# CNJ - Mark I

National Research Council of Canada. Radio Branch



https://doi.org/10.4224/21272437

RESTRICTED SECRET 11210

PRB-128

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# CNJ - MARK I



OTTAWA

JUNE, 1944

WARNING

The potentials used in CNJ Mark I Equipment, are sufficient to cause death on contact. The greatest care should be exercised in making any adjustments.

The plate potential of the oscillator tubes in the transmitter proper is 2000 volts A.C. This voltage is obtained from a 2000 volt 1 ampere transformer located in the power unit proper. Since one side of the transformer secondary is grounded to the power unit frame, failure to have the power unit and transmitter unit securely bonded by a metallic contactor to each other and to ground will result in certain death, if an operator standing on ground should touch one of the units.

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CNJ MARK I

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## INSTALLATION AND OPERATING INSTRUCTIONS

## CNJ MK. I EQUIPMENT

(1) CNJ Mark I is a special frequency and amplitude modulated transmitter designed to transmit a jamming signal which will interfere with the control of a radio controlled missile.

The following equipment and accessories are supplied for one complete installation.

### Equipment

(a) 1 Transmitter Unit #1 (less tubes)
(b) 1 Power Unit #2
(c) 1 Control Switch (Ad. Patt. 4087)
(d) 1 Indicator box including two pilot lights, unit #3
(e) 2 Eimac 304TH tubes
(f) 1 Cone antenna and open wire feeder
(g) 1 high voltage cable. Length determined by installation requirements
(h) 2 sets of Johnson #47 feed through insulators
(i) 1 double pole double throw switch Square D type 92251

### Spare Equipment

(a) Three 3 or 5 amp. Littelfuses, type 8G
(b) Two Eimac 304TH tubes
(c) Two 6 watt pilot lamps
(d) Two 30 amp. A.P. 5504 fuses

(2) TECHNICAL SPECIFICATIONS

(a) This equipment is designed to operate from a 115 or 220 volt 60 cycle source. The transformers in both the transmitter unit proper and power unit are provided with the conventional two windings to take care of either input voltage. The equipment will draw up to 20 amperes at 115 volts from the line.

(b) Power Output - The equipment will deliver between 750 and 1000 watts depending on the type of load presented by the antenna.

(c) Frequency Range - The equipment as presently set up may be tuned to any frequency between 42 and 75 m.c. The upper limit may be extended to approximately 100 m.c. by changing the grid lines and removing the filament condenser from the tank circuit.

(d) Modulation -

(1) Frequency - The frequency is variable over a range of plus or minus 2 m.c. about a mean frequency of 48.3 m.c. As the mean frequency is increased the swing decreases until a limit of approximately -1 m.c. is reached at 74 m.c. The frequency range is swept approximately 150 times per second.

(2) Amplitude - The unrectified AC which is applied to the plates of the oscillator tubes produces a 60 cycle amplitude modulation.

(3) TECHNICAL DESCRIPTION

A basic circuit layout of the equipment is shown on LE-45-26B. A Power Unit #2 capable of delivering 2000 volts of unrectified AC at 1 ampere supplies power to the oscillator tubes.

The oscillators work only on the positive half cycle of the applied voltage. The oscillator consists of two Eimac type 304TH tubes in a push-pull circuit. The plates are placed at ground potential r.f. by the bypass condenser $C_{11}$. The filaments and grids operate in phase and employ resonant lines $L_{11}$ and $L_{12}$ respectively as tank circuits. The filament inductance $L_{11}$ is designed so that it presents a relatively high impedance. The antenna is coupled directly to this circuit by means of an open wire transmission line. Due to the fact that it was necessary to keep the overall length of the transmitter down to 3 feet the filament tank is effectively shortened by the condenser $C_{17}$. This condenser should be removed entirely when operation is desired at the high frequency end of the band.

The grid tank $L_{12}$ is designed for high but not maximum Q. A compromise was necessary in order that the capacity $C_{15}$, required to vary the frequency, might be kept down to a reasonable figure. $C_{15}$ is a specially designed rotating condenser which may be driven by the motor or set at any desired value. The transmitter is tuned to the mean operating frequency by moving the shorting bars on $L_{11}$ and $L_{12}$. Condensers $C_{12}$, $C_{13}$ and $C_{14}$ bypass one side of the filament supply. Condenser $C_{16}$ and resistor $R_{11}$ are the conventional grid condenser and grid leak.

Transformer $T_{11}$ is arranged to operate from either 115 or 220 volts AC. The proper connections for the available supply voltage are outlined in detail in the installation section.

The antenna is designed to present an essentially constant load to the frequency modulated CNJ transmitter over an 8% frequency band.

In normal operation, at some pre-arranged signal a switch is closed applying primary voltage to terminals #5 and 6 in the power unit. Voltage is instantly applied to $T_{11}$ in the transmitter and to the motor switch. Thus the filaments are energized and the condenser starts spinning if the motor switch is already closed. Simultaneously the green pilot light in the Control Unit #3 comes on indicating the equipment is ready for the application of high voltage. On closing $S_{21}$ or the remote switch $S_{31}$, contactor $E_{21}$ in Unit #2 closes energizing $T_{21}$ and applying voltage to the oscillator plates. The meter $M_{21}$ gives an indication of the plate current drawn by the set by measuring the primary current of $T_{21}$.

All contactors, switches, pilot lights, motor, etc. operate on 115 volts, and draw their voltage from the centre tap of $T_{11}$ when the unit is operating on 220 volts.

(4) <u>DESCRIPTION OF UNITS</u>

The major units which make up a complete installation are treated in some detail in the following sections:

(a) <u>Transmitter Unit No. 1</u> (See Figs. 1, 2 and 3)

This unit is housed in a sheet metal case approximately 3 feet long by 16 inches high by 12 inches wide. The anti-vibration mounts increase the height of the complete assembly to approximately 18", while the motor protruding out the side of the box requires an additional space of approximately 4 square inches. The oscillator tube sockets are supported from two channels on bakelite blocks, the plate bypass Condenser $C_{11}$ is mounted on the end panel between the two tubes. The rotating condenser is located on the same channels a short distance from the tubes. One end of the grid tank $L_{12}$ is secured to the stator plates of the rotating condenser while the opposite end is supported by a bakelite block which is fastened to the end of the case. The grid condenser $C_{16}$ and grid leak $R_{11}$ are mounted on the end of the case which supports the grid line. The filament transformer $T_{11}$ is supported on a panel located underneath the filament tank, $L_{11}$, between the two channels. The motor switch and fuse $F_{11}$ are accessible from the side of the unit. The shaft of the rotating condenser is brought out through the front panel so that a dial may be added if required for manual tuning. Access to the unit is provided by a removable cover which engages the gate switch $S_{12}$. Once the cover is removed all side panels may be taken off. In order to remove the bottom panel it is first necessary to disengage the unit from its shock mount assembly.

(b) Power Unit No. 2 (See Figs. 4 and 5)

This unit occupies a space approximately 16" high by 12" wide by 15" deep. The front panel is removable providing access to a 12-connector terminal block $J_{21}$, the fuses $F_{21}$ and $F_{22}$, and the contactor $E_{21}$. The meter $M_{21}$ and Test Switch $S_{21}$ are mounted on a small panel across the front top of the unit. The transformer $T_{21}$ is mounted on an angle iron frame. The angle irons protrude at front and back thus providing a method of securing the unit to the deck. The wires which connect this unit to the transmitter may be brought out either side of the unit.

(c) Control Unit No. 3

This unit consists of a metal box approximately 3-1/4" by 4-1/4" by 4-1/4", which contains a red and green pilot light and a four connector terminal board.

(5) ANTENNA (See Fig. LE-45-27B)

The CNJ antenna is a double cone dipole consisting of two wire-cage cones with points together, and fed at the points with an open wire transmission line. The points are joined to a Pyrex strain insulator. The length of each cone is somewhat greater than a quarter wavelength. The transmission line is constructed of #12 wires spaced four inches, and has an impedance of 550 ohms. This double cone dipole is tuned for frequency by adjusting the length, and its radiation resistance is controlled by angle of flare of the cones. Such a dipole in free space has a very constant radiation resistance over a very broad frequency band, and has a very small reactive component.

Dimensions:

Length of each wire from strain insulator to end wheels: 7'1" (tolerance ± 1/2")

Diameter of end wheel to centre line of pipes: 27" (tolerance ± 1/4")

Construction:

(a) End Wheels - Constructed of 5/8" copper tubing with 1/16" wall. Made by taking four struts and four arcs and sweating together with copper tees and crosses, in the form of a wheel with four radial struts. Each wheel has twelve holes drilled through the rim.

(b) Transmission Line - This is furnished in one 60-foot length. Two #12 hard drawn copper wires are fastened to porcelain insulating spacers at about 2-foot intervals.

(c) Wire Cages - The wire cages are constructed of #12 stranded copper antenna wire. Each cage has twelve wires running from the shackle of the Pyrex strain insulator through the holes in the end wheel. The wires are fastened to the end wheel by crimping on a Nicopress sleeve, care being taken to equalize the strain on the wires.

(d) Mounting - The antenna is slung between two strain insulators fastened to the centre of the end wheels by a short length of steel wire rope.

(6) PRELIMINARY ADJUSTMENT

Prior to installing the Transmitter proper, it is recommended that the following preliminary adjustment be carried out.

(a) Set the power unit and transmitter unit in some convenient place on a bench and run a length of braid or solid conductor between the units and the good metallic ground. Check with an ohmeter or continuity set that both units are connected to the ground and to one another. Care should be taken to insure that the copper braid straps which bridge the rubber shock mounts are in place.

(b) Having determined the power supply voltage on the ship on which the installation is to be made, connect the jumpers on $T_{11}$ and $T_{21}$ in the appropriate manner. Referring to diagram LE-45-26-B it will be noted that for 220 volt operation the two centre terminals on $T_{11}$ and on $T_{21}$ are strapped together. When operated on this voltage care should be taken to insure that the lead from terminal 1 on $P_{11}$ runs to the centre terminal on $T_{11}$. This connection should be checked before applying power.

For 110 volt operation the two outside terminals of $T_{11}$ and $T_{21}$ are jumpered as shown on the note on drawing LE-45-26-B. When operating on 110 volts care must be taken to insure that the wire from terminal 1 on $T_{11}$ runs to A, (diagram LE-45-26-B). If this wire were connected on B neither the motor nor the contactor would operate and no voltage would be developed across these components.

(c) Once the transformers are connected properly, wires should be run between the transmitter and power unit in accordance with the wiring diagram. The control unit and water-tight switch need not be wired up unless it is so desired. Before any primary voltage is applied, remove one of the leads marked C or D (diagram LE-45-26-B), from contactor $E_{21}$, thus enabling this contactor to operate without applying voltage to $T_{21}$.

(d) Remove the top and side covers from the transmitter and insert the tubes. Apply primary voltage to terminals Nos. 5 and 6 on the power unit. The filament should light up and when the motor switch $S_{11}$ is closed the condenser should start spinning. Check that the bearings on this assembly are well greased.

(e) Assuming that the filaments are all alight and the condenser operating satisfactorily close the high tension switch on the power unit and hold down the gate switch $S_{12}$. The contactor $E_{21}$ should now close. Turn off the primary power and put the high tension switch on the power unit in the OFF position. Having checked that the units are wired up satisfactorily, we can now check the set for oscillations. Check that the filament condenser $C_{17}$ is in place and that the plates are securely fastened in place. Set the grid shorting bar approximately 19-1/2 inches from the condenser and remove the filament shorting bar entirely or put it down at the shorted end of the line. Set the condenser at mid-capacity and replace the top, and one side of the unit.

(f) With the primary voltage still removed reconnect the wires to $E_{21}$. Once this is completed turn on the primary voltage. After making sure that the ground leads are still in place close the Test Switch $S_{12}$. The set should now oscillate. Oscillations are indicated by a plate current not exceeding 6 amperes. Usually the current will run about 4 amps. Once the set is in operation the frequency should be checked on a reliable wavemeter and the grid shorting bar adjusted until the frequency is approximately 48.3 megacycles or as otherwise stated in Naval orders.

In making these adjustments the power should not be left on for more than a minute or so at a time, as when the set is unloaded the grid leak $R_{11}$ will become quite warm due to the high grid current.

If oscillations do not take place and the unit draws no plate current, check for an open in the grid leak or the high tension supply. If oscillations do not occur and the unit draws a high value of plate current, check for a short in the grid leak $R_{11}$ or grid condenser assembly. If this circuit is not defective the only other source of trouble would be a short in a transmitter tube. 304TH tubes which show any sign of gas (i.e. show a blue colour), should be replaced at once. It is recommended that the spare tubes be tested at this time to insure that the tubes sent to sea with the equipment are satisfactory.

By following the procedure outlined above and by using one set of inter-connecting cables, several CNJ equipments may be tested in a very short interval of time.

The currents listed in the Preliminary Adjustment and Adjustment Section are for 110 volt operation. 220 volts values will be approximately one half.

## (7) EFFECT OF MISMATCH BETWEEN THE TRANSMISSION LINE AND THE ANTENNA.

Before attempting to install the antenna it is well to consider various factors which govern the operation of the antenna system.

An ideal antenna for the CNJ Mk.I equipment would present to the transmitter a pure resistance equal to the characteristic impedance of the transmission line (550 ohms) over the 8% frequency band. The antenna supplied, when mounted in free space (away from any large grounded metallic objects) is slightly mismatched to the transmission line and has a standing wave ratio of approximately 1.5:1 over the band. Such a standing wave ratio on the transmission line indicates that the impedance presented to the transmitter will be a complex quantity, the resistive component of which will vary with length of line between 550 x 1.5, or 800 ohms; and 550 ÷ 1.5, or 350 ohms. The reactive component may be as high as 250 ohms. The complex impedance changes periodically as the length of feeder is increased, and repeats at one half wavelength intervals along the line. When the antenna is placed on a ship close to the funnels, masts, stays, etc., the mismatch between transmission line and the antenna increases. This increased mismatch is indicated by the standing wave ratio rising to such a figure as 2.5:1. In this instance the impedance presented to the transmitter is again a complex quantity, the resistive component of which may now vary between 1325 ohms and 200 ohms, and the reactive component may be as great as 600 ohms, inductive or capacitive.

The CNJ transmitter is so designed that it is possible at one frequency to load it satisfactorily (17 amperes or more supply current), when the load it sees is any of the impedances associated with a standing wave ratio as bad as 2.5:1. This satisfactory loading is secured merely by movement of the taps along the filament tank lines. However, when loaded up for one impedance, the transmitter will not be properly loaded for other impedances. Thus, if the impedance presented to the transmitter by the transmission line varies with frequency over the 8% band, the transmitter loading may be satisfactory over a small portion of the band only. The loading may be excessive, or very low, or both, at other portions of the band. For example, if the transmission line is cut to such a length that the impedance at the high frequency end of the band is 1100-j550, and at the low frequency end of the band 500 + j400, when the transmitter is loaded at the low frequency end to 17 amperes, the load current at the high frequency end will be very low. Obviously a point must be selected on the line where the reactive components of the complex impedances are of like sign; -- for example 1100 - j500 and 800 - j400. In this case it would be possible to load the transmitter to 17 amperes at the frequency at which the resistive component is 800 ohms, and have it reasonably well loaded at the other frequency. It should be noted that when a low resistance is presented to the transmitter at one frequency, the unit will load up with the antenna taps relatively close to the shorting bar on the filament line.

The reasons for a varying impedance with frequency are twofold.

First, there is a variation of antenna match with frequency. The standing wave ratio may change over the band, and also the position of the standing wave on the line. This effect is usually slight in itself, but due to the initial mismatch, it is magnified by the transformer action of the line, and appears much worse to the transmitter. Second, the length of the line in wavelengths is different as the frequency changes. Consider a line three wavelengths long at the high frequency end of the band. At the low frequency end of the band it is only 2-3/4 wavelengths long. This alone could cause the impedance to vary from maximum to minimum resistance, or to have maximum reactances of opposite signs. A line two wavelengths long could also cause the latter effect.

The CNJ transmitter will accept the spread of impedances found when the standing wave ratio does not exceed 1.5:1 over the band, without cutting the feeders, although proper selection of impedances may allow somewhat heavier loading over the band. However, many combinations of impedances found when the standing wave ratio rises to 2.5:1 over the band are not at all satisfactory. Other combinations may be found which will allow proper loading (about 17 amperes peak with a swing of 4 or 5 amperes over the band).

It is unfortunately impossible to guarantee either that the standing wave ratio will not rise to 2.5:1 or even worse when the antenna is installed, or that a point on the line (combination of impedances) which gives satisfactory loading will be found. It is expected that the procedure outlined in Adjustment Section will give satisfactory loading in most cases.

## (8) INSTALLATION OF THE ANTENNA

Due to the various types of naval craft which will be fitted it is impossible to set down any rigid procedure. However it should be borne in mind that for a good match between transmission line and antenna the antenna should be mounted as far removed as possible from grounded metallic objects. The closer the antenna is to grounded objects the higher the standing wave is likely to be. Photographs embodied in this report show typical antenna installations. While these illustrated installations leave much to be desired they were the best obtainable, the space limitations being what they were.

In such cases it is recommended that one end of the antenna be located at least two feet from the top of the funnel of the ship. The other end should be slung from some point on the mast which will give a tilt of 45° to the antenna.* The antenna should be slung tightly enough to keep it out in a fairly straight line, and to keep the individual wires fairly straight. It should be as far away from other objects as possible, and any other guys, aerial wires, etc. should be perpendicular to it if possible. The transmission line should run away from the aerial at right angles for at least 5 or 6 feet, and then be looped over to the transmitter in as direct a run as possible. It too, should be kept a few feet away from other wires and should be supported if necessary to keep it fairly tight and prevent it from swinging too much. Care must be taken to see that the transmission line cannot become shorted either from twisting or by any other means. Any supporting wires should be attached to it at an insulator and be broken within a few inches by an insulator of some sort. The feeder line should not pass through more bulkheads than is absolutely necessary. The shortest run of feeder is probably the best for finding a combination of impedances suitable for good loading over the frequency band.

* The estimated length of feeder should be cut and an allowance made of an extra half wavelength plus two feet to take care of adjustment.

(9) INSTALLATION OF TRANSMITTER ASSEMBLY

The most important consideration in the installation is the selection of a position for the transmitter unit which permits a convenient arrangement of the transmission lines of the antenna, and provides for ease in running in the interconnecting cables. The power unit should be mounted as close as possible to the transmitter proper as this unit contains the only indicating device. As the equipment will be used on a number of different types of vessels, no specific information as to the location of the equipment can be given. However, present indications are that the transmitter will be slung from the ceiling of the W.T. cabin, while the power unit will be mounted underneath the bench in the same cabin. Diagram LE-45-94-D shows a suggested method of mounting the transmitter unit. Regardless of the position decided on, the following general points should be borne in mind:

(a) The transmitter proper should be located in a position where the feeders run through as few bulkheads as possible. The more bulkheads through which the feeders run, the less effective is the antenna system.

(b) The transmitter unit must be securely grounded by metallic conductor to the deck, and a metallic conductor run between the transmitter case and the grounded terminal of $T_{21}$ in the power unit. In installing the transmitter, care should be taken to make sure that the flexible braid straps which bridge the rubber anti-vibration mounts between the base of the transmitter and the plate which is secured to the deck are in place. Failure to have the transmitter case properly grounded or to omit the metallic conductor between units is likely to result in a serious accident.

(c) The main power switch should be located in a convenient position where it is accessible for closing on the receipt of some pre-arranged signal. Closing this switch energizes the filaments of the oscillator tubes and starts the spinning condenser.

(d) When the transmitter and power units are securely fastened in place, the connections on the transformers $T_{11}$ and $T_{21}$ should be checked to insure that they are correct for the supply voltage. $T_{11}$ and $T_{21}$ are normally connected for 110 volt supply. For 220 volt supply connections should be made in accordance with diagram LE-45-26B. Care should be taken to insure that terminal 1 on $P_{11}$ is connected to the two centre terminals on $T_{11}$ when the unit is to operate on 220 volt supply. The note on diagram LE-45-26B shows the connection for 110 volt input.

Assuming the transmitter and power unit are installed, the control unit and Admiralty Pattern 4087 switch should be mounted in some convenient position on the bridge. The unit should then be wired up in accordance with LE-45-26B. Two twin conductor lead covered cables are required between the transmitter and power unit and between the power unit and control unit, if no four conductor lead covered cable is available. High voltage is carried from the high voltage connector on the transmitter proper to the ungrounded terminal (secondary) of $T_{21}$ by means of high voltage cable.

(10) <u>ADJUSTMENT OF TRANSMITTER AND ANTENNA SYSTEM</u>

Assuming the equipment has been adjusted in accordance with the preliminary adjustment outlined on page 6, and that the antenna has been installed, final adjustment should proceed as follows:

(a) Remove the top cover of the transmitter unit, thus disengaging the gate switch and take off one of the side front panels. Place the test switch on the power unit in the OFF position and make sure that the control switch on the bridge is also in the OFF position.

(b) Close the main switch so that power is applied to the unit. The filaments should light up and on closing the motor switch the rotating condenser should start up. Turn off the condenser and set it at mid-capacity. Check that the shorting bars on the filament and grid lines have not been changed from the proper positions determined during the preliminary adjustment. Remove all power from the unit.

(c) After checking that all units are securely bonded together, and grounded, and that the straps bridging the rubber shock mounts are in place, put the cover back in place, thus engaging the gate switch. It should be noted that the equipment is now ready for operation and before any power is applied to the unit personnel on the bridge should be instructed to check that the remote switch is in the OFF position, and on no account is it to be closed until instructions are received from the personnel who are making the adjustments to the transmitting proper.

(d) Apply filament power to the unit and close the test switch on the power unit. Oscillations should be indicated by a current of approximately 4 amperes. Check the frequency and set the condenser at a mid frequency (i.e. 48.3 mc.)

(e) When the transmitter is operating satisfactorily on frequency turn off the power and connect the feeder. Adjust the load tap to a position approximately half way between the shorted end of the filament line and the polystyrene supports. Turn on the power and check the current at the mid-frequency point. If the current is above 20 amperes turn off the power and move the antenna taps back towards the shorted end of the line. If the current is under 20 amperes slowly rotate the condenser and note the change in current. If the current rises to a value exceeding 20 amperes move the taps back towards the shorted end of the filament line until it is possible to rotate the condenser throughout the whole range without the current exceeding 20 amperes. If the current is very low throughout the whole range move the load taps towards the polystyrene supports until the peak current is approximately 20 amperes.

Note the change in plate current as the condenser is rotated. If the swing in current does not exceed 4-5 amperes the load taps should be adjusted for a peak current of between 17 and 20 amperes. The feeders should then be shortened by a half wavelength less one foot at the mean frequency. Trim the feeders in 6 inch steps, over 2 feet from this point. Determine the length of feeder which gives a minimum swing and if necessary add in a length of feeder to get back to the best condition.

If it is found during the cutting process that the peak load current drops and the swing in plate current is reduced determine the length of feeder which gives the minimum swing, and readjust the load taps for a peak of 17-20 amperes. A swing in plate current of one or two amperes would indicate an excellent match between the antenna, transmission line, and transmitter. This condition is however very hard to achieve, and a change of 4 or 5 amperes with a peak not exceeding 20 amperes is perfectly satisfactory from the operational point of view.

If on first applying power it is found that the current swing is in excess of 4-5 amperes, it will be necessary to clip the feeders 6" at a time over a half wavelength plus 2 feet at mean frequency. In each clipping point swing over the frequency band and record the change in current, adjusting the load taps when necessary to keep the peak current under 20 amperes. Clip the feeder until a satisfactory load current is reached and then adjust the load taps on the transmitter for optimum operation.

A set of measurements of load current for one antenna with standing wave ratios of 2:1 and 2.4:1 at the ends of the band is given below, for clipping intervals of one foot along the feeder line towards the antenna. These measurements are not representative of what may be found on a ship, but give an idea of the variations to be expected.

| POINT | SUPPLY CURRENT (Freq.) High | Intermediate | Low | CONDITION |
|---|---|---|---|---|
| 1 | 13 | 20.0 | 15.5 | Poor |
| 2 | 17.5 | 20.5 | 13.5 | Poor |
| 3 | 20 | 14.5 | 19.5 | Bad |
| 4 | 19 | 13.5 | 11 | Bad |
| 5 | 19.5 | 15.5 | 13.5 | Fair |
| 6 | 19 | 16.5 | 16 | Good |
| 7 | 18 | 16.5 | 17.5 | Very good |
| 8 | 16.5 | 15.5 | 18.5 | Good |
| 9 | 14.5 | 15. | 20.5 | Good |
| 10 | 11 | 13.5 | 20 | Bad |
| 11 | 14 | 20.5 | 18 | Poor |
| 12 | 17.5 | 22 | 14 | Bad |

Note the large swing in plate current over the frequency band for certain feeder lengths. However as exemplified above, in most cases it is possible to obtain a satisfactory operating point.

Should it be found impossible to select the correct operating point by cutting the feeder, the antenna should be re-positioned and the process of clipping repeated. If this fails try altering the length of the antenna. Stub matching may alter the characteristics of the antenna and transmission line sufficiently to allow satisfactory loading, but this requires specialized equipment and technique. One of the emergency substitutes may also be tried, (Section 14), if the other methods fail.

If during the adjustment one transmitting tube should become much redder than the other, it indicates that there is an unbalance and a mechanical check should be made of the symmetry of the antenna and transmission line. If the system is found to be unsymmetrical this should be corrected at once. If to all outward appearances the antenna system is symmetrical adjust the loading taps until equal dissipation is obtained in the tubes. If unbalancing the load taps does not produce the desired balance, replace the transmitting tubes.

(f) When the transmission line has been adjusted for optimum operation, the condenser should be set at maximum capacity and the plate current noted. The same procedure should be followed with the condenser at minimum capacity. The frequency at both positions should be checked. Total frequency swing should be approximately 4 megacycles.

(g) Power can now be removed from the unit and the front cover put in place. As a final check the frequency should be measured with the unit completely enclosed. Little or no frequency variation should be noted. The operation of the complete system may now be checked from the remote control point on the bridge. Under normal conditions when the double pole switch is closed, a green pilot light will come on indicating filaments are alight and the rotating condenser spinning. On closing either the test switch on the power unit or the remote switch, the red pilot light will come on, indicating that the equipment is in operation.

(11) OPERATION

The exact procedure to be followed in the use of this equipment will be laid down by Naval authorities. Roughly the procedure will be as follows:

Upon receipt of some pre-arranged signals from the bridge, the W.T. operator will close the appropriate switches applying primary power to the unit. This will cause the green pilot light in the bridge to come on, and the equipment may then be turned on at will from the remote point.

(12) MAINTENANCE

In view of the important role which this equipment will be called upon to play in action, it is recommended that the following maintenance schedule be followed:

1. The transmitter unit should be opened at least once a day and examined to insure that nothing has come loose.

2. The wiring should be inspected to insure that no connections have come loose particularly the ground between the units.

3. The complete operation of the equipment should be checked once a day.

(13) REPAIRS OR ALTERATIONS TO ANTENNA SYSTEM

Insulators can be replaced by blocks of wood, varnished or dipped in paraffin wax.

In replacing or repairing wires of the cage, leave two inches of wire extending through the wheel, bend around and solder to itself, leaving a double section of wire one inch long past the wheel to prevent the wire being pulled out.

If the end wheels buckle outwards because of too great tension, an improvement can be made by making a very flat bridle to attach the strain insulator to the outer edges of the wheel, rather than to the centre. This operation will probably require the adjustments to the transmission line length detailed in Section 10.

(14) EMERGENCY ANTENNA SUBSTITUTES (See Fig.LE-45-28B)

When it is not possible to construct something similar to the CNJ antenna, and the situation requires the possible use of the equipment within a day or so, one of the following emergency substitutes should be tried. Any emergency substitute will probably necessitate the adjustments to transmission line length given in Section 10. Various suggestions, including dimensions are given below:

Order of Preference: Folded Dipole - Stub Matched
Folded Dipole - Unmatched
Dipole - Stub Matched
Dipole - Delta Matched
Dipole - Unmatched

Dipole - Unmatched: Half-wave dipole, each quarter-wave arm has a length of 4'10". (234 ft./freq. Mc.).

Dipole - Stub Matched: At feed point of above dipole connect a quarter-wave open stub (4'10" long) of the same type of line as the main transmission line. The main transmission line is tapped down on this open stub. This position can only be determined by trial and error, and a final shortening (4" or 5" in 1" steps) of the stub may be necessary, as well as adjustment of the transmission line length.

Dipole - Delta or Y Matched: A certain length of transmission line (L) is tapered out to fasten on to a single wire "dipole" at points distant (D) from the centre of the dipole.

The length of the "dipole" wire is 9'8" (468 ft/Freq. Mc.). The tapered section of line (L) is 3 feet long. The tapping points are 2'6" apart (2D) or 1'3" from the centre of the dipole (D). Adjustment of the tapping points may be useful (L = 148 ft./Freq. Mc. 2D - 123 ft./Freq. Mc.).

Folded Dipole: A very narrow loop fed at the exact centre of one side. Support two wires 4" or 6" apart. The length from end short to end short should be 9'8". Try unmatched or stub-matched as above.

Transmission Line: A 500 - 600 ohm open wire line (#12 at 4" spacings) should if possible be used for the above substitutes, especially for a delta-matched dipole. For an unmatched dipole (not folded) much lower impedances can be used, -- even coaxial lines or telcothene cables.

## GENERAL NOTES

### Ventilation of Transmitter Proper.

The transmitter as supplied is completely enclosed to take care of installations where it is impossible to mount the equipment in the W.T. cabin.

When the equipment is installed on Naval craft which will be operating in areas of high ambient temperatures, it is recommended that the side of the unit adjacent to the bulkhead be left off, or vents cut in the case.

### Period of Operation.

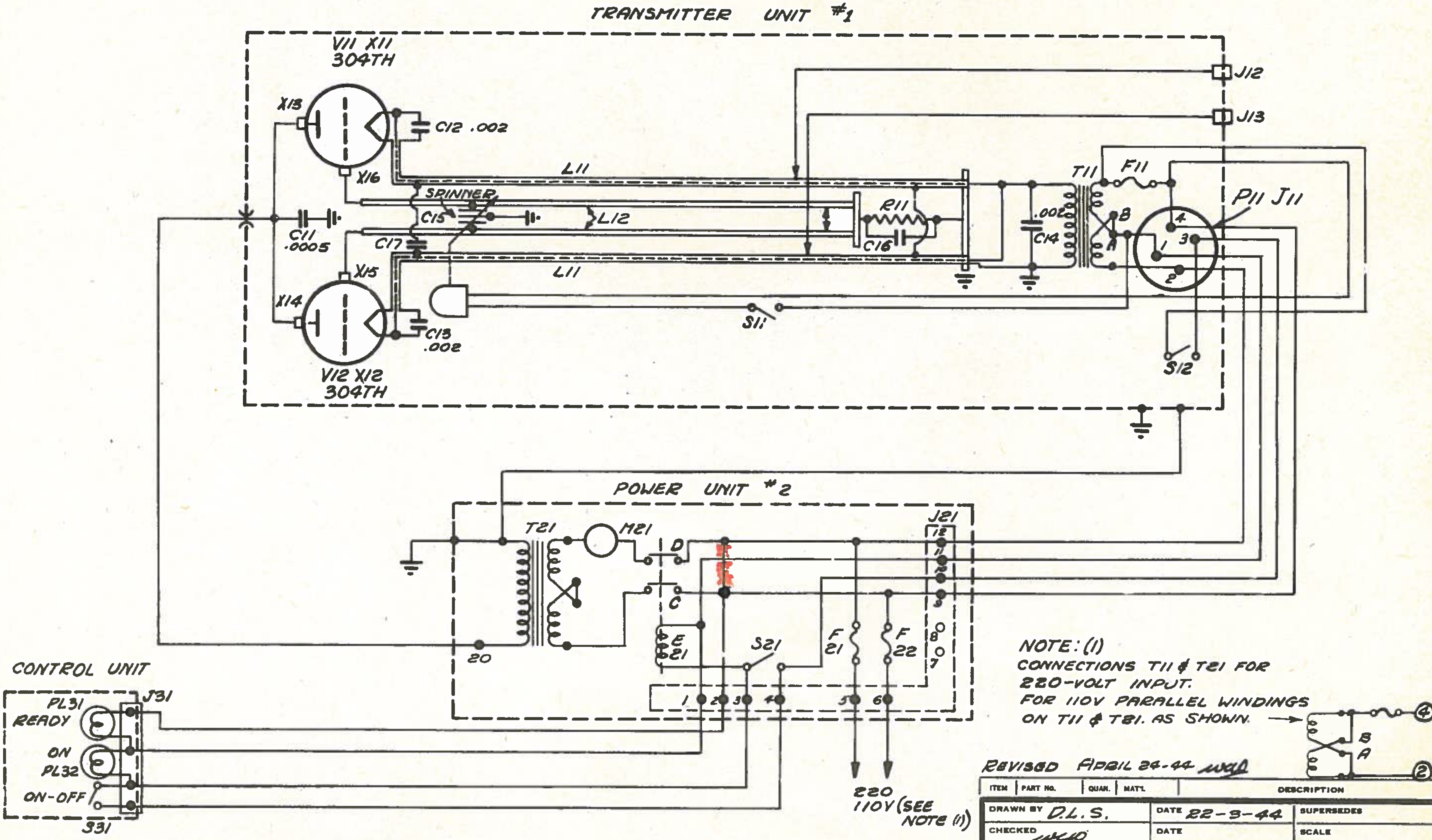
When operating at an input of 110 volts, 20 amperes, the power transformer is rated for 18 minutes on, 45 minutes off.

W. C. Wilkinson

R. S. Rettie

Ottawa

May 15, 1944




NOTE: (1)
CONNECTIONS T11 & T21 FOR 220-VOLT INPUT.
FOR 110V PARALLEL WINDINGS ON T11 & T21. AS SHOWN.

REVISED APRIL 24-44

| ITEM | PART NO. | QUAN. | MAT'L | DESCRIPTION |
|---|---|---|---|---|

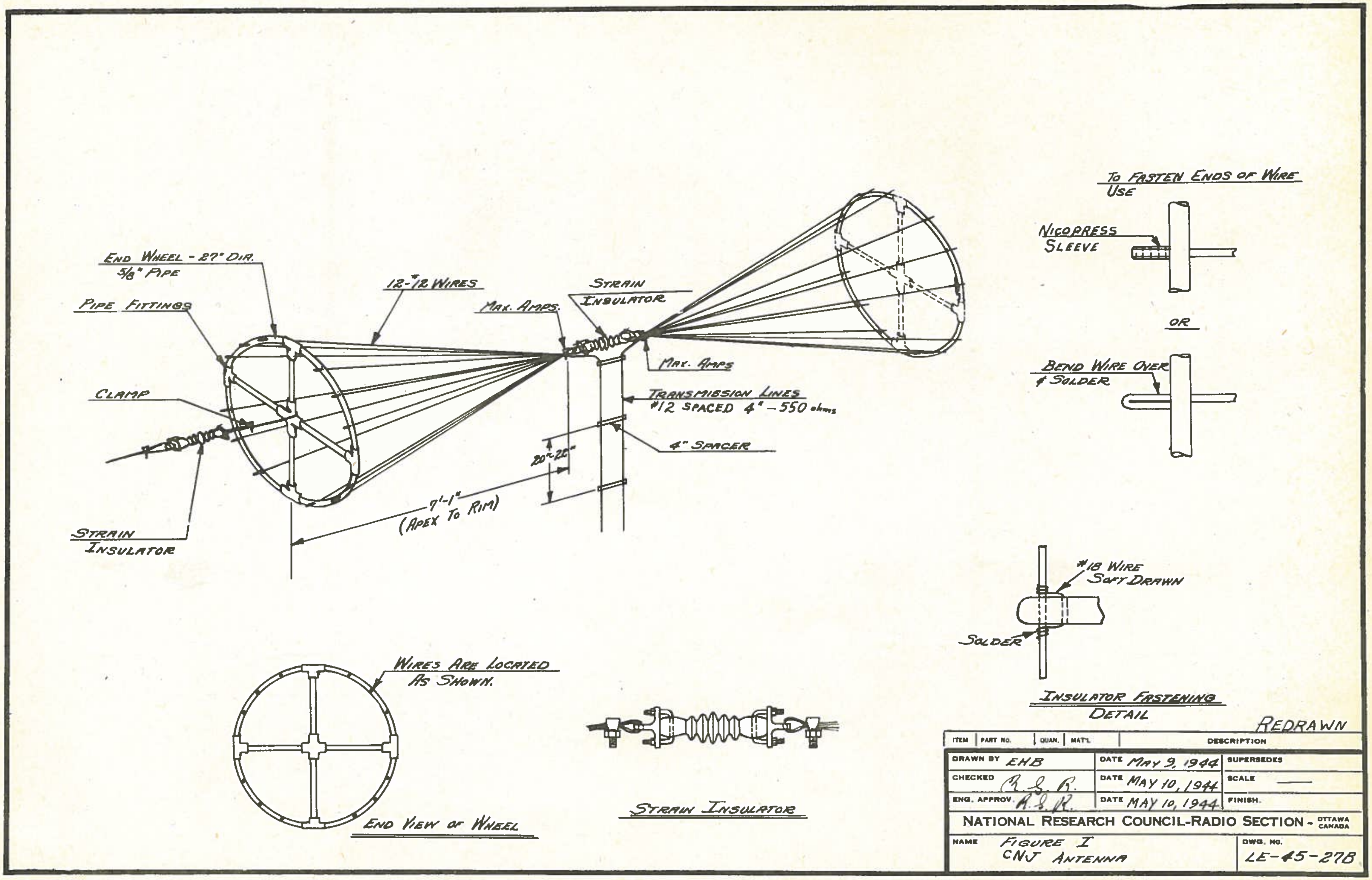
| | | | |
|---|---|---|---|
| DRAWN BY D.L.S. | DATE 22-3-44 | SUPERSEDES | |
| CHECKED | DATE | SCALE | |
| ENG. | DATE 22-3-44. | FINISH. | |

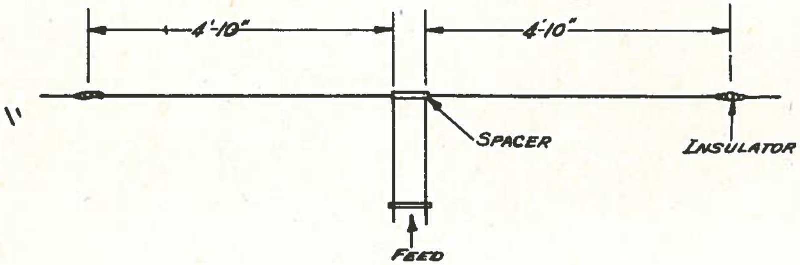
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME SCHEMATIC - SPECIAL TRANSMITTER FOR R.C.N.

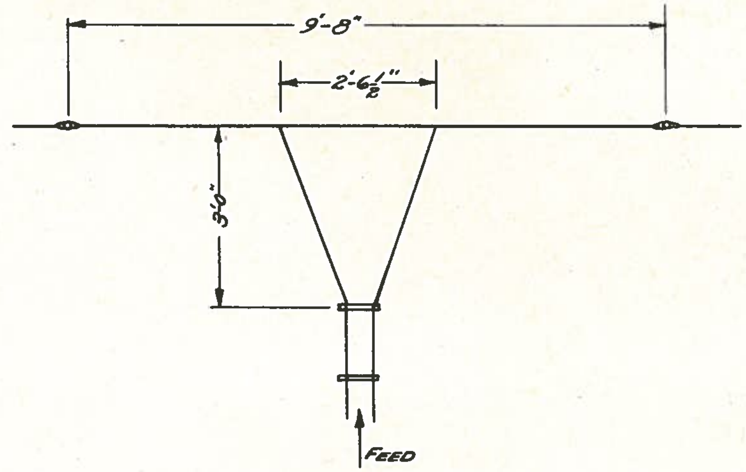
DWG. NO. LE-45-268

SEE DRG# LE-45-60A & 61A ALSO 17D

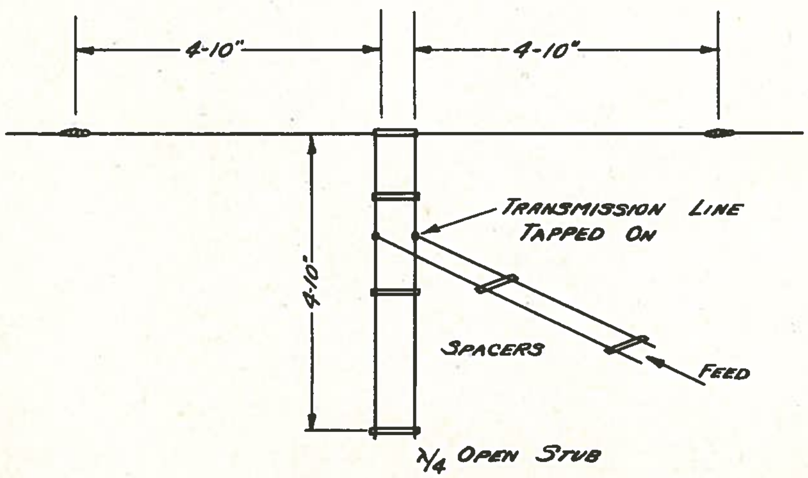

END WHEEL - 27" DIA.
5/8" PIPE
PIPE FITTINGS
12-#12 WIRES
MAX. AMPS.
STRAIN INSULATOR
CLAMP
MAX. AMPS
TRANSMISSION LINES
#12 SPACED 4" - 550 ohms
4" SPACER
20"-22"
7'-1"
(APEX TO RIM)
STRAIN INSULATOR
TO FASTEN ENDS OF WIRE USE
NICOPRESS SLEEVE
OR
BEND WIRE OVER & SOLDER
#18 WIRE SOFT DRAWN
SOLDER
INSULATOR FASTENING DETAIL
WIRES ARE LOCATED AS SHOWN.
END VIEW OF WHEEL
STRAIN INSULATOR
REDRAWN
ITEM
PART NO.
QUAN.
MAT'L
DESCRIPTION
DRAWN BY EHB
DATE MAY 9, 1944
SUPERSEDES
CHECKED R.S.R.
DATE MAY 10, 1944
SCALE
ENG. APPROV. R.S.R.
DATE MAY 10, 1944
FINISH.
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA
NAME FIGURE I
CNJ ANTENNA
DWG. NO.
LE-45-27B



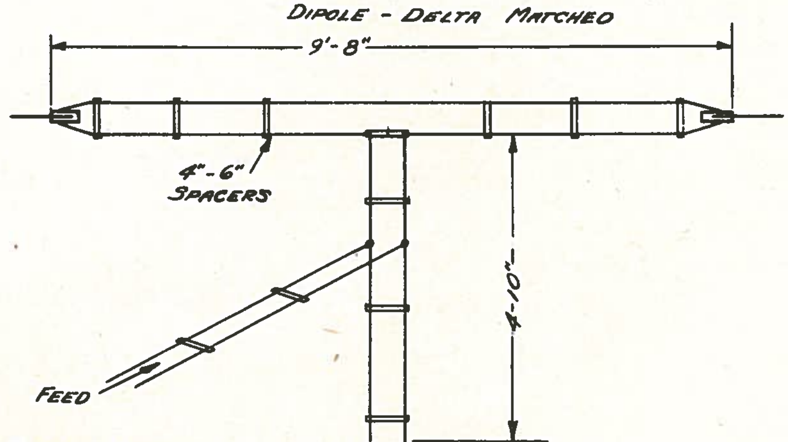

DIPOLE




DIPOLE - DELTA MATCHED




DIPOLE - STUB MATCHED




FOLDED DIPOLE
STUB MATCHED

| ITEM | PART NO. | QUAN. | MAT'L | DESCRIPTION |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| DRAWN BY | E.H.BELL | DATE | MARCH 29, 1944 | SUPERSEDES | |
| CHECKED | R.S.R. | DATE | 29/3/44 | SCALE | — |
| ENG. APPROV. | R.S.R. | DATE | 29/3/44 | FINISH | |

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

| NAME | DWG. NO. |
|---|---|
| FIGURE 2 EMERGENCY SUBSTITUTES | LE-45-28B |

## ELECTRICAL PARTS LIST FOR SPECIAL TRANSMITTING EQUIPMENT FOR RC/N

| Part No. | Designation | Description | Quantity Per Set |
|---|---|---|---|
| 1. | $C_{11}$ | Plate By-pass Condenser .0025 mfd. 6000 volts CD Type 586-59 | 1 |
| 2. | $C_{12}$ | Filament Line By-pass .002, 600 volt mica receiving type | 3 |
| | $C_{13}$ | Same as $C_{12}$ | |
| | $C_{14}$ | Filament Transformer By-pass same as $C_{12}$ | |
| 3. | $C_{15}$ | Spinning Condenser - See dwg. # LE-45-8D | 1 |
| 4. | $C_{16}$ | Grid Condenser - .0001 capacity, 2500 volts Test | 1 |
| 5. | $C_{17}$ | Filament Condenser - See dwg.# LE-45-36A | 1 |
| 6. | $E_{21}$ | High Voltage Contactor - Allan Bradley Bulletin, 700 open type 110 V. 60 cycle - Coil #A209 | 1 |
| 7. | $F_{11}$ | 3 amp. Little Fuse - Type 8AG. | 1 |
| 8. | $F_{21}$ | 30 amp., 250 volts - Adm. Patt. # 5504 - renewable | 2 |
| | $F_{22}$ | Same as $F_{21}$ | |
| 9. | $J_{11}$ | 4 Conductor - Male Amphenol # 4G | 1 |
| 10. | $J_{12}$ | Alsimag #1175 - Feed through Insulators | 2 |
| | $J_{13}$ | | |
| 11. | $J_{21}$ | 12 Connector Terminal Board - dwg. # LE-45-29A | 1 |
| 12. | $J_{31}$ | Connector Terminal Board - dwg. # LE-45-30A | 1 |
| 14. | $L_{11}$ | Filament Tank - See dwg. # LE-45-88C | |
| 15. | $L_{12}$ | Grid Tank - See dwg. # LE-45-87C | |
| 17. | $M_{21}$ | Plate Current Meter - 0-25 amps. A.C. Hoyt Model - #584 Round Flush Mounting | 1 |
| 18. | $P_{11}$ | 4-Connector - Female - Amphenol # 4G | 1 |
| 19. | $PL_{31}$ | Pilot Light Assy. Green Marconi Assy. # 100-D | 1 |
| | $PL_{32}$ | Pilot Light Assy. Red Marconi Assy.# 100-D | 1 |

(continued on drawing LE 45 - 61A)

| ITEM | PART NO. | QUAN. | MAT'L | DESCRIPTION |
|---|---|---|---|---|

| | | |
|---|---|---|
| DRAWN BY | DATE | SUPERSEDES |
| CHECKED | DATE | SCALE |
| ENG. APPROV. | DATE | FINISH. |

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME ELECTRICAL PARTS LIST FOR SCHEMATIC LE45-26B

DWG. NO. LE 45 - 60 A

ELECTRICAL PARTS LIST FOR SPECIAL TRANSMITTING EQUIPMENT FOR RC/N (continued from drawing LE 45 - 60A)

| Part No. | Designation | Description | Quantity Per Set |
|---|---|---|---|
| 20. | $R_{11}$ | Grid Leak - 2750 ohms IRC Type HZ "C" Coating 38 watts | 1 |
| | $S_{11}$ | Condenser Drive Motor Switch - 115 volt - DPST 1 amp., 250 volts | 2 |
| 21. | $S_{21}$ | Test Switch - Same as $S_{11}$ | |
| 22. | $S_{12}$ | Gate Switch - AH&H #3392 Normally open | 1 |
| 23. | $S_{31}$ | Main HT Switch - Adm. Patt. #4087 - W.T.S.P. | 1 |
| 24. | $T_{11}$ | Filament Transformer - 115 -220V, 60 cycle Primary, Sec. 10 V. 26 cycle. #18579 | 1 |
| 25. | $T_{21}$ | Plate Transformer - Prim. 115-220 V. 60 cycle. Sec. 2000 volts. 1 amp 15 min. on 45 " off #18578 | 1 |
| 26. | $V_{11}$ | Oscillator Tubes - Eimac Type 3047H | 2 |
| | $V_{12}$ | Same as $V_{11}$. | |
| 27. | $X_{11}$ | Oscillator Tube - Socket Johnson Type 213 | 2 |
| | $X_{12}$ | Same as $X_{11}$. | |
| 28. | $X_{13}$ | Osc. Plate Connectors - Bud. Type 1923 | 2 |
| | $X_{14}$ | Same as $X_{13}$. | |
| 29. | $X_{15}$ | Osc. Grid Connectors Bud. Type 1920 | 2 |
| | $X_{16}$ | Same as $X_{15}$. | |
| 30. | | Condenser Drive Motor EMC. 115 V. AC/DC Type A445 - REL #11864 | 1 |
| 31. | | Fuse Clips for $F_{21}$ and $F_{22}$ | 2 pairs |

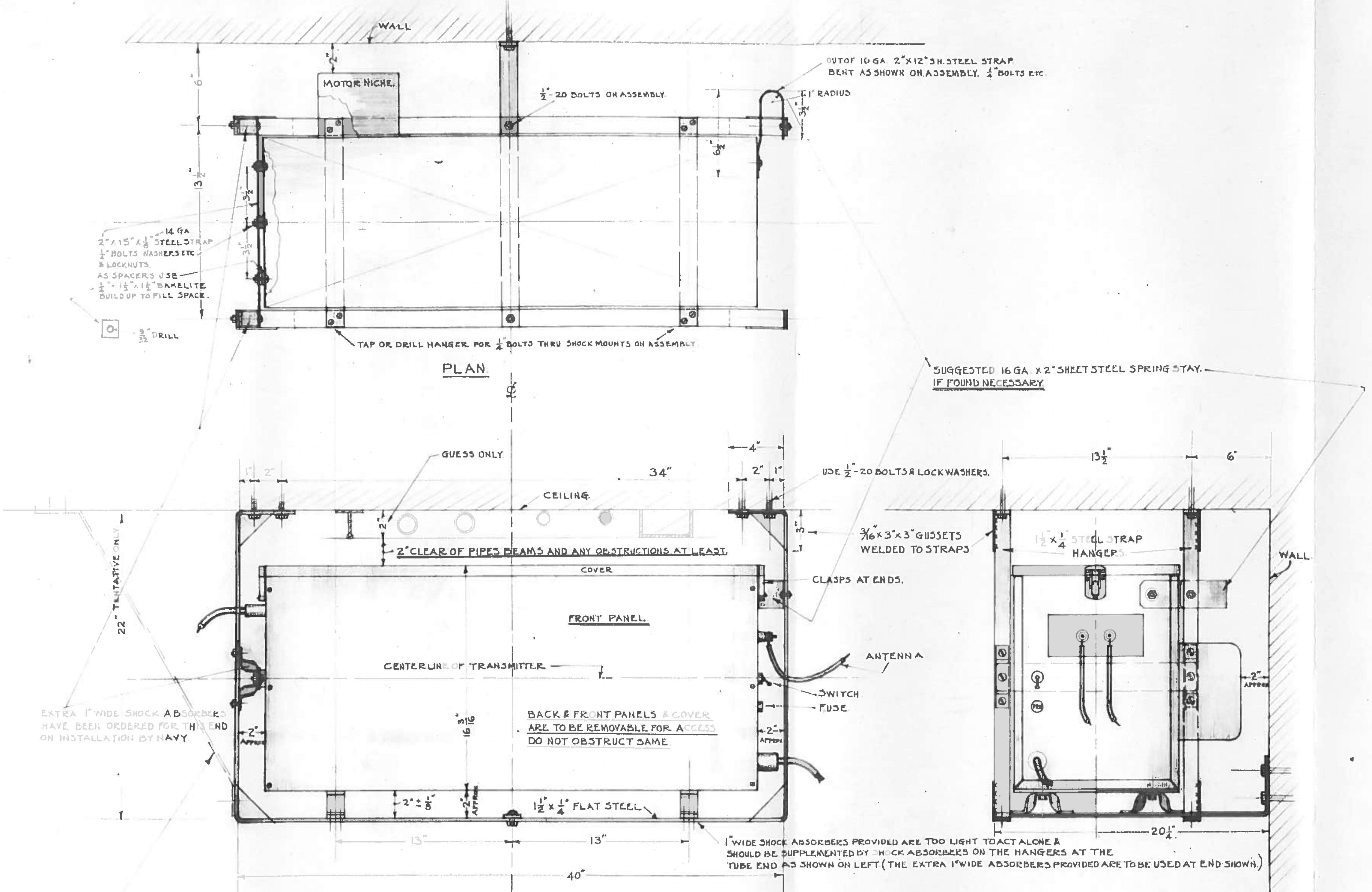
| ITEM | PART NO. | QUAN. | MAT'L | DESCRIPTION |
|---|---|---|---|---|

| | | |
|---|---|---|
| DRAWN BY | DATE | SUPERSEDES |
| CHECKED | DATE | SCALE |
| ENG. APPROV. | DATE | FINISH. |

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME: ELECTRICAL PARTS LIST FOR SCHEMATIC LE 45 -26B

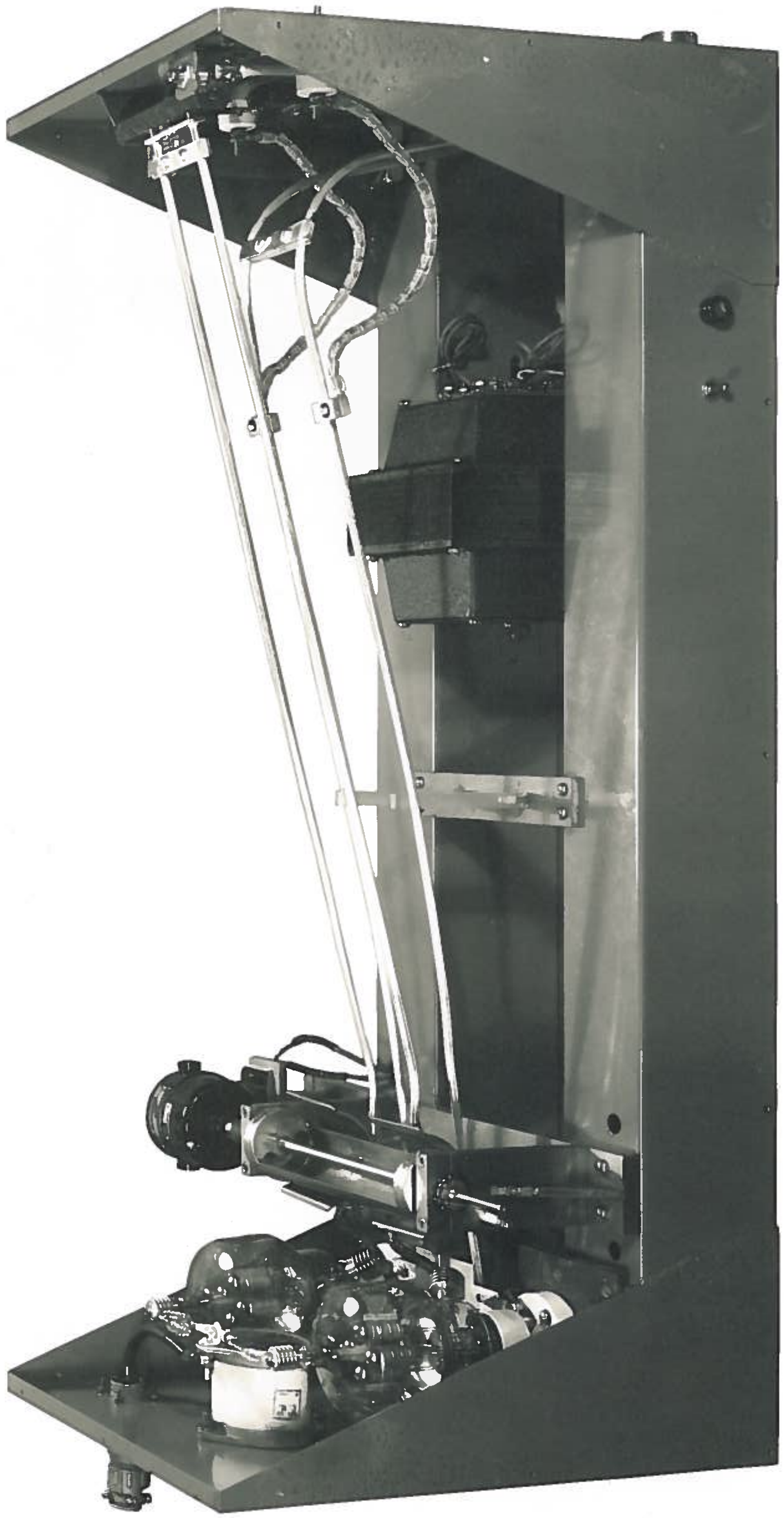
DWG. NO. LE 45 - 61A



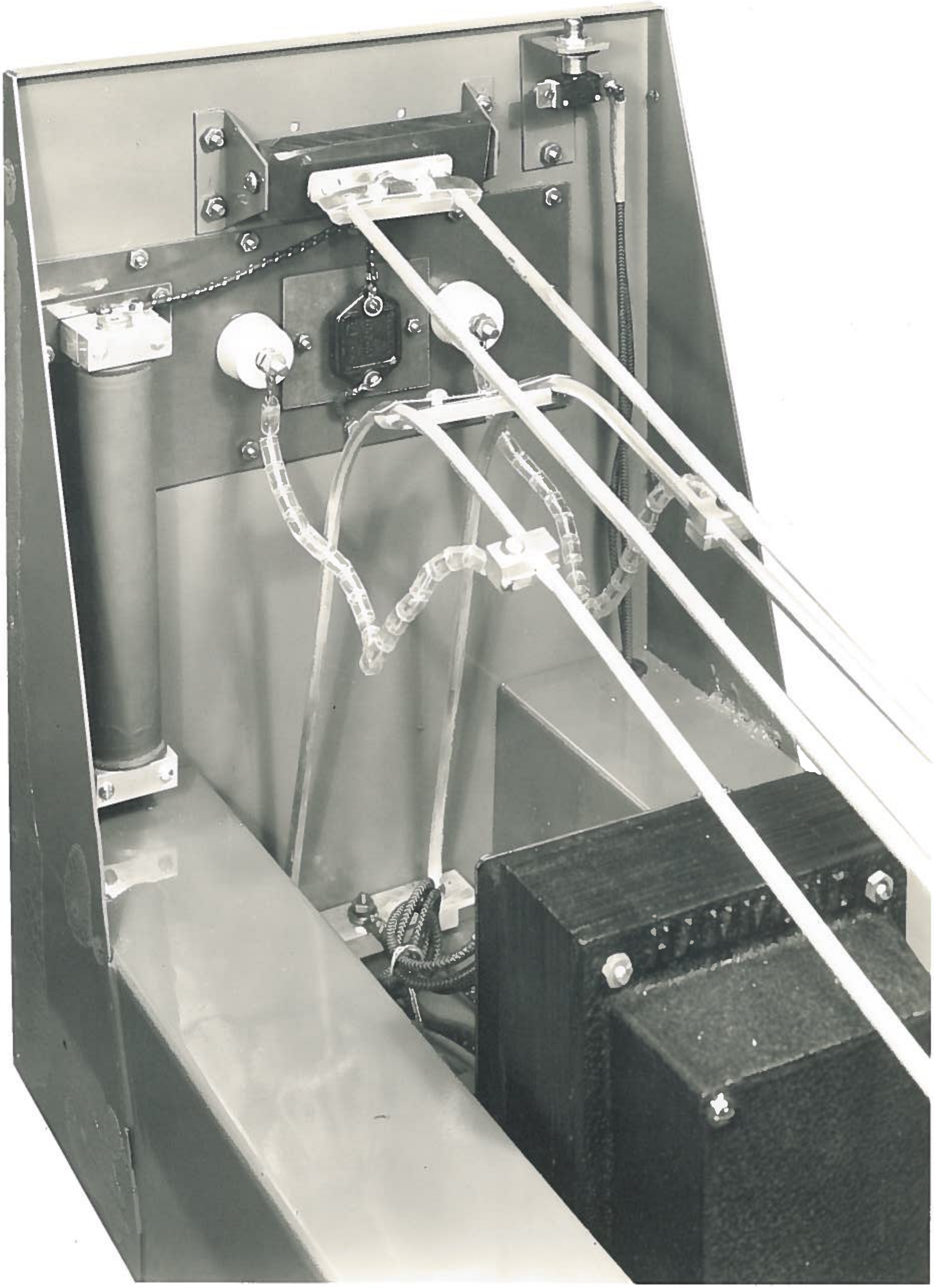

NOTE: – THE ABOVE HANGER DATA IS TO BE TAKEN MERELY AS A SUGGESTION.
IT MIGHT BE CALLED HANGER METHOD "A".
CHOICE OF INSTALLATION METHOD IS UP TO PERSON IN CHARGE OF EACH CASE, TO SUIT CONDITIONS PREVAILING.
HANGERS NOT SUPPLIED WITH SETS, ARE TO BE MADE ON SITE TO CLEAR OBSTRUCTIONS MET WITH.
ADD ANY DIAGONAL BRACES DEEMED NECESSARY. BEND VERTICALS TO AVOID PIPES, OR MOVE SET OVER OR CHANGE METHOD OF CEILING CONNECTION ETC.

TENTATIVE ONLY

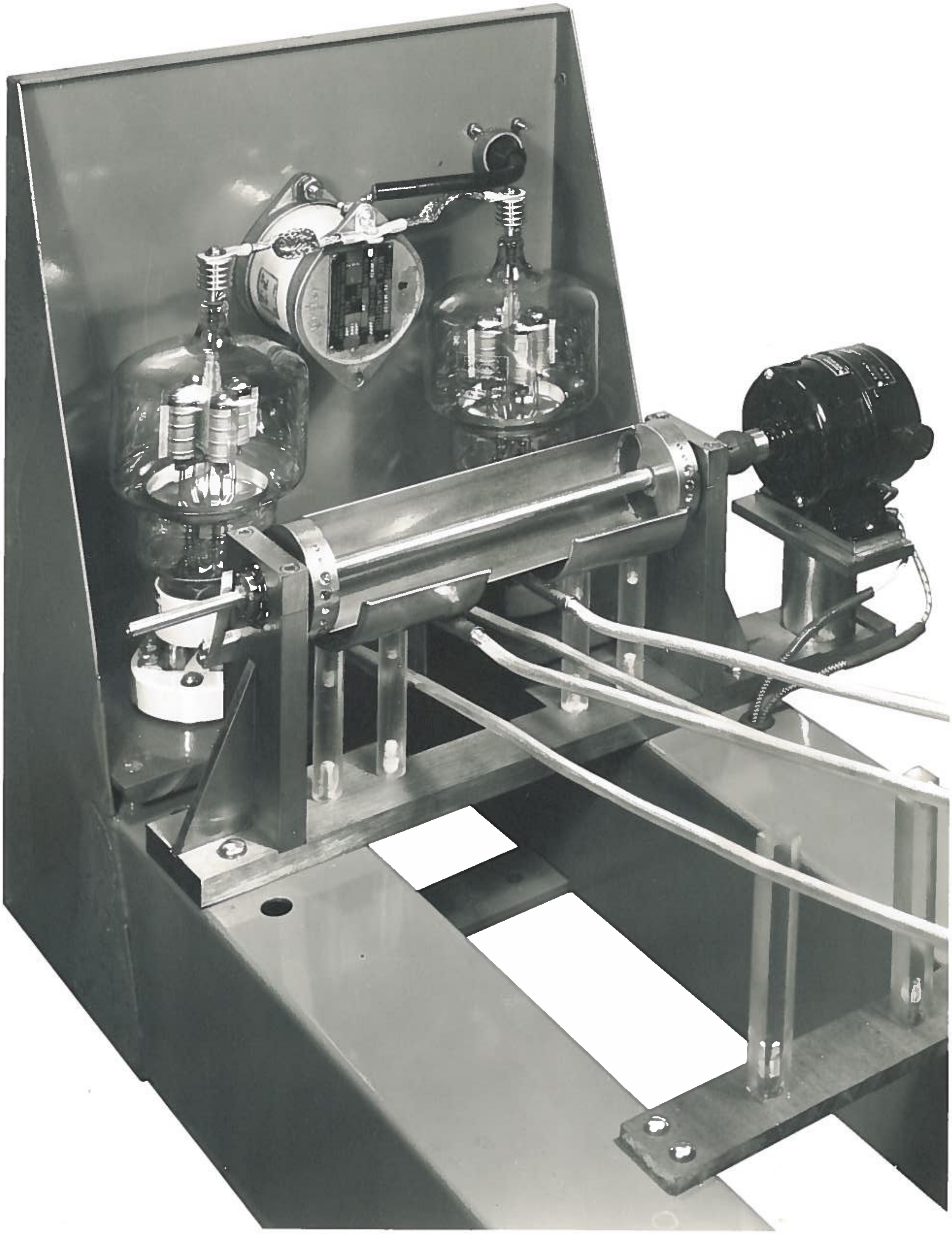
| | | | |
|---|---|---|---|
| DRAWN BY H.E.L. WILSON | DATE 20 APR 44 | SUPERSEDES | |
| CHECKED | DATE | SCALE ¼" = 1" FS. | |
| APPROVED | DATE | FINISH | |
| NATIONAL RESEARCH COUNCIL-RADIO SECTION | | | |
| NAME DATA ON CEILING HANGER FOR SP TRANSMITTER RCN | | DWG. NO. LE 45-94-D | |



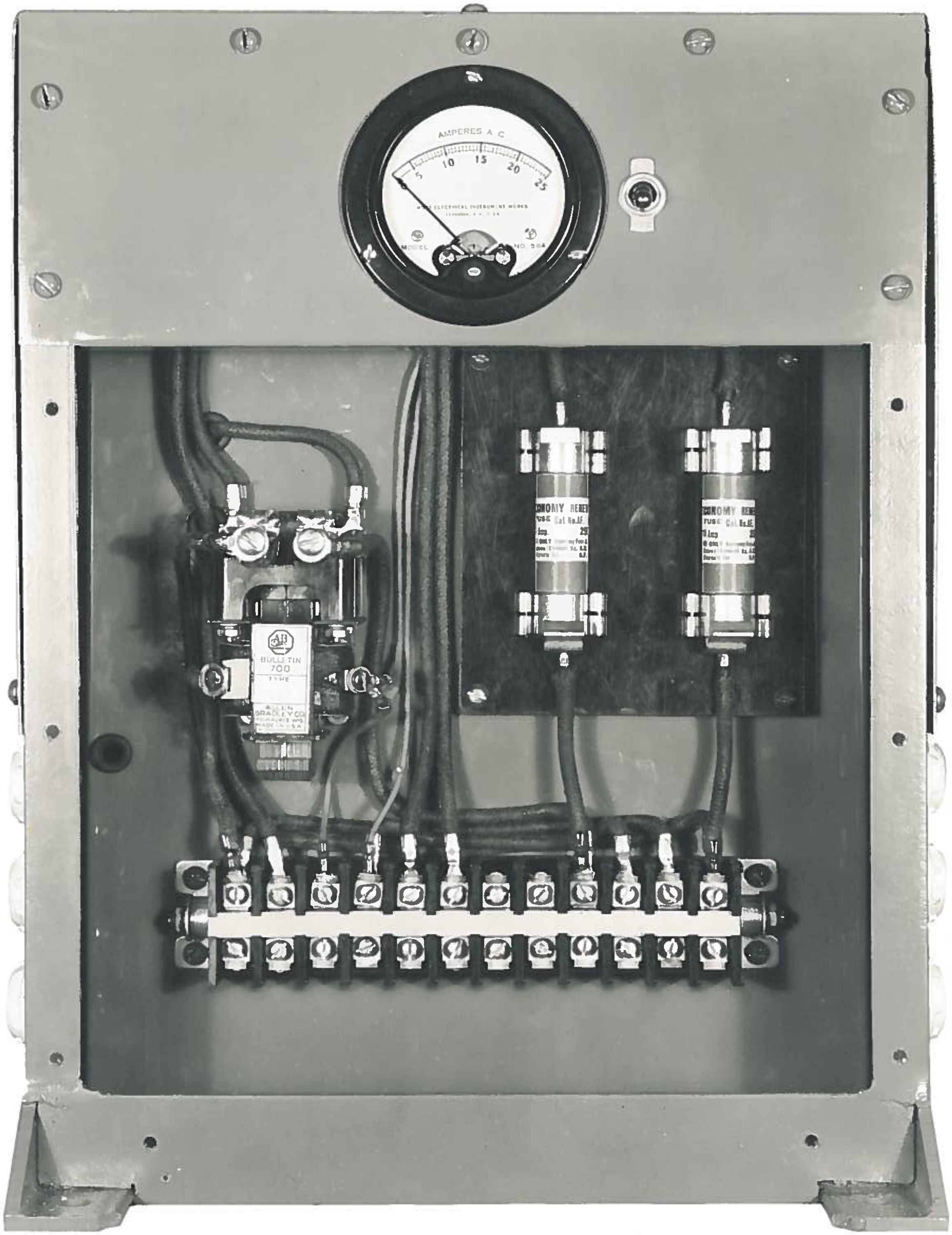
N.R.C. PHOTO
FIG. 1



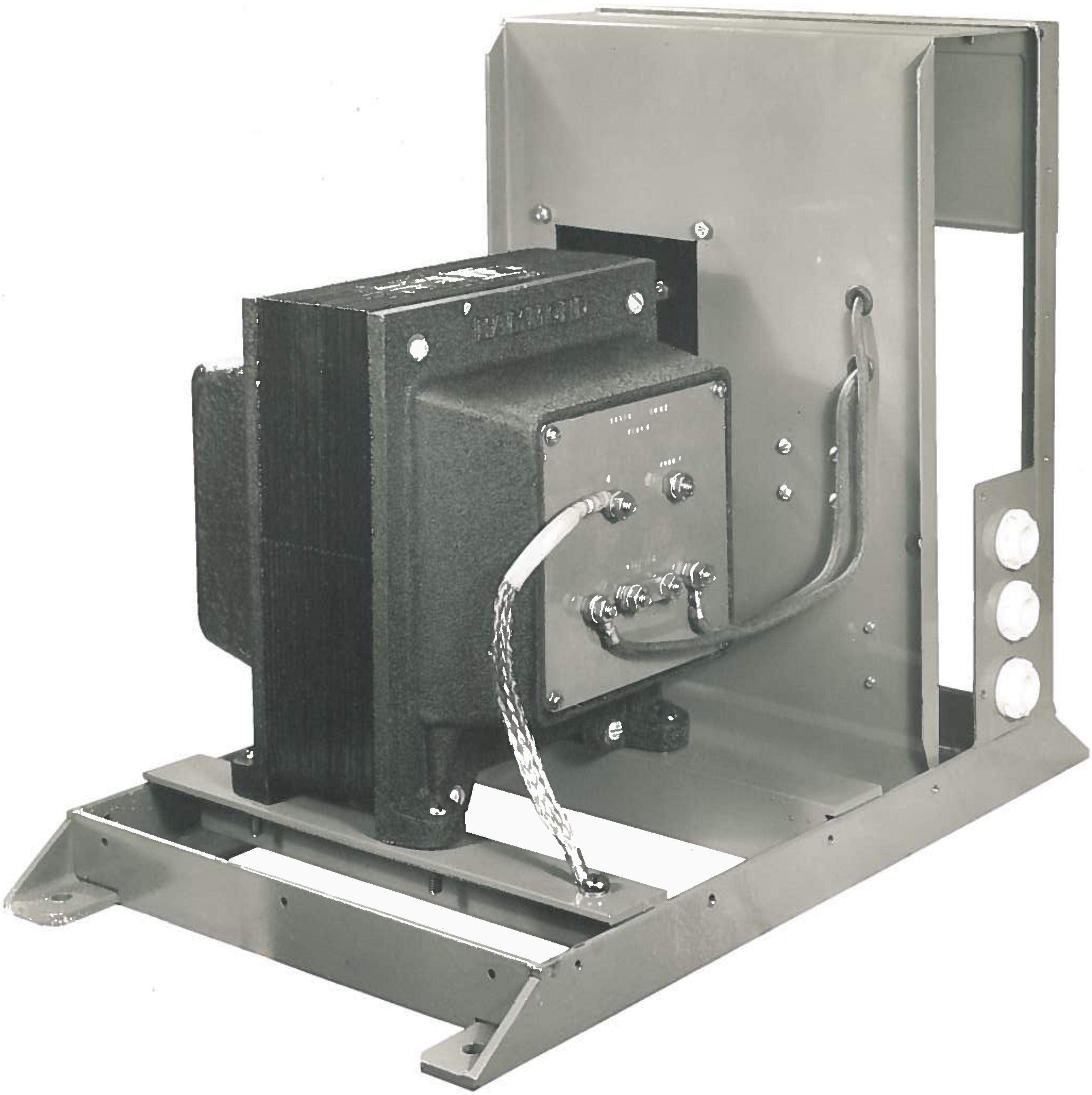
N.R.C. PHOTO
FIG. 2



NRC PHOTO
FIG. 3




N.R.C. PHOTO
FIG. 4

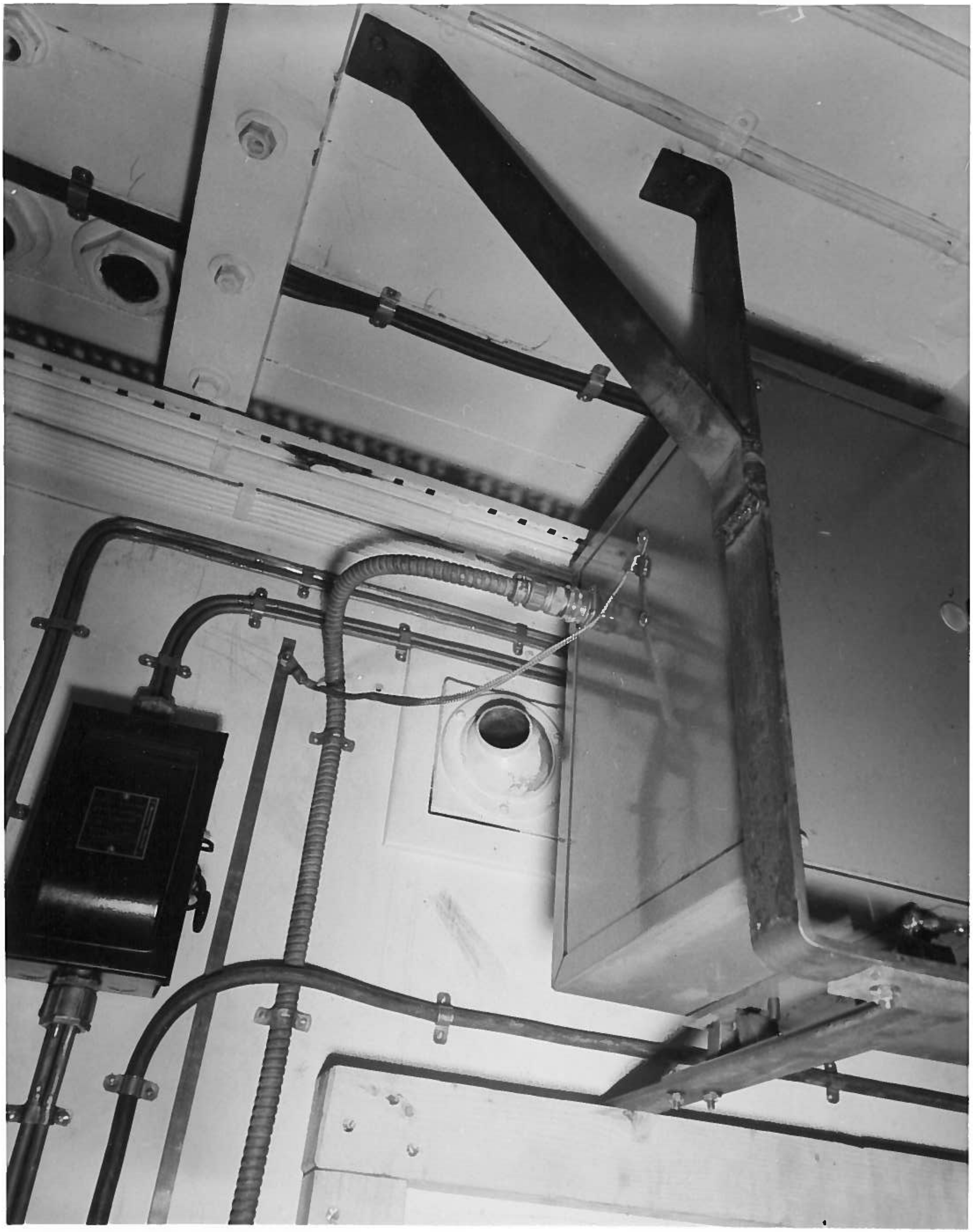


N.R.C. PHOTO
FIG. 5

0486-1 INSTALLATION "A". RIGGING OF DOUBLE CONE ANTENNA.

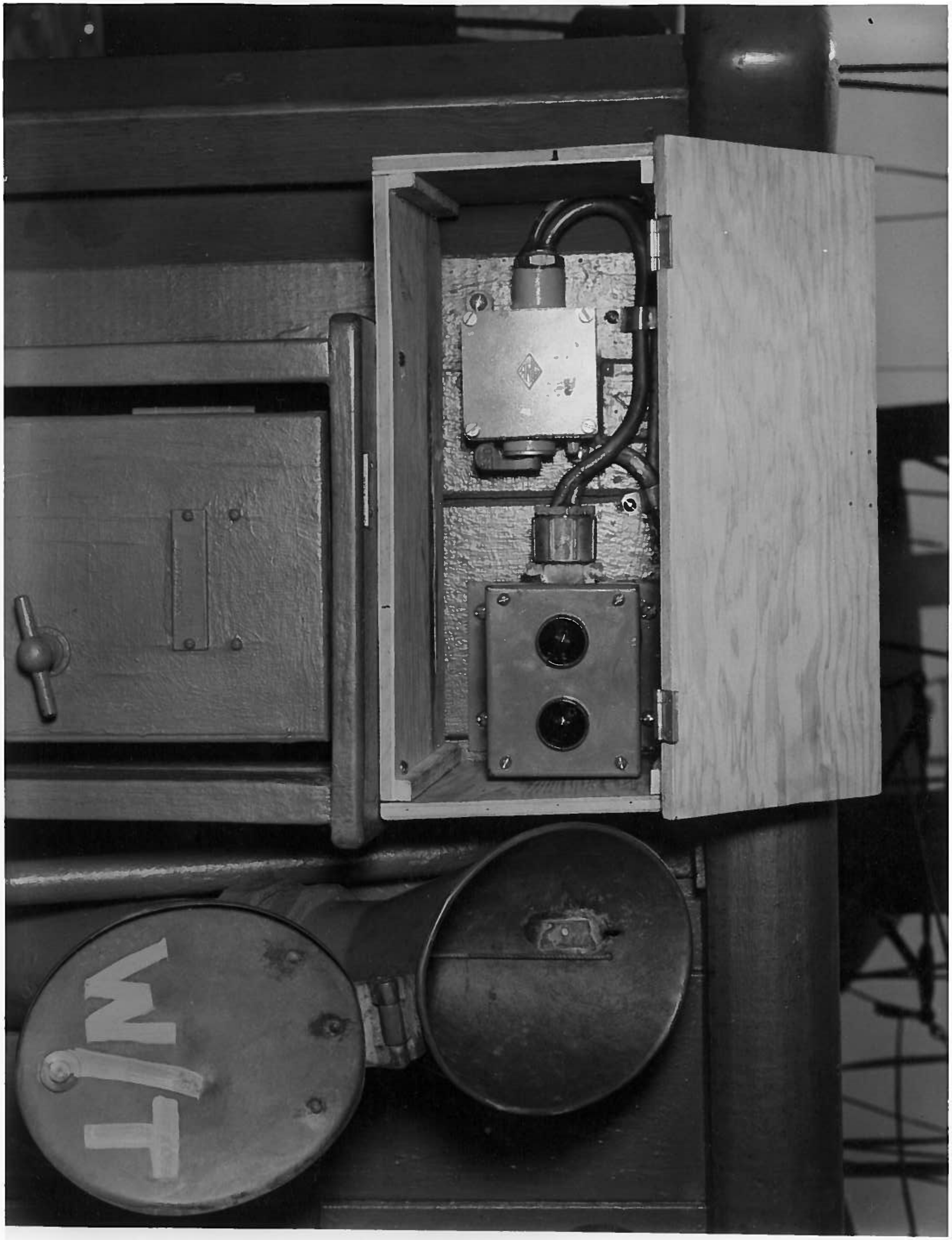
0486-2 INSTALLATION "A". MOUNTING OF TRANSMITTER IN W/T OFFICE.

0486-3 INSTALLATION "A". POWER UNIT ON W/T OFFICE DECK.



0486-4 INSTALLATION "A": GROUND AND h-t CONNECTION TO TRANSMITTER.

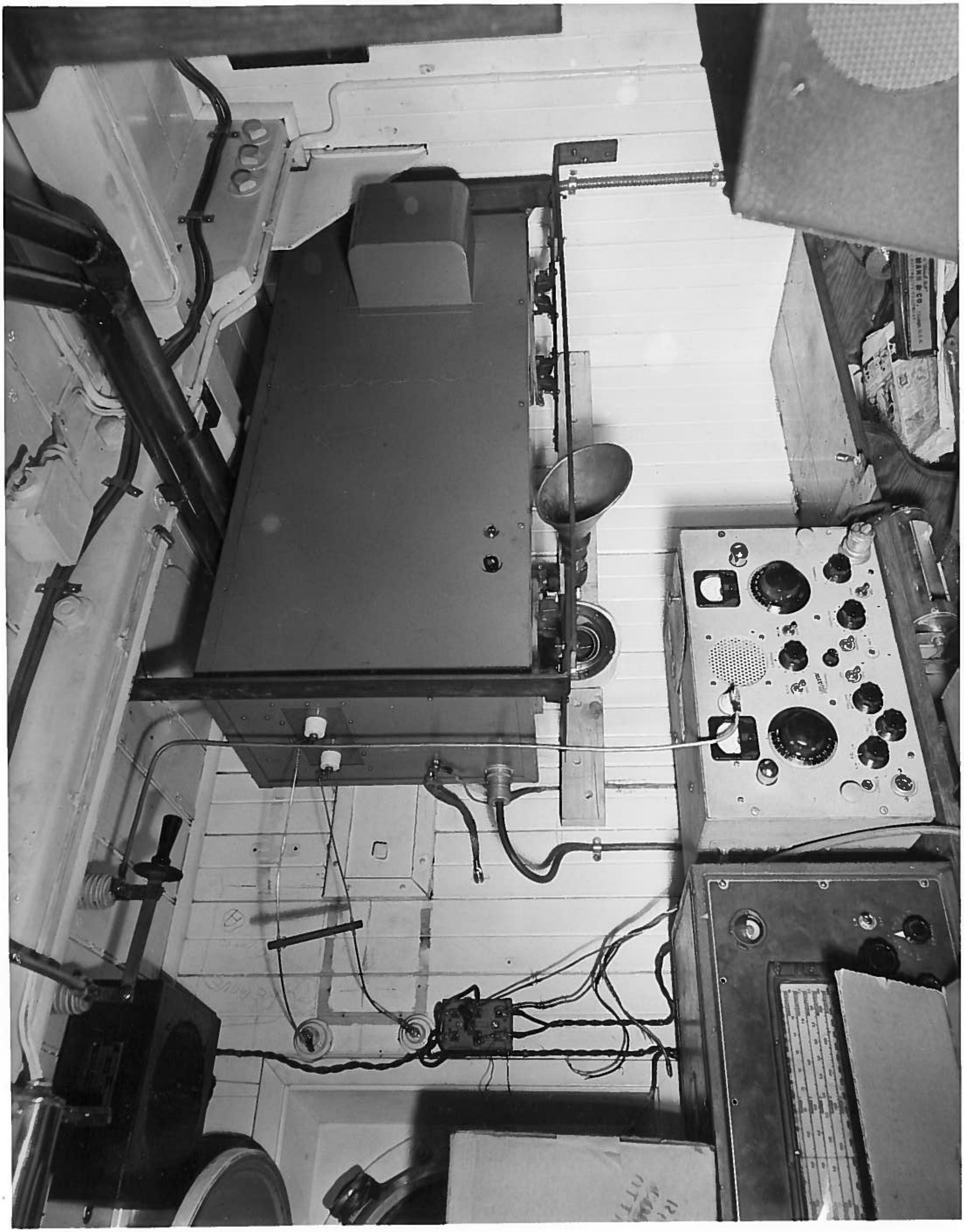
0486-6 INSTALLATION "A". RIGGING OF ANTENNA AND FEEDER.




0486-7 INSTALLATION "A". REMOTE CONTROL POSITION ON BRIDGE.

0486-9 INSTALLATION "A". MOUNTING OF TRANSMITTER IN W/T OFFICE.

0490-2 INSTALLATION "B". RIGGING OF DOUBLE CONE ANTENNA.



0490-4 INSTALLATION "B". MOUNTING OF TRANSMITTER IN W/T OFFICE.