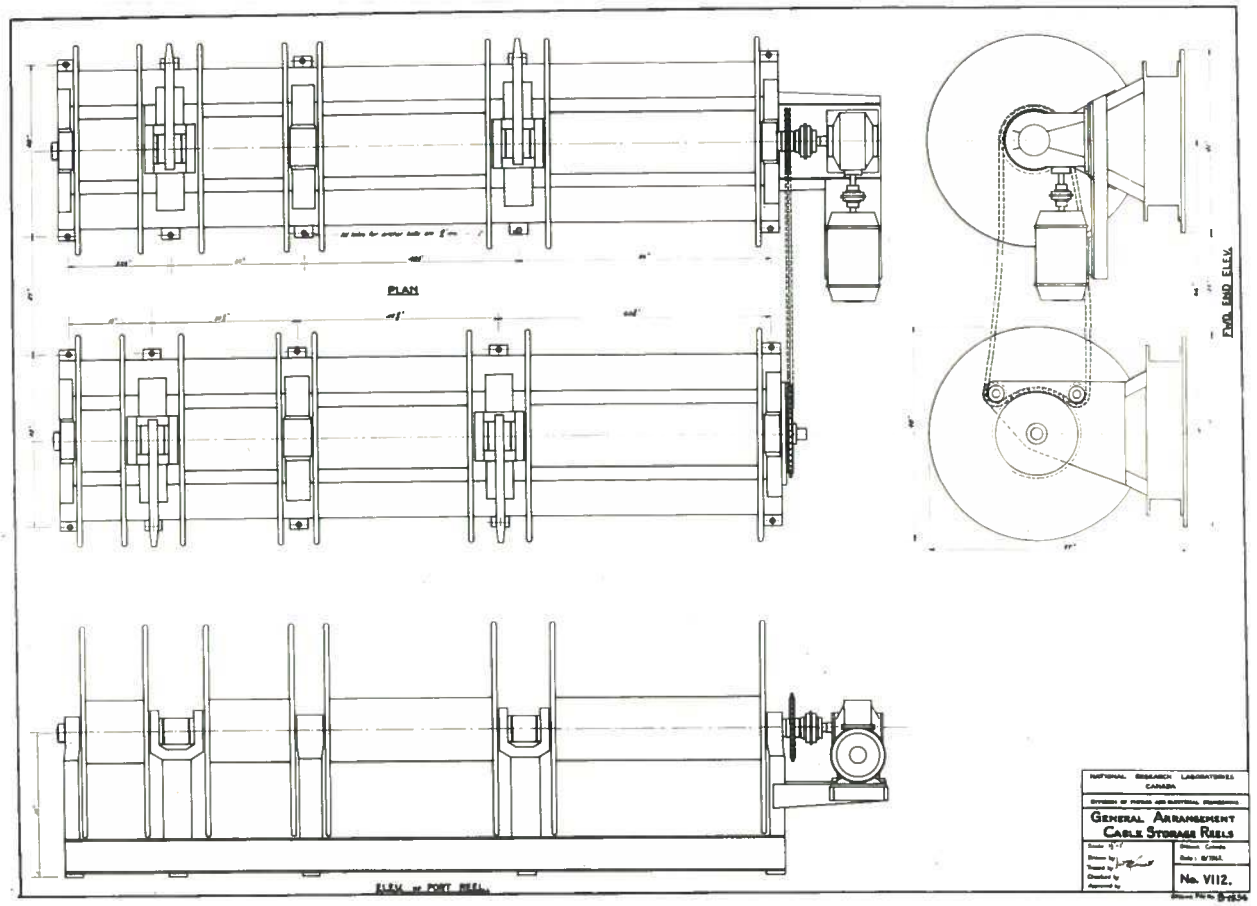

PLAN
END ELEV.
GENERAL ARRANGEMENT
CABLE STORAGE REELS
No. V112.

FIG.1E.

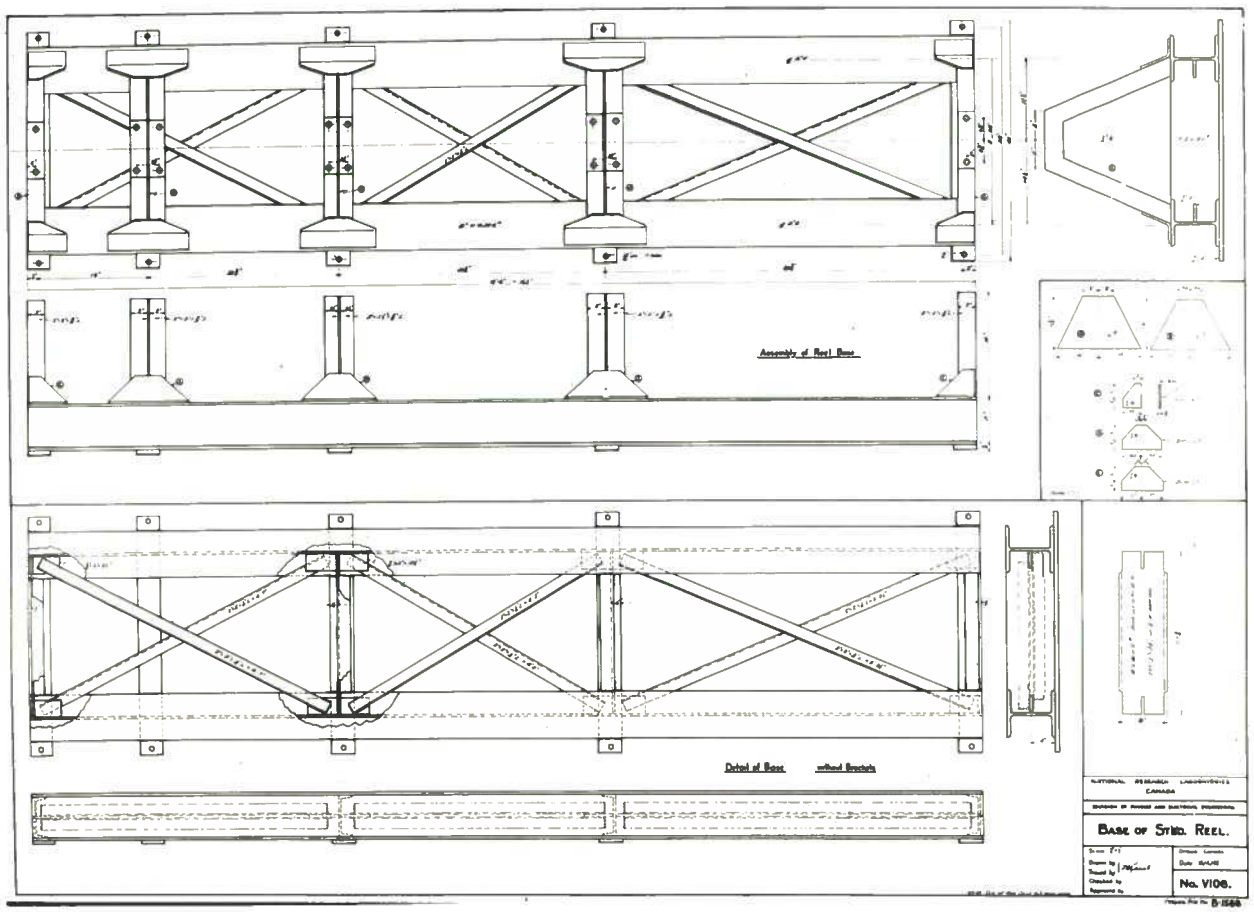

Assembly of Reel Base
Detail of Base without Brackets
BASE OF STEEL REEL.
No. V108.

FIG.2E.

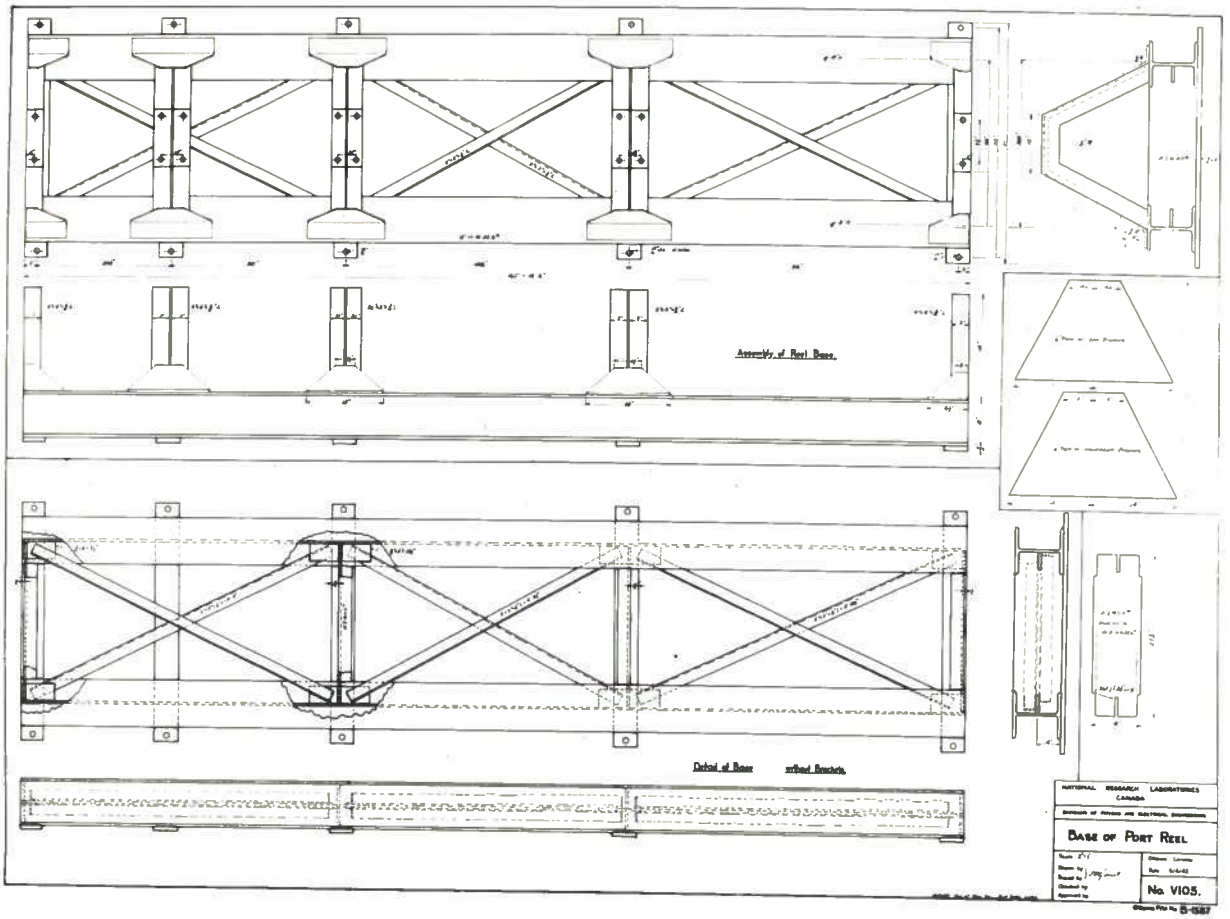

Assembly of Port Base.
Detail of Base without Brackets.
NATIONAL RESEARCH LABORATORIES
CANADA
BASE OF PORT REEL
No. V105.

FIG.3E.

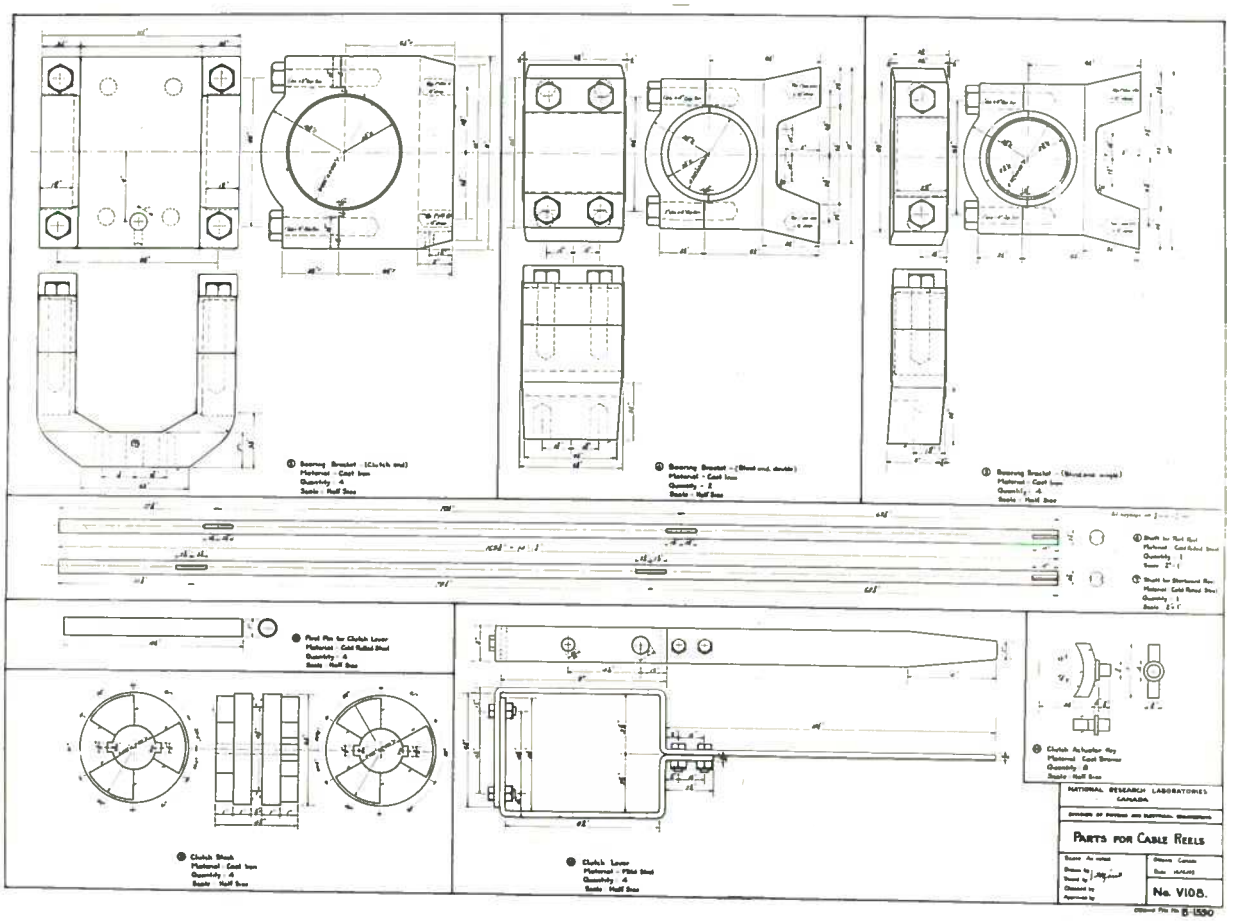

NATIONAL RESEARCH LABORATORIES
CANADA
PARTS FOR CABLE REELS
No. V108.

FIG.4E.

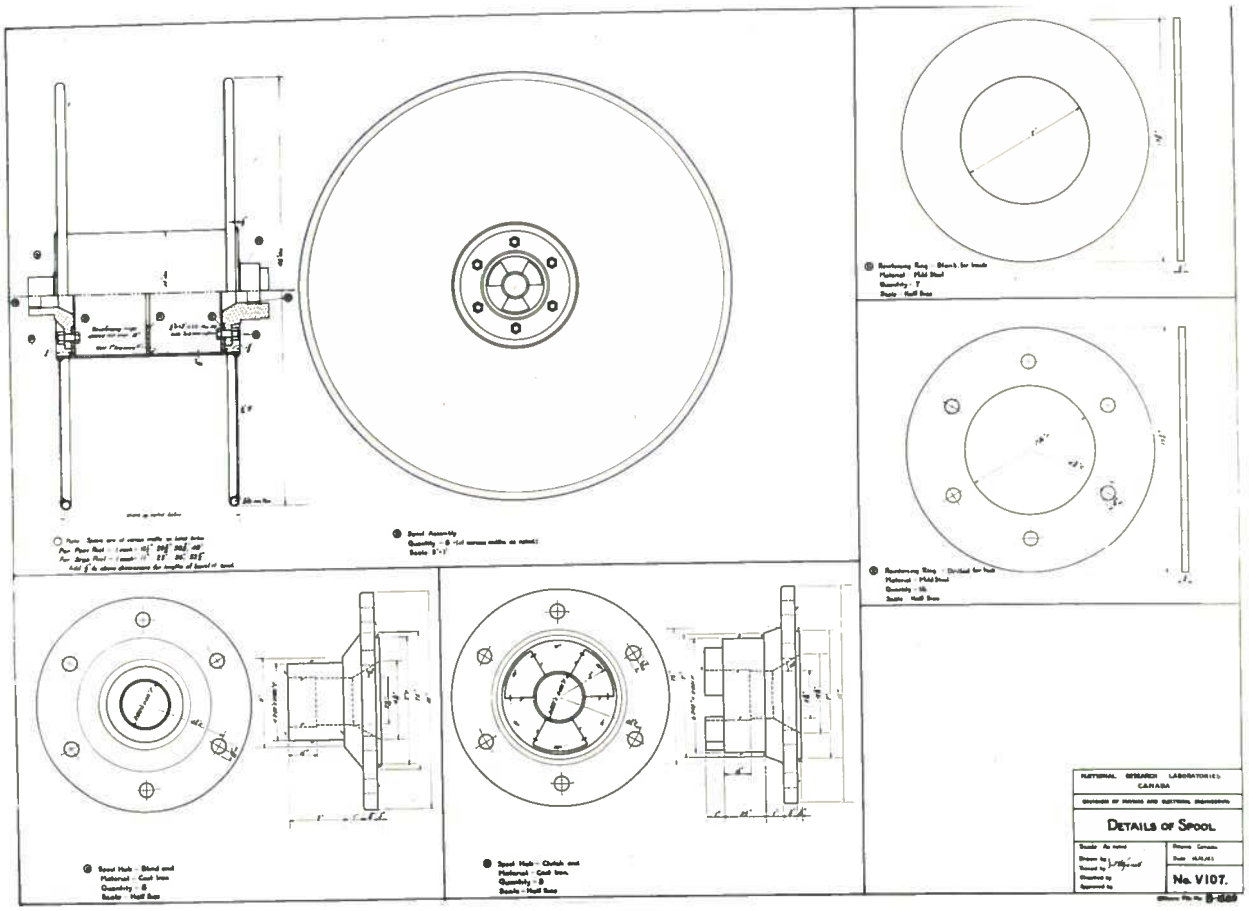


FIG.5E.

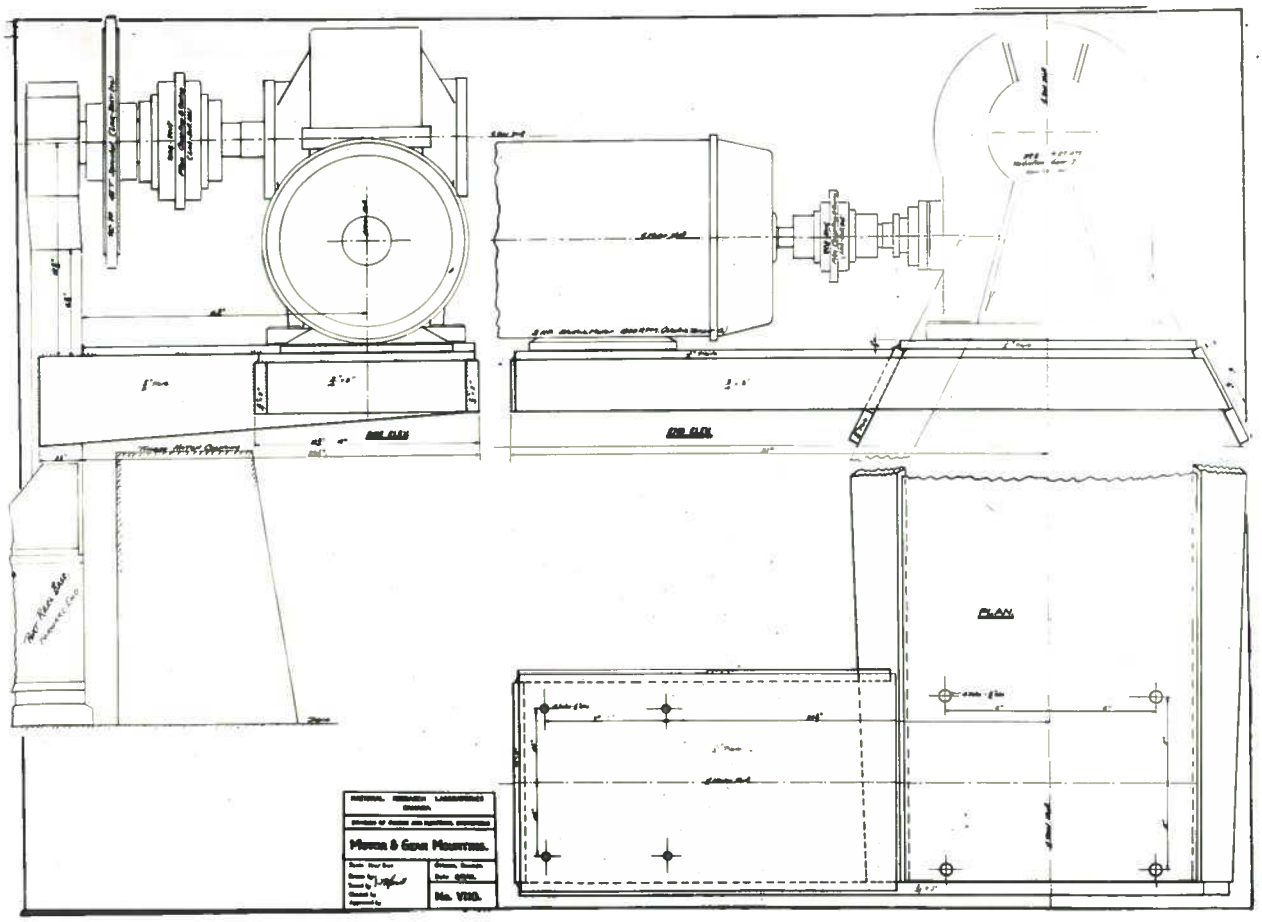


FIG.6E.

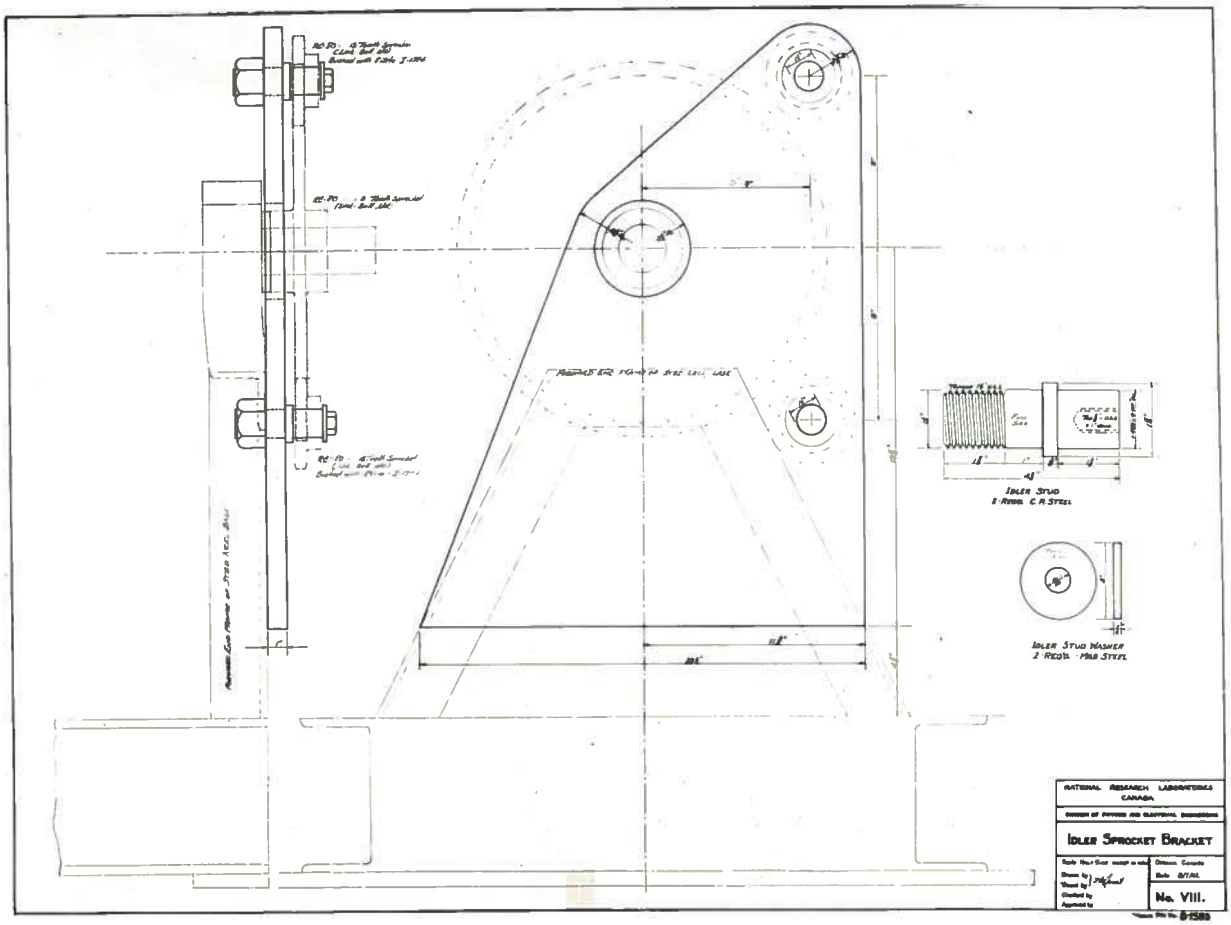

Idler Stud
2 Reqd. C.R. Steel
Idler Stud Washer
2 Reqd. Mild Steel
National Research Laboratories
Canada
Idler Sprocket Bracket
No. VIII.

FIG. 7E.

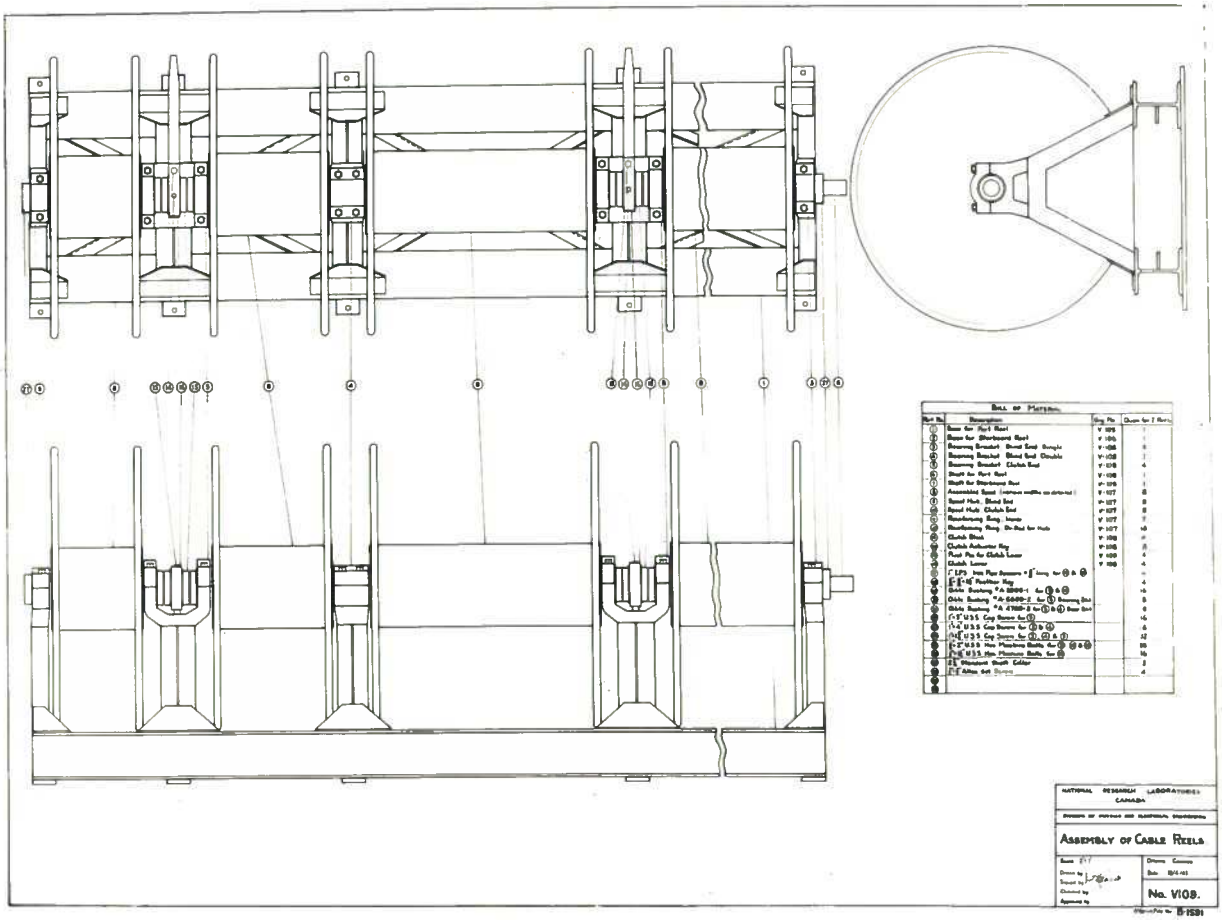

Bill of Material
National Research Laboratories
Canada
Assembly of Cable Reels
No. V108.

FIG.8E.

APPENDIX F - CONNECTION DIAGRAM

Figure 1F is the schematic diagram of connections in the deperming installation. The weight of line used indicates the relative magnitude of conductor section. The grouping of components on the diagram closely follows the grouping of the actual equipment in the ship.

Figures 2F, 3F and 4F show details of the deck terminal box. This box was made with duplex terminals to permit two cables to be used in parallel when necessary.

Figure 5F shows the layout of the selector switch panels, the switches, in this view, being in the same sequence as shown in the schematic diagram. Engraved marking plates, not shown, were attached to indicate the purpose of each switch.

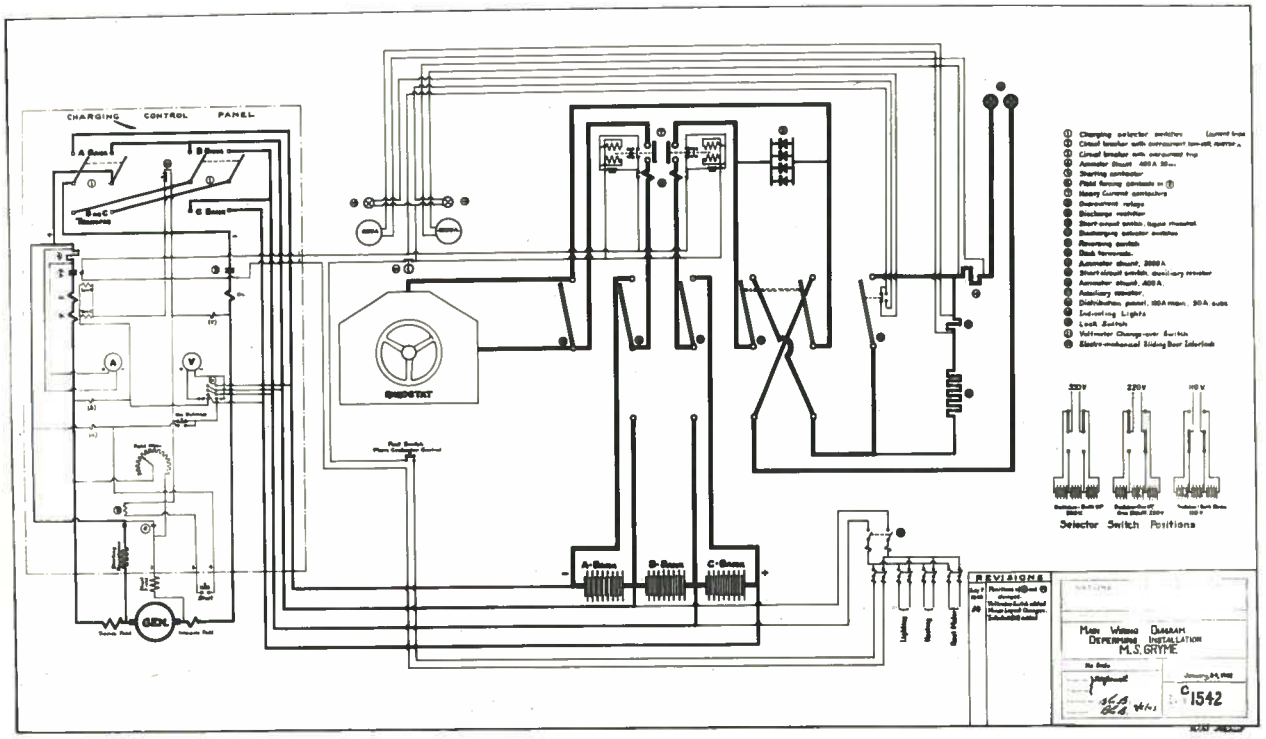

CHARGING CONTROL PANEL
A-Brush
B-Brush
C-Brush
GEN.
REVISIONS
Selector Switch Positions
1542

FIG.1F.

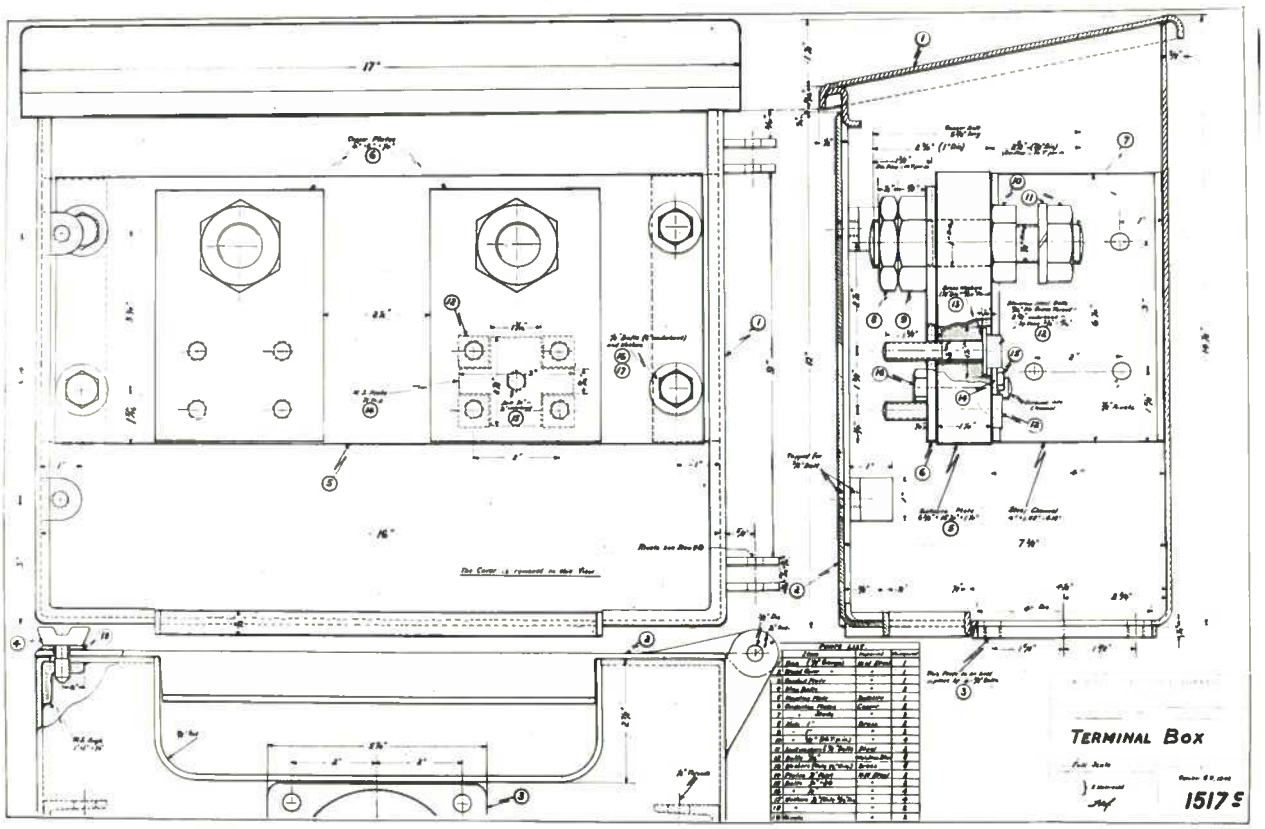

TERMINAL BOX
1517 S

FIG.2.F.

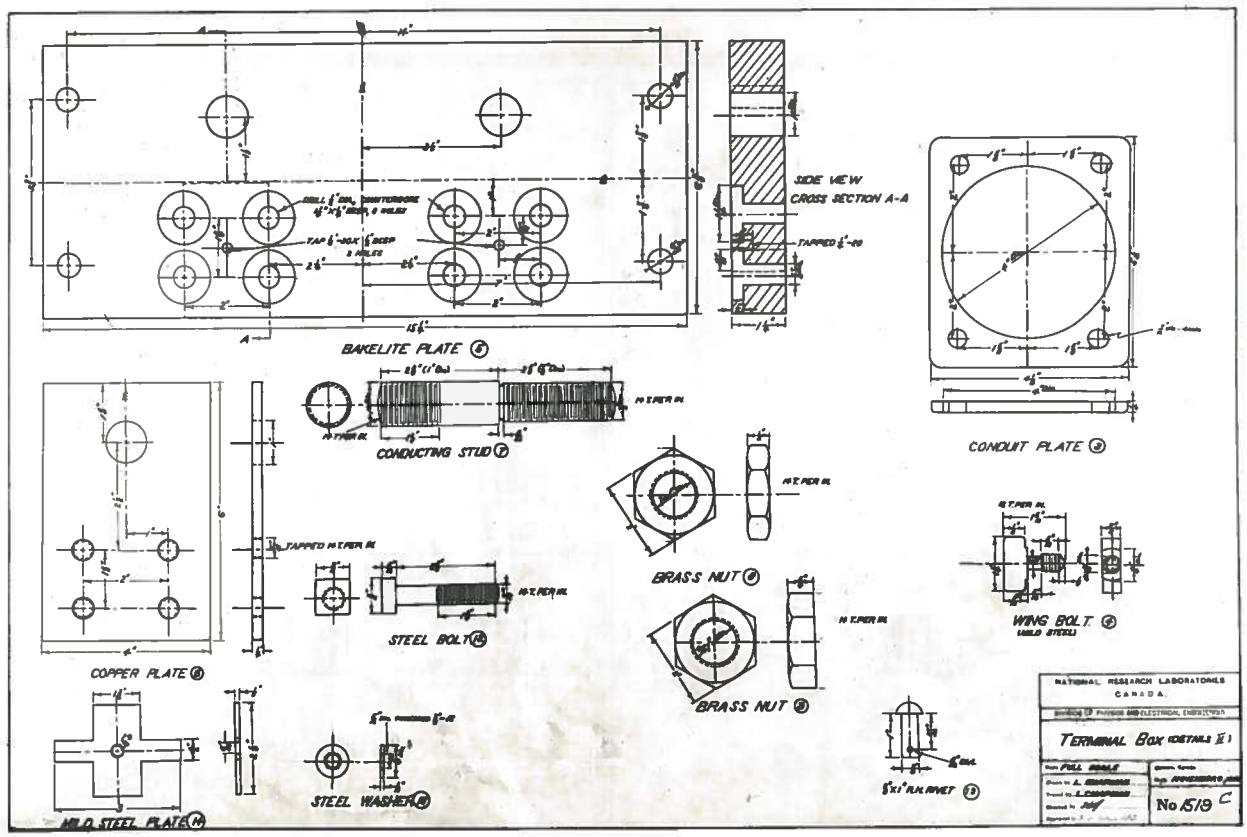

BAKELITE PLATE ⑤
SIDE VIEW
CROSS SECTION A-A
CONDUIT PLATE ③
CONDUCTING STUD ⑦
BRASS NUT ④
WING BOLT ⑨
COPPER PLATE ⑥
STEEL BOLT ⑧
BRASS NUT ②
MILD STEEL PLATE ⑩
STEEL WASHER ⑪
NATIONAL RESEARCH LABORATORIES
CANADA.
TERMINAL BOX (DETAILS 1)
No 1519 C

FIG.3F.

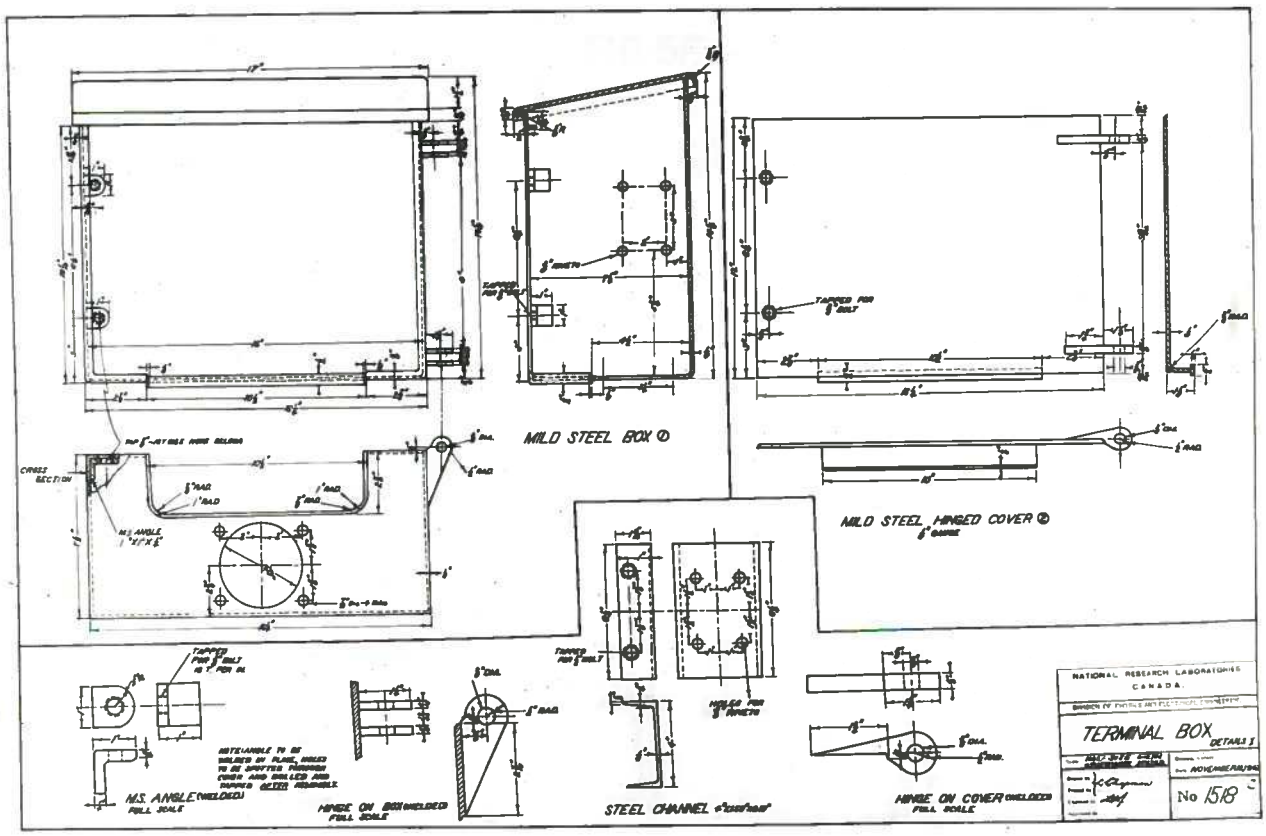

MILD STEEL BOX ①
MILD STEEL HINGED COVER ②
M.S. ANGLE (WELDED)
HINGE ON BOX (WELDED)
STEEL CHANNEL
HINGE ON COVER (WELDED)
NATIONAL RESEARCH LABORATORIES
CANADA.
TERMINAL BOX DETAILS 2
No 1518 C

FIG.4F.

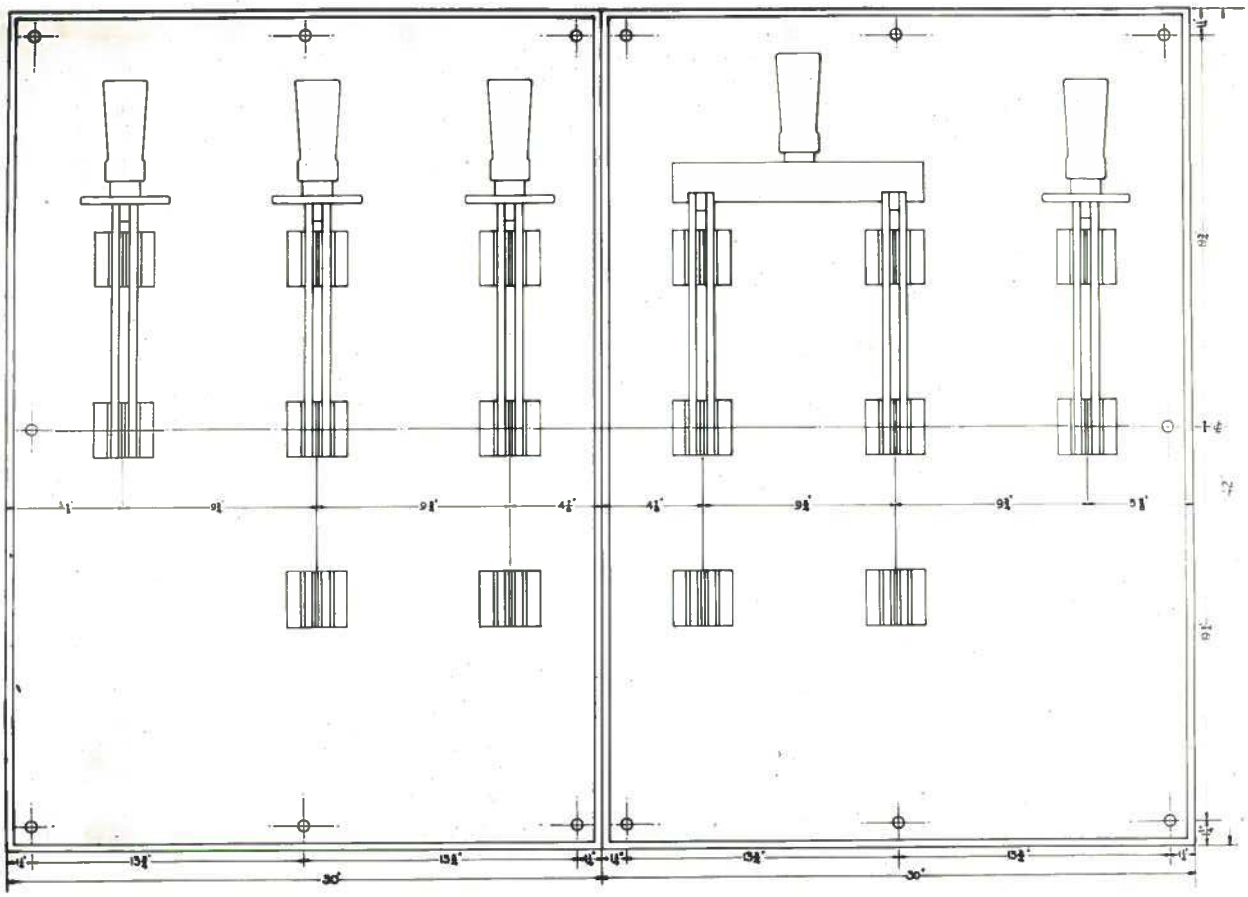


FIG. 5F.