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SECTION 2

MODEL SC-3 RADAR TRANSMITTING EQUIPMENT

ELECTRICAL AND MECHANICAL TESTS

2-1. ABSTRACT

During the period from 29 November 1943 to 20 March 1944, the mechanical construction and electrical operation of the transmitting portion of the Model SC-3 Equipment, Serial 24, as listed below was investigated to determine the suitability of this equipment for use in the Naval Service. The following units were involved in these tests.

Unit	Navy Type	Serial No.
Radar Transmitter	CG-52ABH-1	24
Control Unit	CG-23ADL	24
Motor Dynamo Amplifier Unit	CG-21ADU	24
Duplexing Unit	CG-50AAS	24
Alignment Section	- - - - -	--

The results of these investigations are discussed below.

2-1-1. Contents. For convenience, the results of the tests are discussed under the following headings:

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2-1-2. List of Tables. The following tables are appended to Section 2 of this report:

2-1-3. List of Plates. The following plates are appended to Section 2:

2-2. <u>EFFECTS OF AMBIENT TEMPERATURE</u>

Tests were made to determine the ability of the equipment to operate properly over a wide range of ambient temperature and to start operating when exposed to a low temperature.

2-1-1. <u>Variation of Ambient Temperature - 222 Mc.</u> The following effects were observed when the equipment was subjected to variations of ambient temperature from 50°C to 0°C while operating at a freouency of 222 MC/S. The ambient temperature was reduced from 50°C to 0°C in four discrete steps over a period of 5-1/2 hours as shown in Table 1.

(a) The peak radio frequency power remained substantially constant during the test.

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(b) The transmitter frequency varied between 221.71 and 222.58 mcs. However, no correlation was noted between the changes that occurred in the frequency and the changes that were made in the ambient temperature.

(c) The pulse length remained substantially constant at 4.7 microseconds during the test.

2-2-2. <u>Variation of Ambient Temperature - 200 Mc</u>. The following effects were observed when the equipment was subjected to variation of ambient temperature from 50°C to 0°C while operating in the yellow band at a frequency of 200 MC/S. The ambient temperature was reduced in four discrete steps over a period of 4-1/4 hours as shown in Table 2.

(a) The peak radio frequency power output remained substantially constant during the test.

(b) The transmitter frequency varied between 200.96 and 201.25 mc/s during the test. However, no correlation was noted between the changes that occurred in the frequency and the changes that were made in the ambient temperature.

(c) The pulse length remained substantially constant at 2.3 microseconds during the test.

2-2-3. <u>Cold Start.</u> The following effects were observed when the equipment was energized after being allowed to remain idle for a period of 8 hours in an ambient temperature of 0°C

(a) Upon the application of power at the end of the eight hour idle period, the transmitter started operating normally and no substantial change was noted either in power output or frequency as compared with conditions at the start of the test.

(b) During the hour following the time at which the transmitter was energized, the frequency decreased from 222.47 to 222.24 MC/S.

2-3 <u>EFFECT OF HIGH HUMIDITY</u>.

The following effects were observed when the transmitter was energized after it had been allowed to remain idle for a period of 6-1/4 hours in an atmosphere of 97% relative humidity and 40°C ambient temperature.

(a) Upon the application of power at the end of the 6-1/4 hour period, the transmitter started operating immediately without developing flashover or excessive current leakage.

(b) The power output and frequency of the transmitter was substantially the same when the equipment started operating at

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the end of the idle period as it had been at the beginning of the test

2-4. EFFECT OF VIBRATION.

The following effects were noted when the transmitter was subjected to vibration at frequencies between 0 and 2000 cycles per minute.

(a) The equipment suffered no mechanical or electrical damage as a result of its exposure to vibration.

(b) The relay K-301 opened during vibration but after an interval of about one minute, reclosed. The source of this difficulty was not immediately discovered, but a subsequent occurrence indicated that the relay had opened because vibration had caused the interlock switch on the pulse indicator unit to become open circuited. It is presumed that, in the instance above, continued vibration had caused the interlock switch to reclose and thus enable the relay K301 also to reclose. Better workmanship should therefore be used in the installation of this interlock to insure that it will be aligned properly.

2-5. EFFECT OF SHOCK.

The following effects were noted when the transmitter was subjected to shock by means of the NRL Shock-Vibration-Roll Testing machine.

(a) The transmitter was not damaged by shock.

(b) As a result of the cumulative action of several shocks, the left side panel worked upward a sufficient distance to prevent the "plate shorting" switch from being transferred from "safe" to "operate". Before the transmitter could be placed in operation, it was necessary to loosen the nuts and bolts holding this panel and force the panel downward into its proper place. The type tests on the Model SC Equipment revealed that the thumb screws used to retain the side and back shields would permit the shields to fall off when the equipment was subjected to shock. As an expedient to overcome this difficulty the contractor added two hexagonal bolts to each shield. Although this modification was effective in preventing the shields from being dislodged completely from the transmitter, it added complication to the process of removing the shields and, in addition, as shown by the results of the present shock test, does not sufficiently restrain the vertical movement of the shields. This difficulty is considered to be a serious defect since at some critical moment the fact that the side shields had been displaced upward a small amount might not be noticed and an extensive and time consuming search for the difficulty might be necessary before the equipment could be placed in operation. It is recommended that the arrangement of thumb nuts

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2-6-3. Effect of Applying Test Potentials. In addition to the tests involving the variation of the operating potentials applied to the eouipment, 60 cycle test potentials at voltages ranging up to 1230 volts were applied between the chassis and various sections of the 115 volt a.c. circuits. When the test potential applied between the chassis and the primary of the Pulse Indicator power transformer was 1185 volts, a flashover occurred after 8 seconds. This was the only instance in which difficulty was experienced either in the Transmitter or Control Unit. Since the flashover occurred at a voltage relatively close to the specified test potential of 1230 volts, this difficulty is not considered serious

2-7. R.F. POWER OUTPUT.

As described below, the r-f power output of the transmitter was measured at several frequencies and under various conditions of operation.

2-7-1. The r-f power output obtained at various frequencies is listed in Table 4 and summarized as follows:

Frequency MC/S	Peak Power Output Kilowatts
Yellow Band	
192.8	199
199.2	200
212.2	201
Blue Band	
214.2	168
216.0	150
219.0	179
231.4	146

2-7-2. Effect of Varying The Standing Wave Ratio. The power output obtained with different standing wave ratios on the transmission line between the transmitter and dummy antenna is shown by the data contained in Table 5.

2-7-3. Effect of Alignment Section. The power output was measured both with and without the alignment section in the transmission line between transmitter and the load. A comparison of the results so obtained indicated that the alignment section caused no substantial reduction in the peak power output. The data obtained during this test are listed in Table 6.

2-7-4. Effect of Duplexer. The power output was measured both with and without the duplexer in the line between the transmitter

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and load. A comparison of the results obtained indicated that the duplexer had no substantial effect on the peak power output. The data obtained during this test are listed in Table 7 and summarized below:

Freq. MC/S (Approx.)	Peak Power Output - KW		
	Without Duplexer	With Duplexer*	With Duplexer**
215	151	143	137
220	152	150	160
225	149	145	150

* Duplexer at load end of Transmission Line.
** Duplexer at transmitter end of Transmission Line.

2-7-5. Effect of Using Long Pulse Length. The power outputs listed in Table 8 were obtained with the pulse length control set at "long". The data is summarized as follows:

Frequency* MC/S	Peak Power Output - KW
191.2	128
196.6	126
200.4	141
204.1	134
210.0	128

* Blue Band

2-8. PULSE WIDTH.

Plate 16 shows the manner in which the output pulse width varies with the setting of the "output matching" and the "output coupling" controls. It should be noted that because of certain limitations in the measuring equipment, all of the values shown for pulse lengths are too short by an estimated 1/2 microsecond. For example, where a pulse length is shown to be 1.5 microseconds according to the graph the true value is approximately 2 microseconds.

2-9. IFF VOLTAGE.

The voltage available for triggering IFF equipment from the Model SC-3 Equipment was measured to be as follows:

Load Resistance Ohms	Peak Pulse Voltage - Positive
50	21.5
68	24.0
100	40.0

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2-10. MARKING AND IDENTIFICATION.

The following items were observed concerning the markings for component parts.

(a) Markings have not been provided to indicate the type of tube to be used in the socket for the type 5R4GY tube in the Transmitter. Suitable markings should be provided adjacent to the socket.

(b) No circuit symbol has been provided in the Transmitter to identify the "Test-Operate" switch.

(c) The transformer T311 in the Pulse Indicator should be provided with a Navy type nameplate.

(d) The capacitors C303 and C304 in the Transmitter each consist of 3 sections in a common container. The terminals on these containers are not identified. It is recommended that the terminals be marked to permit their identification.

(e) The 5100 ohm resistor which is connected between the capacitor C305 and the negative terminal of the meter M303 is supported between these two points by its leads. It is recommended that this resistor be mounted on a terminal strip.

(f) The mounting blocks for the fuses F301 and F302 in the transmitter have not been marked to indicate the voltage and current ratings of the fuse to be used. These markings should be provided.

(g) No chassis markings have been provided to indicate the type of tubes that are to be employed in the sockets of the Control Unit. Suitable markings should be applied to the top of the chassis adjacent to the tube sockets.

(h) There are two resistors in the Control Amplifier having the identical circuit symbol, R163. This discrepancy should be eliminated.

(i) No information as to the manufacturer or rating appears on the capacitor C101 in the Control Unit. Such data should be marked on the capacitor in accordance with Navy Specifications.

(j) The composition resistors in the Control Amplifier have had their circuit symbols stamped on them by a rubber stamp or a similar method. Should a resistor be replaced, or badly overheated, the marking would be lost. It is recommended that the circuit symbols be marked on the chassis or terminal strip so that they will be adjacent to the corresponding resistors.

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2-11. WIRING AND WORKMANSHIP.

The following observations were made concerning the wiring and workmanship used in the equipment.

(a) There is a wire in contact with the envelope of the type 5R4GY tube in the Transmitter. Proper clearance should be provided by rerouting the wiring.

(b) Four leads from the filament winding of the transformer T203 are bound together with friction tape. This type of binding should be replaced by lacing cord.

(c) Care should be taken to insure that the wiring in the equipment is properly secured. Two examples of relatively long lengths of wire that are not properly secured are: (1) the wires leading to the "test-operate" switch and (2) the wires leading to the interlock switches S303 and S304.

(d) The metal tubes that form the cathode tuning frame of the transmitter should be provided with grommets at the point at which the filament leads enter the tubes. These grommets are necessary to protect the insulation of these leads against abrasion.

(e) The locking bar, which is intended to prevent the removal of the right side panel while high voltage is present within the Transmitter, is too short and the shield can therefore be removed when in the supposedly locked position. The locking bar should be made sufficiently long to provide the desired protection.

(f) Loose pieces of uninsulated wire were found in the Control Amplifier. Better workmanship and inspection are required.

2-12. COMPONENT PARTS.

The following items were noted concerning the component parts used in the equipment.

(a) The filter capacitor C301, Navy type CG481524, is exactly the same as that employed in the Transmitter of the Model SC-2 Equipment. Attention is directed to the fact that there were 27 reported failures of this type of capacitor between March 1943 and January 1944, inclusive. The fact that ten of these failures were reported in January 1944 may indicate that progressive deterioration may be occurring. The defects in the type of construction used in this capacitor have previously been investigated as indicated in NRL Report R-2225 to BuShips.

(b) The type 6N7 and 6L6 tubes in the Control Unit are not listed on the Army-Navy preferred list of Radio Electron Tubes dated 16 February 1944. However, since the basic design of this unit originated at an earlier date, the requirement, that Navy

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Equipment employ only tubes which are on this list, does not apply.

(c) The resistors R105 and R108 in the Control Unit have a portion of their wire exposed to permit the use of a variable tap. The use of such resistors is not desirable since the resistance wire is exposed to the effects of high humidity.

(d) The resistors R111 and R112 of the Control Unit do not have type approval for use in shipboard equipment unless special approval for their use has been granted by the Bureau of Ships.

(e) The grid milliammeter M303 became defective during the tests. This meter indicated much less current than was actually flowing through it. The plate milliammeter M302 also became defective in a similar manner. These failures are believed to have been caused by the extremely large r-f potentials which were present on the meters during operation. It is therefore recommended that both of these meters be shielded against r-f fields.

(f) Refillable fuses are used in the Equipment. It is recommended that these be replaced by non-refillable fuses.

2-13. MECHANICAL AND ELECTRICAL DEFECTS.

The following mechanical and electric defects were noted during the course of the tests.

(a) When the equipment was received, the grid coils were not of the proper shape to permit installation, and it was found necessary to bend them before they could be fitted into place. In addition, the spring contacts on the ends of the coils were too tight to permit installation and had to be spread apart. Better workmanship should be required.

(b) A number of unplated brass screws are used as terminals of the main power switch. These screws should be suitably plated to prevent their becoming corroded and causing a bad electrical contact. A number of other unplated brass or bronze parts are present in the transmitter as follows: parts of the "test-operate" switch; the bushing on the shaft of the output coupling control; parts of relays K301 and K302; parts of the "time-elapsed" meter.

(c) The tension pulley of the "output coupling" control abrades against the shield of the oscilloscope tube in the Pulse Indicator. Proper clearance should be provided.

(d) One of the brackets which holds the shafts of the transmitter mechanical interlock system is spot welded to the frame in a manner which indicates that this method of securing the bracket is not sufficiently rugged.

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(e) The plating of the grid coils (blue band) was found to be corroded and pitted. This condition is presumed to be the result of the flashovers and corona which occurred at certain settings of the transmitter controls.

(f) The shield of the Pulse Indicator Unit does not fit properly and must be forced into place. Better workmanship is required.

(g) One of the elastic stop nuts on the terminal board of the filament variable transformer seized so tightly that the screw on which it fitted broke before the nut would move. It is probable that the seizing occurred because of the plating used on the screw and nut.

(h) The case of the r-f noise filter in the Transmitter Unit should be made smaller so that it will be possible to remove the cover without unfastening the case from the transmitter chassis.

(i) The screw holes in the case of the r-f noise filter are not properly aligned. Better workmanship is required.

(j) On several occassions, the interlock switch S310 on the Pulse Indicator Unit developed an intermittent open circuit causing the equipment to stop operating. The difficulty was found to have been caused by two parts of the interlock switch being out of alignment. To eliminate this difficulty, it is suggested that the interlock switch be mounted at the front of the Pulse Indicator rather than in its present position. It was noted that the section of the interlock that is mounted on the Pulse Indicator rubs against the wires leading to the other section of the interlock. This wiring should be relocated.

(k) There are no tube base clamps for the type 6H6 and the type 5R4GY tubes in the Pulse Indicator and the vacuum tubes in the Control Unit.

(l) The grounding strap at the left hand top corner of the Transmitter was found to be torn almost apart. This difficulty occurred because the strap had been made too short and had been located in the wrong position. The Contractor should be required to eliminate the difficulty by proper design and installation.

(m) The operating rollers of the two micro switches in the Control Unit bear on a cam which is rotated by the plate variac shaft. However, only one of the switches is opened and closed by this cam. The other switch remains continuously in the same position as the cam is rotated from limit to limit. The Contractor should be required to explain the need for this microswitch.

(n) The use of set screws alone to secure the variac (T101)

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rotor to its shaft is not satisfactory. A tapered pin through the rotor collar and shaft should be provided.

(o) The screw used to secure the rear of the left chassis slider of the Control Unit was found to be loose. All of the screws holding these sliders should be provided with an effective type of lockwasher or other means of insuring that they will not become loose.

(p) The rubber gasket on the terminal board cover of the Control Unit came loose from the cover. An improved method of fastening the gasket to the cover should be provided.

(q) One of the through-bolts on the Motor Dynamo Amplifier Unit loosened during the shock test and also on several other occassions during tests. A more effective method of locking should be provided for the nuts on these bolts.

(r) Corrosion in the form of a white powder was noted on case for the transformer (T103) and on both synchros.

(s) The heater voltages applied to the vacuum tubes V151, V152, and V153 in the Control Unit exceed the rated values by more than 5% (7%, 7% and 8% respectively). It is recommended that the filament transformers now used be replaced by transformers that will provide the correct heater voltages for these tubes.

2-14. DIMENSIONS.

The weights and overall dimensions of the various units are listed below:

Unit	Overall Dimensions In Inches				Weight
	Height	Width	Depth	Length	Pounds
Motor Dynamo Amplifier	9.50	13.0	----	21	128
Control Unit	20.75	13.5	21.5	--	125
Transmitter	61.50	21.0	21.5	--	333

2-15. CONTROLS.

Table 9 lists the controls of the Transmitter and Control Unit.

2-16. FUSES.

Table 10 lists the fuses employed in the equipment.

2-17. POWER REQUIRED BY TRANSMITTER.

When operating at full load, the Transmitter requires an input of 888 watts. The current requirement was 9.5 amperes at

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115 volts, 60 cycles a.c.

COMPARISONS OF RESULTS OF TYPE TESTS OF MODELS SC-2 AND SC-3 EQUIPMENTS

2-18. In the following paragraphs, the defects encountered in the Model SC-2 equipment are reviewed and compared with results of the type test of the Model SC-3 equipment. The numbers in parenthesis preceding each item refer to paragraph numbers in NRL Report R-2225.

2-18-1. (2-14-1) No difficulty was encountered when the Model SC-3 equipment was placed in operation while exposed to high humidity. This result contrasts with the results obtained with the Model SC-2 equipment which required three minutes to attain normal operation under the same conditions.

2-18-2. (2-14-2) The coupling jack J303A of the Model SC-2 equipment became loose when the transmitter was subjected to vibration. This difficulty did not occur in the Model SC-3 equipment.

2-18-3. (2-14-3) The overload relay of the Model SC-3 transmitter did not rattle during the vibration test.

2-18-4. (2-14-4) Several of the tabs holding the center of the oscillator grid inductors in the Model SC-2 equipment broke during the course of the type tests. This difficulty was not experienced with the Model SC-3 equipment but there has been no apparent change in the design of these coils.

2-18-5. (2-14-5) The tube sockets provided with the Type 327A tubes used in the Model SC-2 transmitter were considered to be mechanically unsatisfactory. The same type of socket is used in the Model SC-3 transmitter.

2-18-6. (2-14-6) During the vibration test, the ceramic insulators mounted on the top of the capacitor C301 in the Model SC-2 transmitter vibrated with respect to each other. The same type of capacitor is used in the Model SC-3 equipment.

2-18-7. (2-14-7) No difficulty was experienced with excessive play in the brush rigging of the variable transformer by which the oscillator tube filament voltages of the Model SC-3 transmitter are controlled.

2-18-8. (2-14-8) The results of the shock and vibration on the Model SC-3 antenna assembly have been reported to the BuShips by NRL letter C-S67/5(380-FCK) of 27 November 1943.

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2-18-9. (2-14-9) No difficulty was experienced with the angle brackets for transmitter jacks J301A and J303A which loosened as the result of the shock tests to which the Model SC-2 equipment was subjected.

2-18-10. (2-14-10) The deflection of the top of the Model SC-3 transmitter unit which occurred when this unit was subjected to shock was approximately equal to that of the Model SC-2 transmitter under the same conditions.

2-18-11. (2-14-11) No change has been made in the thumb nuts by which the side and back shields are held on the transmitter. The difficulties experienced with these side shields during the shock test on the Model SC-3 equipment is described in paragraph 2-5 of this report.

2-18-12. (2-14-12) It was found that the antenna rotation control system of the Model SC-2 equipment had 35 minutes of arc backlash. This amount was not considered excessive. No investigation was made of the backlash in the Model SC-3 equipment.

2-18-13. (2-14-13) The IFF control switch of the Model SC-3 equipment is labeled correctly.

2-18-14. (2-14-14) Several non-Navy type resistors were used in the Control Unit of the Model SC-2 equipment. The Model SC-3 employs the same type of resistors.

2-18-15. (2-14-15) There was a discrepancy between the actual power dissipation rating of the resistors R171 and R172 in the Model SC-2 equipment and the power dissipation rating in the instruction book. No instruction book for the Model SC-3 equipment was available.

2-18-16. (2-14-16) No change has been made in the method of supporting the resistor R102c.

2-18-17. (2-14-17) No oil was observed to be leaking from the case of the capacitor C302 in the Model SC-3 transmitter.

2-18-18. (2-14-18) The same type of capacitor, C301, which failed during the course of the type test of the Model SC-2 equipment is also used in the Model SC-3 equipment.

2-18-19. (2-14-19) The terminals on the capacitor C303 are not marked to permit their identification.

2-18-20. (2-14-20) The filament voltage for the rectifier tubes in the transmitter was found to be within the tolerance specified by the tube manufacturer.

2-18-21. (2-14-21) Base clamps have still not been provided for the vacuum tubes in the Control Unit.

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2-18-22. (2-14-22) The base of the Pulse Indicator oscilloscope tube in the Model SC-2 equipment was found to be loose. This difficulty was not encountered in the Model SC-3 equipment.

2-18-23. (2-14-23) Refillable fuses are also used in the Model SC-3 equipment.

2-18-24. (2-14-24) The same difficulty was experienced with slippage of the plate voltage variac rotor of the Model SC-3 equipment as was experienced with that of the Model SC-2 equipment.

2-18-25. (2-14-25) The insulation on the oscillator plate voltage supply transformer and the rectifier filament transformer in the Model SC-3 transmitter has a voltage rating of 12.5 kv. This is not sufficiently high to satisfy Navy Specifications since the peak voltage applied to the insulation will upon certain occasions exceed 12.5 kilovolts.

2-18-26. (2-14-26) No oil was found to be leaking from the case of transformer T104.

2-18-27. (2-14-27) No change has been made in the method of mounting the resistor R307 in the transmitter unit.

2-18-28. (2-14-28) The difficulty encountered with the deformation of the grid inductors of the Model SC-3 equipment is described in paragraph 2-13 of the present report.

2-18-29. (2-14-29) No damage occurred to the insulators which form a part of the switch S102 in the Control Unit of the Model SC-3 equipment.

2-18-30. (2-14-30) No rust or corrosion was observed on the gears in the Control Unit in the Model SC-3 equipment.

2-18-31. (2-14-31) The shield cover on the type 5U4G vacuum tube in the Pulse Indicator unit is removable without difficulty.

2-18-32. (2-14-32) Lockwashers have been provided on terminal screws of the terminal board TB31.

2-18-33. (2-14-33) The interconnecting cables between the Control Unit chassis and the terminal boards at the top of the cabinet are satisfactorily protected against abrasion but a cable connecting the Control Amplifier to the main chassis of the Control Unit should be supported to protect it against damage.

2-18-34. (2-14-34) The main line switch has not been provided with the Navy type nameplate and there is, therefore, no means of identifying it as a part of the Model SC-3 equipment.

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2-18-35. (2-14-35) The resistors which were not marked in the Model SC-2 equipment have been provided with markings to show the resistance value and circuit symbol.

2-18-36. (2-14-36) No instruction book was available for the Model SC-3 equipment and it was, therefore, not possible to compare the ratings on components with those listed in the instruction book.

2-18-37. (2-14-37) Nameplates have been omitted from the transformers T151, T152, T301, and T311. The information marked on transformer T310 has been put on by rubber stamp or by similar method and is not considered sufficiently durable.

2-18-38. (2-14-38) The terminals on the Transformer T151 have not been numbered.

2-18-39. (2-14-39) No difficulty was experienced with the terminal studs of the transmitter overload relay when disconnecting the relay leads.

2-18-40. (2-14-40) The threads in one of the bolt holes in the line switch box of the Model SC-2 equipment became stripped during the type tests. This difficulty did not occur in the Model SC-3 equipment but no change has been made in the design of the switch box.

2-18-41. (2-14-41) The desirability of a change in the method of securing of the shields on the transmitter is pointed out in paragraph 2-5 of this report.

2-18-42. (2-14-42) This item refers to the antenna assembly.

2-18-43. (2-14-43) This item refers to the antenna assembly.

2-18-44. (2-14-44) The antenna control system gears in the Control Unit of the Model SC-3 equipment were found to be lubricated with grease.

2-18-45. (2-14-45) The bolts holding the capacitors C101 and C102 have been made sufficiently long to extend completely through the "Elastic Stop Nuts" by which they are secured.

2-18-46. (2-14-46) This item refers to the antenna assembly.

2-18-47. (2-14-47) This item refers to the antenna assembly.

2-18-48. (2-14-48) This item refers to the antenna assembly.

2-18-49. (2-14-49) No instruction book for the Model SC-3 equipment was available and it was, therefore, not possible to

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compare the chassis markings of the resistors in the pulse indicator unit with those listed in the instruction book.

2-18-50. (2-14-50) The preceding comment applies here also.

2-18-51. (2-14-51) The fuse holders in the line switch box have still not been marked with the current and voltage ratings of the fuses to be employed and with appropriate "Symbol Designations".

2-18-52. (2-14-52) Instances in which the "Symbol Designations" in the Model SC-3 equipment have been omitted or unsatisfactorily accomplished as discussed in paragraph 2-10 of this present report.

2-19. SUMMARY OF DEFECTS AND RECOMMENDATIONS.

The defects encountered during the tests of the Model SC-3 equipment are summarized below. The numerals in parenthesis preceding each item refer to the paragraph of this report in which the item is discussed at greater length. The relative order of listing is not indicative of the relative importance attached to the item.

2-19-1. (2-4, 2-5) The interlock system should be modified in the manner necessary to prevent the interlock switches from accidentally open circuiting when the equipment is subjected to shock or vibration. In addition, the equipment should be provided with a "battle short" switch to permit the interlock system to be short circuited completely and effectively whenever such a measure is deemed necessary. This type of switch has appeared on the more recent types of Radar Equipments and is intended to prevent the accidental open circuiting of an interlock switch from interfering with the operation of the equipment during critical periods. The "battle short" switch should be interlocked mechanically with the "plate shorting" switch so that the "battle short" cannot be used to shunt the interlocks unless the "plate shorting" switch is in the "operate" position.

2-19-2 (2-5) The means by which the side and back shields are secured to the transmitter should be modified so that these shields will not shift their position when the equipment is subjected to shock. As one method of accomplishing this purpose, it is recommended that the present type of side shield securing screws be replaced by knurled head bolts that are captive to the shields and which would fit into floating keepers in the main frame.

2-19-3. (2-10) Care should be taken to mark the components to permit their quick identification when repairs are being made. A number of instances in which the desired markings have been omitted or have been accomplished in an unsatisfactory manner are listed in paragraph 2-10.

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2-19-4. (2-11) The workmanship and design should be improved in certain instances as listed in detail in paragraph 2-11.

2-19-5. (2-12) As indicated in paragraph 2-12, a number of components should be modified or otherwise improved to insure that they will provide satisfactory and trouble-free service.

2-19-6. (2-13) The contractor should be required to make the modifications necessary to eliminate the mechanical and electrical defects listed in paragraph 2-13.

2-20. CONCLUSIONS.

The results of the tests conducted on the Model SC-3 equipment, Serial 24, lead to the following conclusions:

(a) The equipment operated satisfactorily over a wide range of ambient temperatures and relative humidities.

(b) The equipment suffered no damage when subjected to a vibration test. However, the interlock switches are not satisfactory since one of them vibrated open and caused the equipment to stop operating.

(c) The transmitter unit is not satisfactorily resistant to shock because its side and back shields are not properly secured.

(d) A number of component parts require improvement or modification of a mechanical or electrical nature. Particular attention should be given to the transmitter high voltage filter capacitor C301.

(e) The Model SC-3 Transmitter differs only slightly from the Model SC-2 Transmitter. The main modification appears to be in the manner in which the grid circuit is synchronized. It may therefore be expected that the performance which will be obtained from the Model SC-3 will be similar to that of the Model SC-2 equipment.

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Table 1 - Section 2

Model SC-3 Transmitting Equipment
Variation In Ambient Temperature - 222 MC

Time	Temp. (°C)	Frequency MC/S	Power Output Aver. (Watts)	Power Output Peak (Kw)	Duty Cycle (%)
1000	50	----	8.1	29.1	0.028
1015	50	221.92	7.2	26.7	0.027
1030	50	221.71	7.4	28.1	0.026
1045	50	221.97	7.4	27.6	0.027
1100	50	221.96	7.4	26.6	0.028
1115	35	222.05	7.7	27.7	0.028
1130	35	222.58	7.7	27.7	0.028
1145	35	222.01	8.4	30.1	0.028
1200	35	221.96	8.0	29.7	0.027
1215	35	221.90	8.1	29.1	0.028
1230	35	222.40	8.1	29.1	0.028
1245	20	221.93	7.7	27.7	0.028
1300	20	221.86	8.1	29.1	0.028
1315	20	222.30	8.0	28.3	0.028
1330	20	221.95	8.1	29.0	0.028
1345	20	221.96	8.2	29.3	0.028
1400	0	221.91	8.4	30.0	0.028
1415	0	222.04	8.4	29.2	0.029
1430	0	222.11	8.4	30.2	0.028
1445	0	222.05	8.6	30.9	0.028
1500	0	222.11	8.4	30.0	0.028

Load lamp used as dummy antenna during this test.
Humidity was maintained below 25% relative.

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Table 2 - Section 2

Model SC-3-Radar Transmitting Equipment
Variation In Ambient Temperature - 200 MC/S

Time	Temp. (°C)	Frequency MC/S	Power Output Aver. (Watts)	Power Output Peak (Kw)	Duty Cycle (%)
1000	50	200.96	20.7	148	0.014
1015	50	201.15	20.5	146	0.014
1030	50	201.10	20.0	143	0.014
1045	50	201.12	19.5	135	0.014
1100	50	201.14	17.2	123	0.014
1115	50	201.16	20.5	146	0.014
1130	50	201.10	19.7	141	0.014
1145	50	201.10	20.0	143	0.014
1200	50	201.25	19.7	141	0.014
1215	35	201.25	17.7	127	0.014
1230	35	201.11	19.7	141	0.014
1245	35	201.05	19.7	141	0.014
1300	35	201.12	17.2	123	0.014
1315	35	201.11	20.0	143	0.014
1330	35	201.12	20.0	143	0.014
1345	20	201.14	20.5	146	0.014
1400	20	201.15	20.7	151	0.0138
1415	20	201.17	20.0	147	0.0136
1430	20	201.15	21.0	152	0.0139
1445	20	201.15	21.2	152	0.0140
1500	20	201.15	20.7	150	0.0139
1515	0	201.15	20.7	150	0.0139
1530	0	201.16	20.7	151	0.0138
1545	0	201.18	20.2	146	0.0139
1600	0	201.16	18.0	130	0.0139
1615	0	201.21	20.2	146	0.0139

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Table 3 - Section 2

Model SC-3 Radar Transmitting Equipment
Variation in Line Voltage - ±10%

Line Volts	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (Kw)	Plate Voltage (K.V.)
115	0.0180	25.2	140	15
103.5	0.0165	20.3	123.2	13
105.0	0.0160	----	----	13.3
107.5	0.0170	----	----	13.4
110.0	0.0170	----	----	13.9
112.5	0.0180	----	----	14.0
117.5	0.0180	----	----	15.0
120.0	0.0185	----	----	15.1
122.5	0.0190	----	----	15.6
125.0	0.0190	----	----	15.7
126.5	0.0200	32.5	162	16.1

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Table 4 - Section 2

Model SC-3 Radar Transmitting Equipment
Power Output at Various Frequencies

Frequency MC/S	Standing Wave Ratio	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (K.W.)
		Yellow Band		
192.8	0.91	0.0155	30.6	199
199.2	0.95	0.0150	30.0	200
212.2	0.93	0.0160	32.2	201
		Blue Band		
214.2	0.95	0.023	38.7	168
216.0	0.95	0.019	28.5	150
219.0	0.96	0.019	34.0	179
231.4	0.92	0.014	20.5	146

Table 5 - Section 2

Model SC-3 Radar Transmitting Equipment
Power Output - Effect of Varying Standing Wave Ratio

Frequency MC/S	Standing Wave Ratio	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (K.W.)
231.0	0.97	0.018	25.7	143
232.9	0.50*	0.020	28.9	144
230.8	0.50**	0.019	25.7	135
230.8	0.25	0.023	26.0	113

* Capacitive
** Inductive

The date above wereobtained by changing the position of the tuning stub along the line.

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Table 6 - Section 2

Model SC-3 Radar Transmitting Equipment
Power Output - Effect of Alignment Section

Frequency MC/S	Standing Wave Ratio	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (K.W.)
Power Output With Alignment Section In Line				
214.2	0.91	0.018	22.3	124
219.7	0.93	0.019	27.2	143
224.8	0.92	0.016	22.7	142
Power Output Without Alignment Section				
215	0.96	0.020	30.3	151
220	0.94	0.019	29.0	152
225	0.96	0.0175	26.2	149

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Table 7 - Section 2

Model SC-3 Radar Transmitting Equipment
Power Output - Effect of Duplexer

Frequency MC/S	Standing Wave Ratio	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (K.W.)
Blue Band - Power Output With Duplexer Between Transmitter and Transmission Line.				
214.7	0.98	0.016	22.0	137
220.0	0.92	0.013	22.0	160
224.8	0.94	0.013	19.5	150
Blue Band - Power Output With Duplexer At Load End of Transmission Line.				
215.6	0.92	0.021	30.1	143
220.4	0.93	0.018	27.1	150
225.2	0.93	0.0167	24.7	145
Blue Band - Power Output Without Duplexer.				
215	0.96	0.020	30.3	151
220	0.94	0.019	29.0	152
225	0.96	0.0175	26.2	149

- -

Comparison of Power Output With And Without Duplexer In Use

Frequency MC/S (Approx.)	Power Output: Average Watts: Without Duplexer	Average Watts: Duplexer at Trans.	Average Watts: Duplexer at Load	Peak Kilowatts: Without Duplexer	Peak Kilowatts: Duplexer at Trans.	Peak Kilowatts: Duplexer at Load
215	30.3	22.0	30.1	151	137	143
220	29.0	22.0	27.1	152	160	150
225	26.2	19.5	24.7	149	150	145

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Table 8 - Section 2

Model SC-3 Radar Transmitting Equipment
Power Output - Effect of Long Pulse Length

Frequency MC/S	Standing Wave Ratio	Duty Cycle (%)	Power Output Aver. (Watts)	Power Output Peak (K.W.)
191.2	0.97	0.028	35.1	128
196.6	0.92	0.027	34.1	126
200.4	0.95	0.027	38.0	141
204.1	0.90	0.028	37.5	134
210.0	0.94	0.032	40.9	128

Yellow Band - Pulse Length Control Set on "Long".

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Table 9 - Section 2

Model SC-3 Radar Transmitting Equipment
List of Controls

Cont.	Control Marking	Circuit Controlled	Control Calibration or Positions. Type of Control
----	A Output Matching	Match impedance of output of osc. to line	0-100
----	B Output Coupling	Adjust coupling to cathode line	0-100
----	C Oscillator Tuning	Tuning of grid coils of osc. change freq.	0-100
T-309	Filament Voltage Increase	Variac in primary of Filament Transformers	-----
S305	Short Long Pulse Width	Varies pulse width by adding or removing capacity from grid network	-----
R317	Intensity	Pot. to control intensity of trace on pulse indicator	Resistor
R319	Pulse Indicator Focus	Pot. to vary focus of trace on Pulse Ind.	Resistor
R327	-------	Vary deflecting voltage of C.R. Tube (Pulse Ind.)	Screw Driver Cont. Resistor
R303	-------	Controls amplitude of IFF Pulse	Screw Driver Cont. Resistor
R109	---Increase--- Dial Lights	Vary intensity of panel lights in Control Unit	Resistor
T101	B Plate K.V. Transmitter	Controls pri. voltage of H.V. Transformer	0-17 K.V.
----	H Manual	Manual control of Antenna Rotation	0-10°

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Table 9 - Section 2 (Cont'd)

Cont.	Control Marking	Circuit Controlled	Control Calibration or Positions. Type of Control
S103	Signal On Locked Radar Silent Momentary On	Controls Pri. of T101 and T104 shorts out R113	T.P.D.T. Switch
S110	Local K PPI	-------	T.P.D.T. Toggle Switch
S107	------	Micro Switches on Cam on Shaft of T101	Micro Switches
S106	J On Off IFF	Controls IFF Pulse Voltage	D.P.S.T. Switch
S105	E Auto. Manual	Controls Voltage to D.C. Motor in Control Unit	D.P.S.T. Switch

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Table 10 - Section 2

Model SC-3 Radar Transmitting Equipment
List Of Fuses

Circuit Symbol	Circuit	Fuse Mount Marking Cir. Syn.	Amps.	Volts	Rating On Fuse Amps.	Volts	Operating Conditions Amps.	Volts
F301	Trans-mitter	F301	None	None	20	250	9.5	115
F302	Trans-mitter	F302	None	None	20	250	9.5	115
F101	Control Unit	F101	40	250	40	250	17*	115
F102	Control Unit	F102	40	250	40	250	17*	115
----	Main Line Switch	None	None	None	20	600	5*	440
----	Main Line Switch	None	None	None	20	600	5*	440

* This is the current required by the Transmitter, Motor Dynamo Amplifier Unit, and Control Unit and does not include the requirement of the PPI, Receiver Indicator or Antenna Heater.

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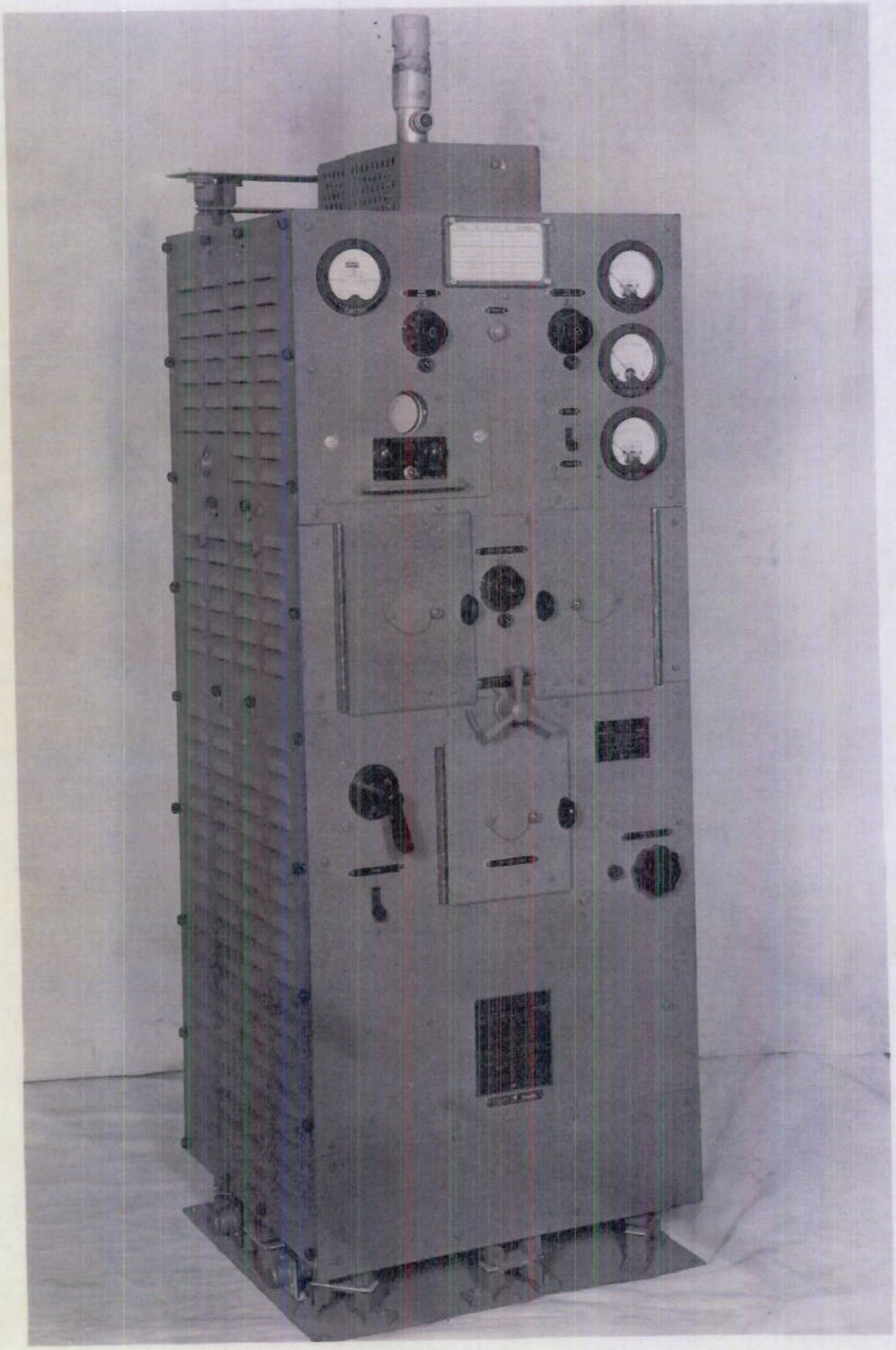

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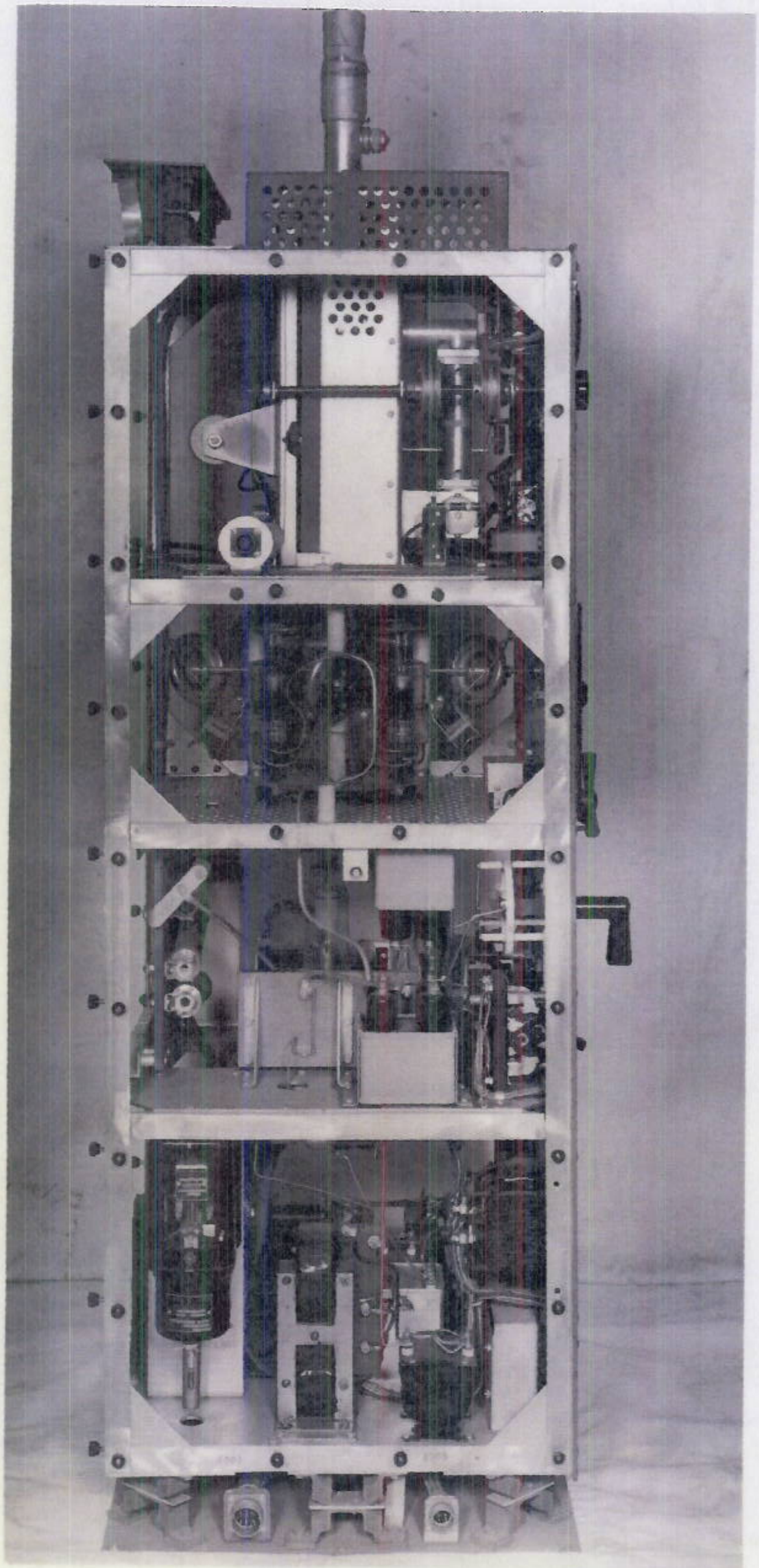

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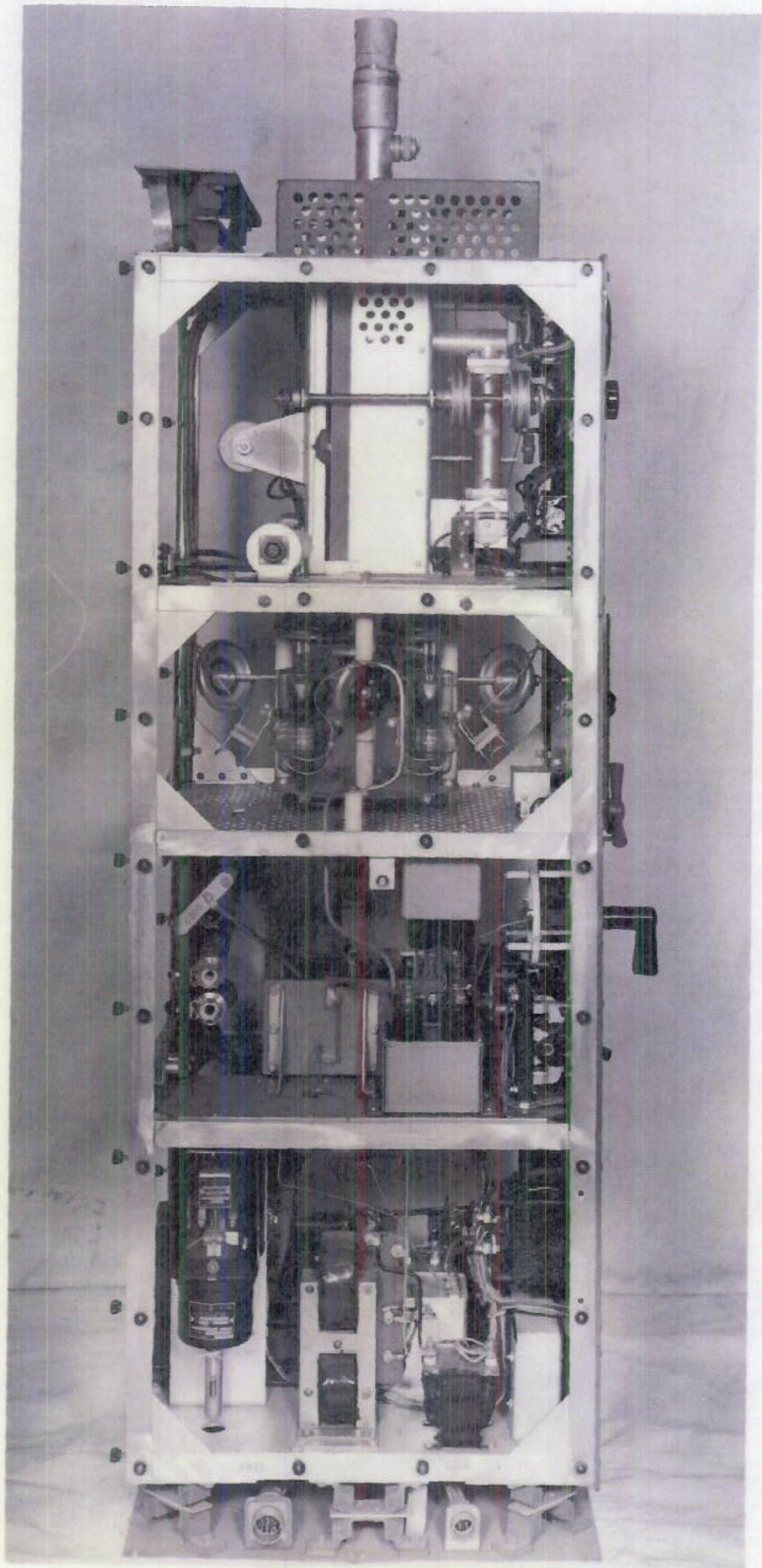

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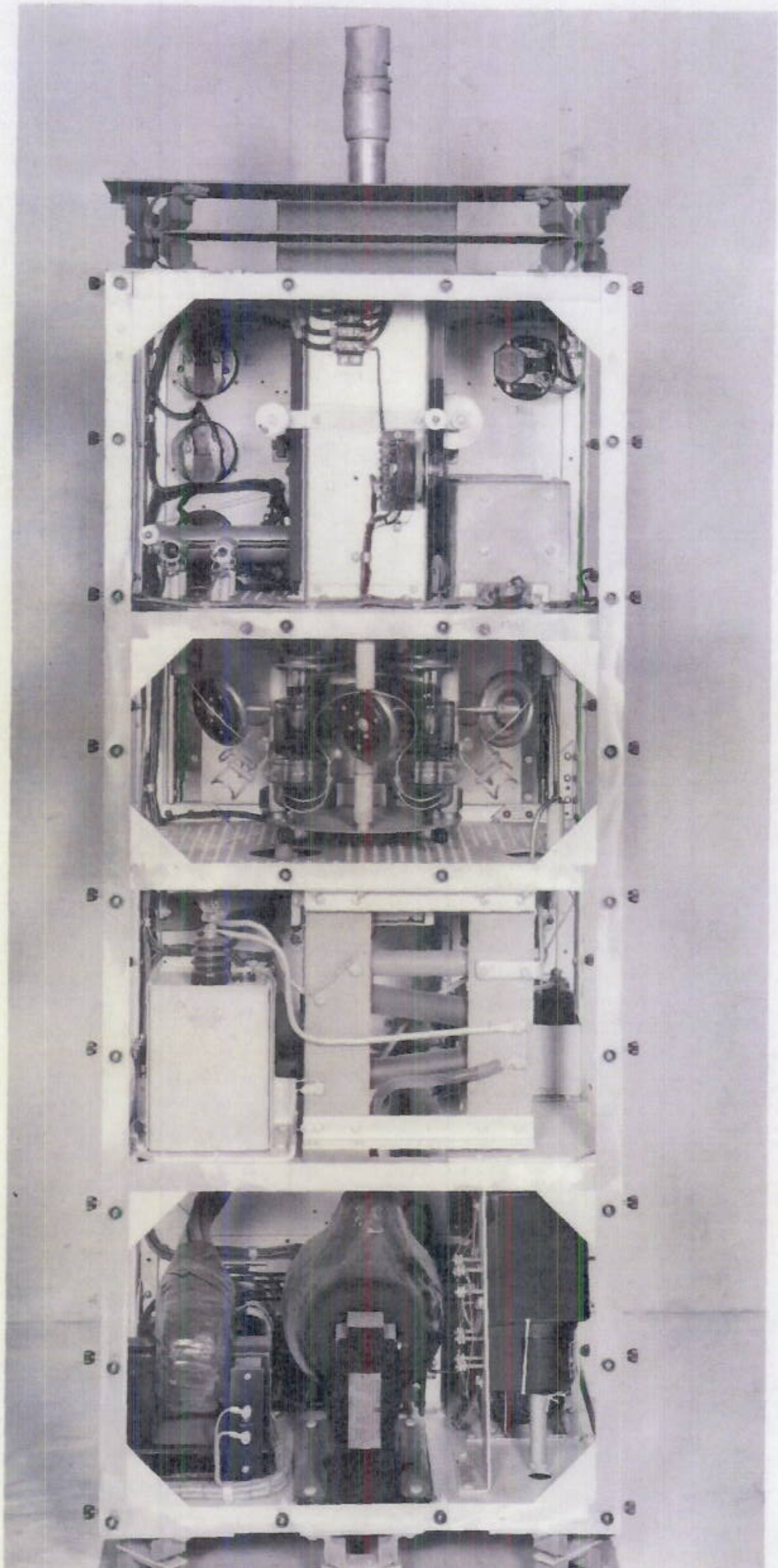

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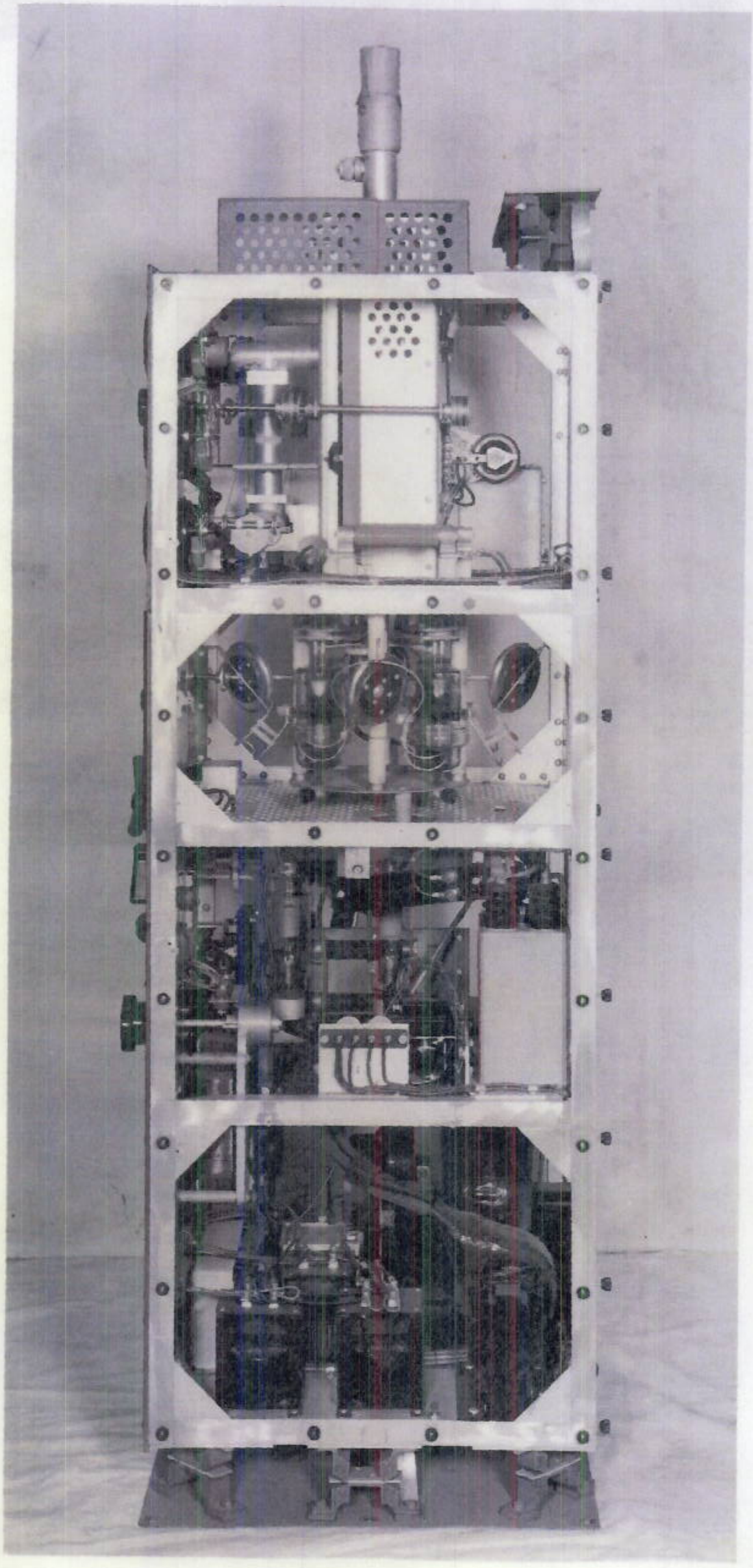

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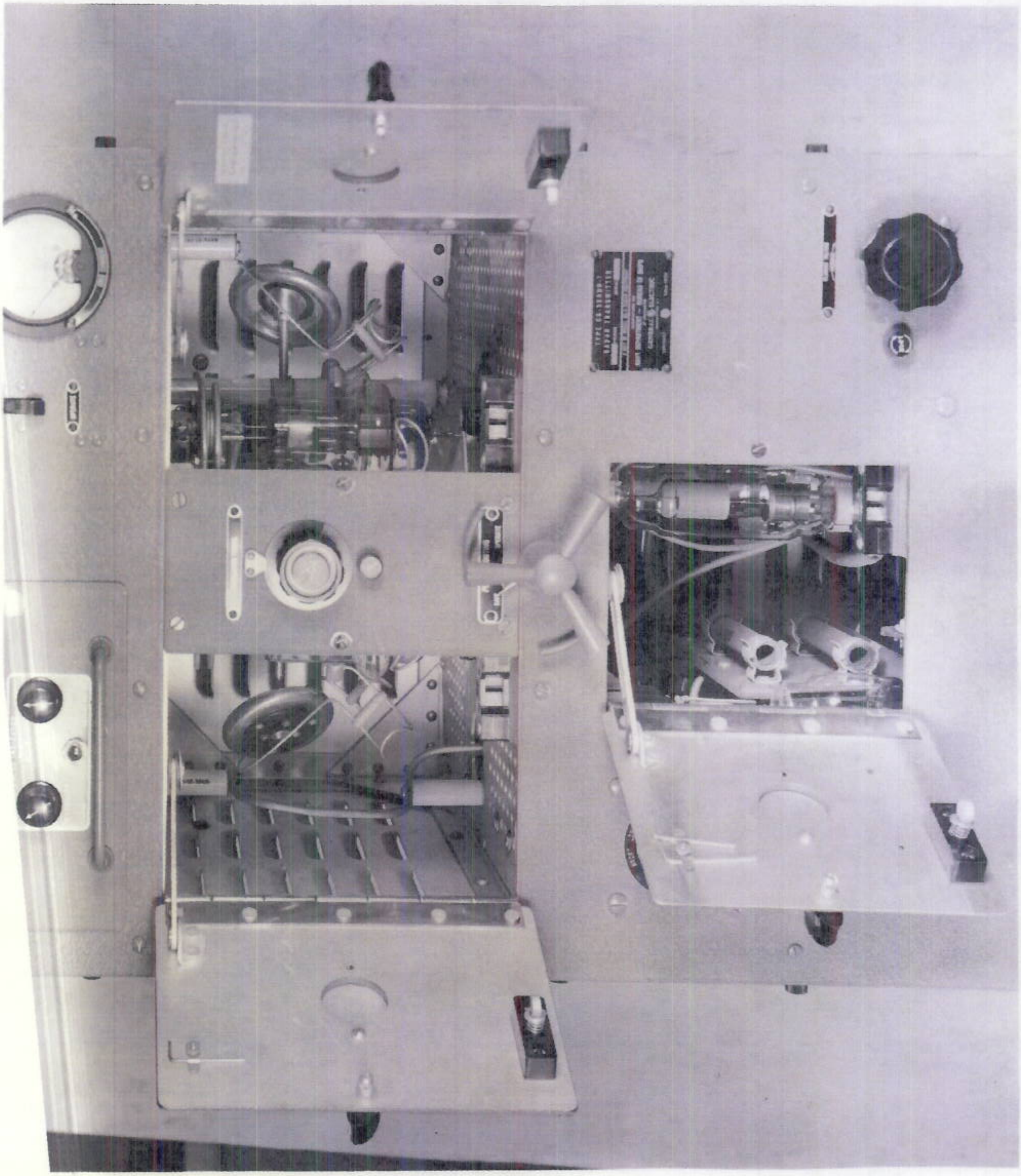

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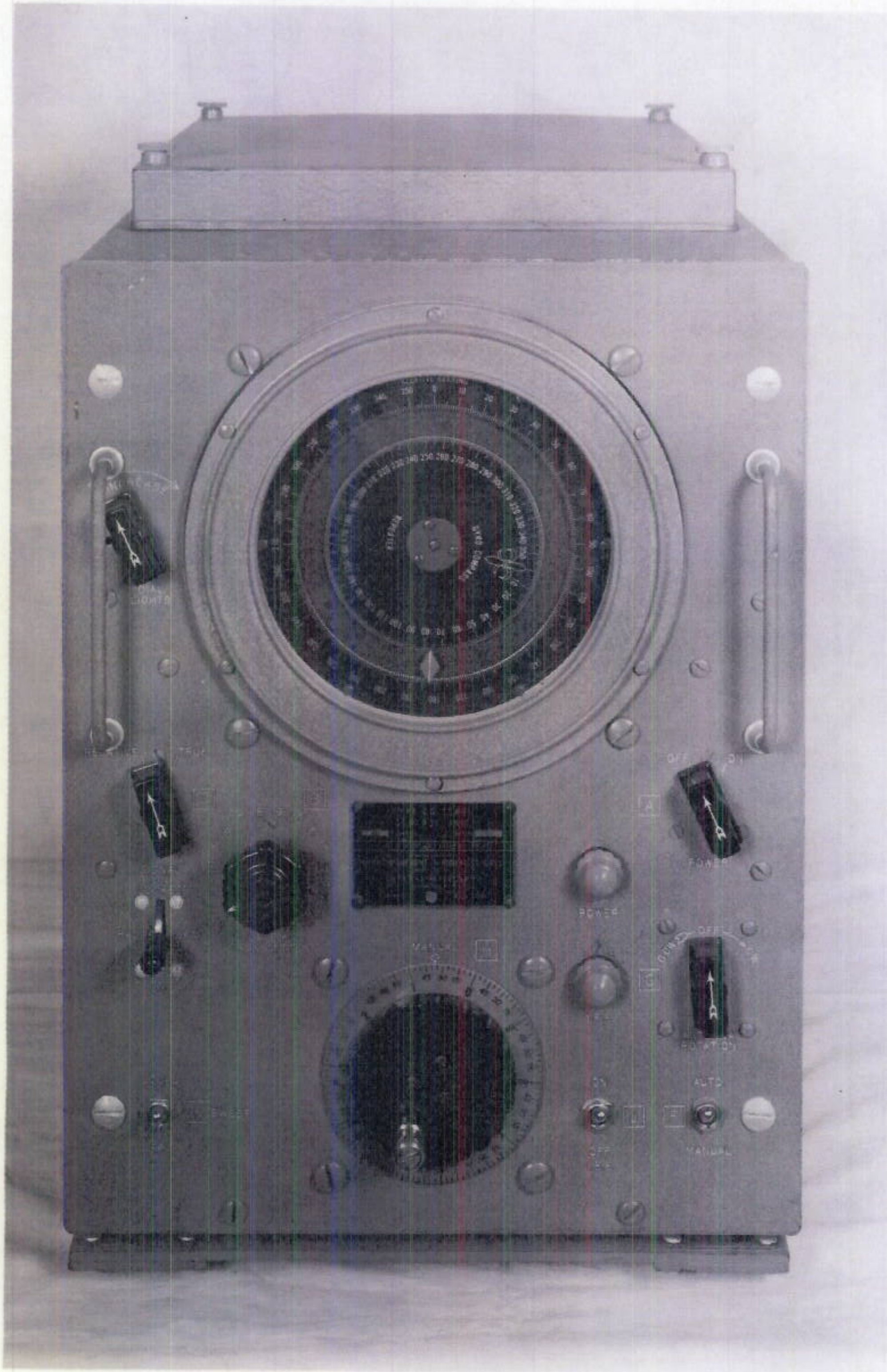

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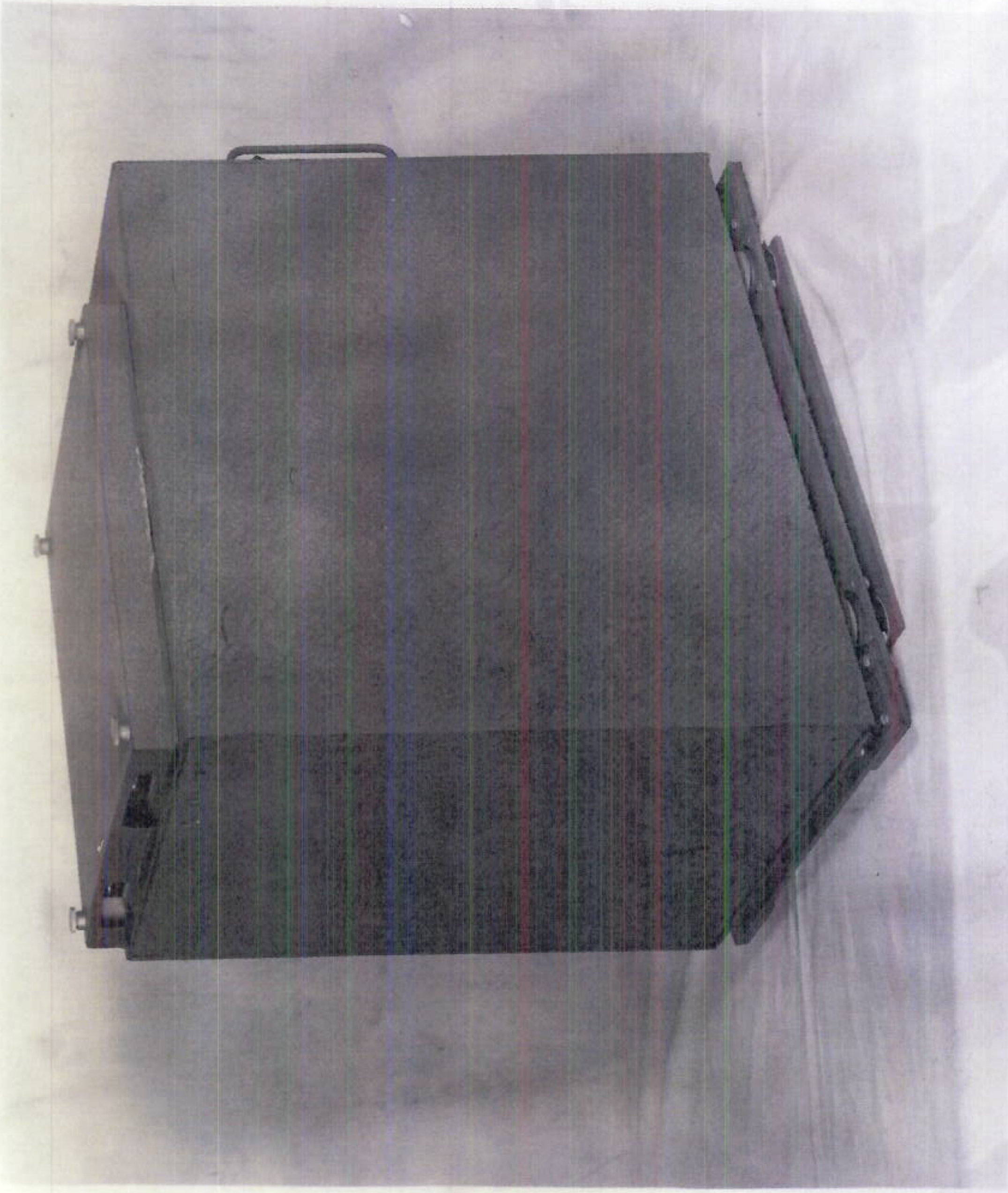

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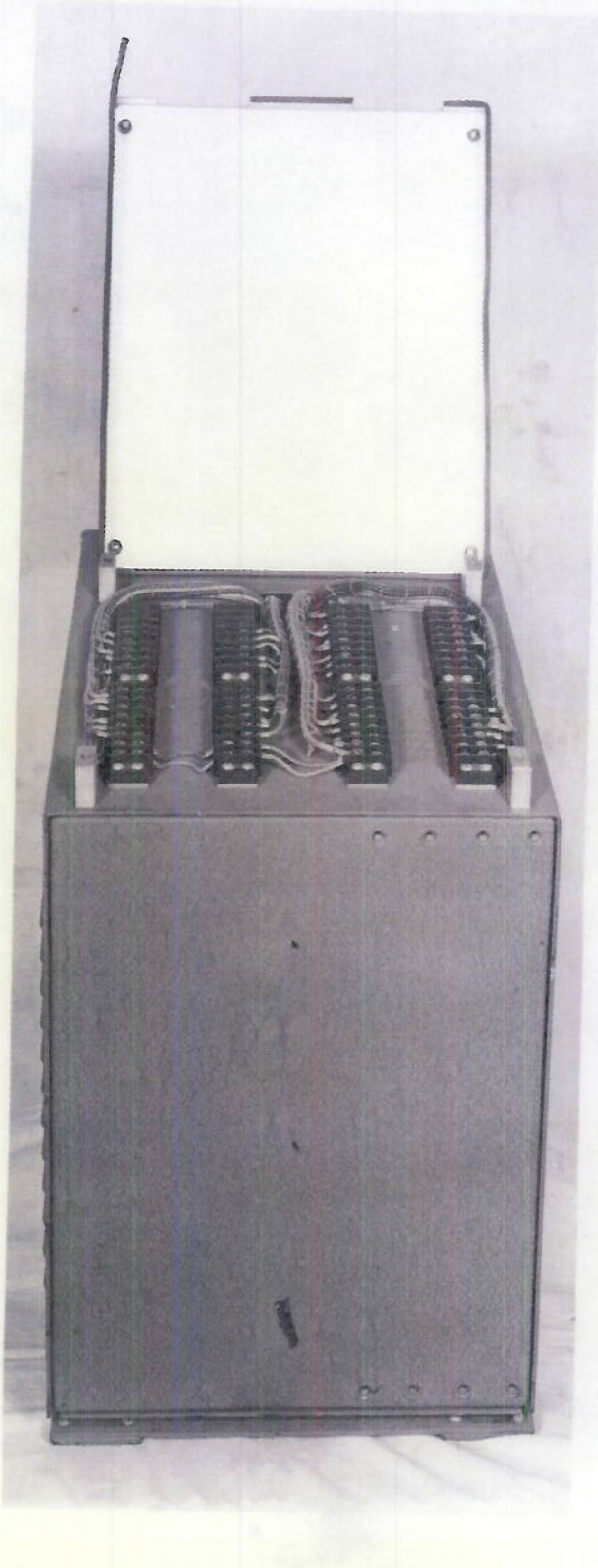

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PLATE 9 SEC. 2

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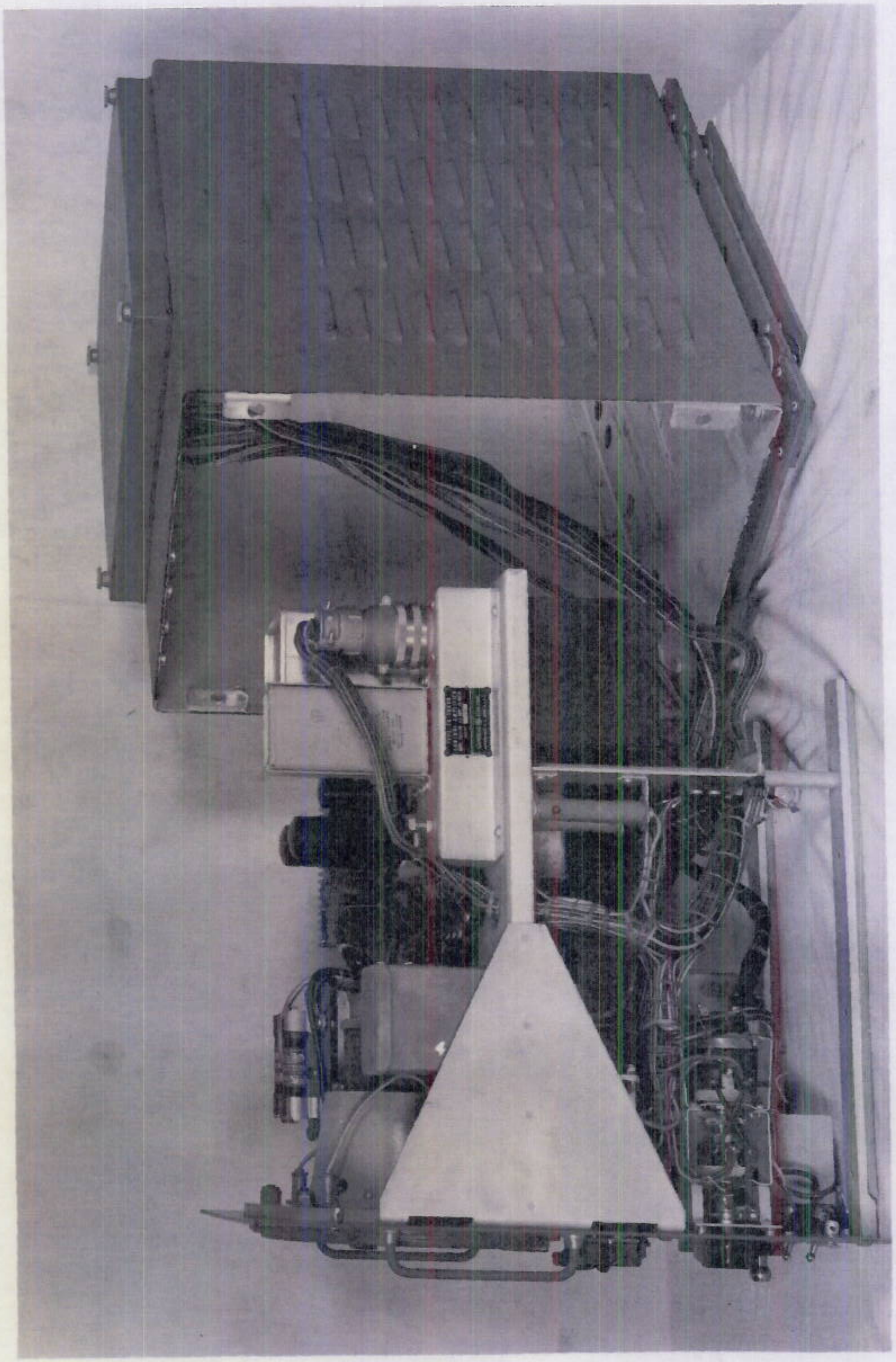

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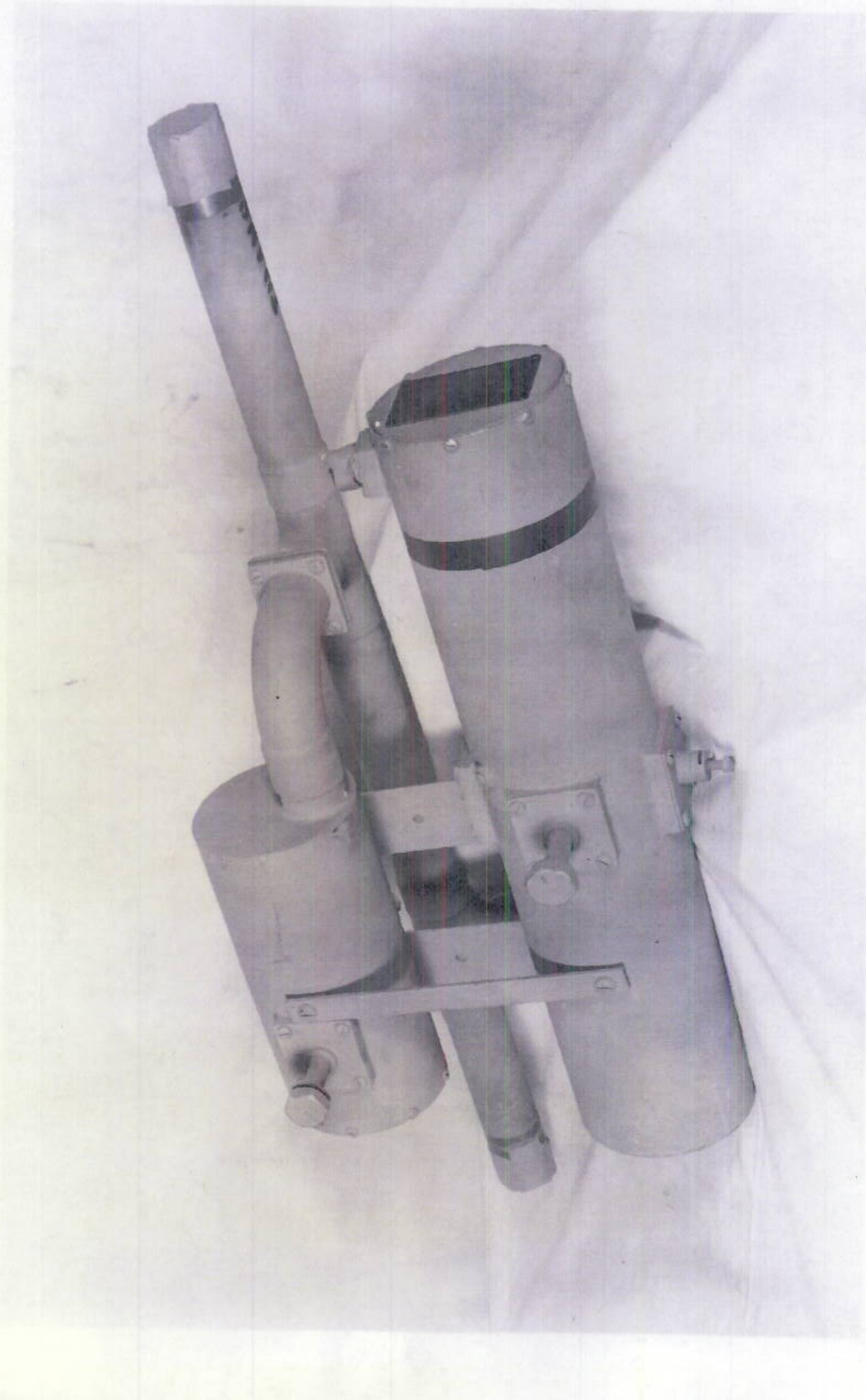

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PLATE II SEC.2

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PLATE 12 SEC. 2

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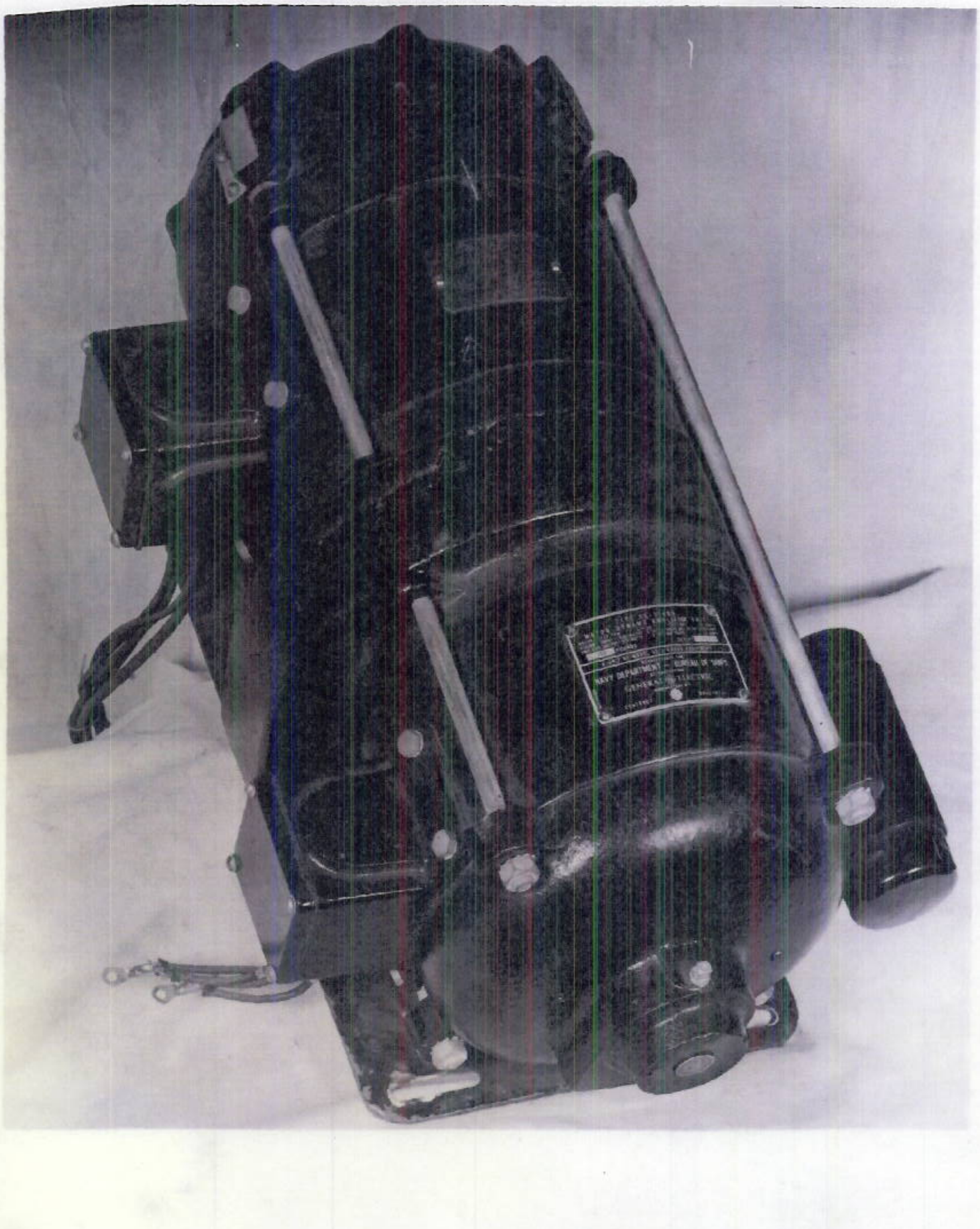

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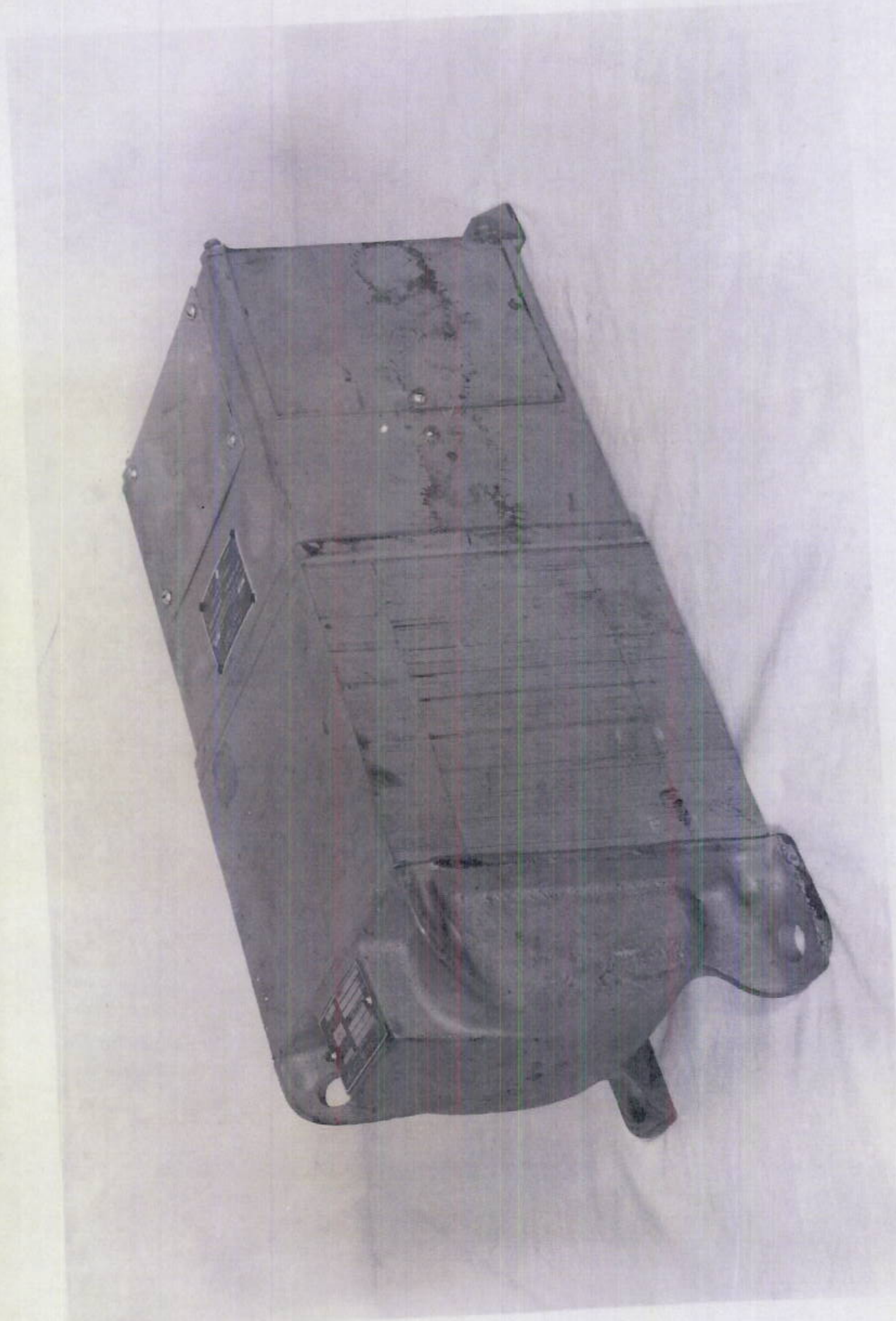

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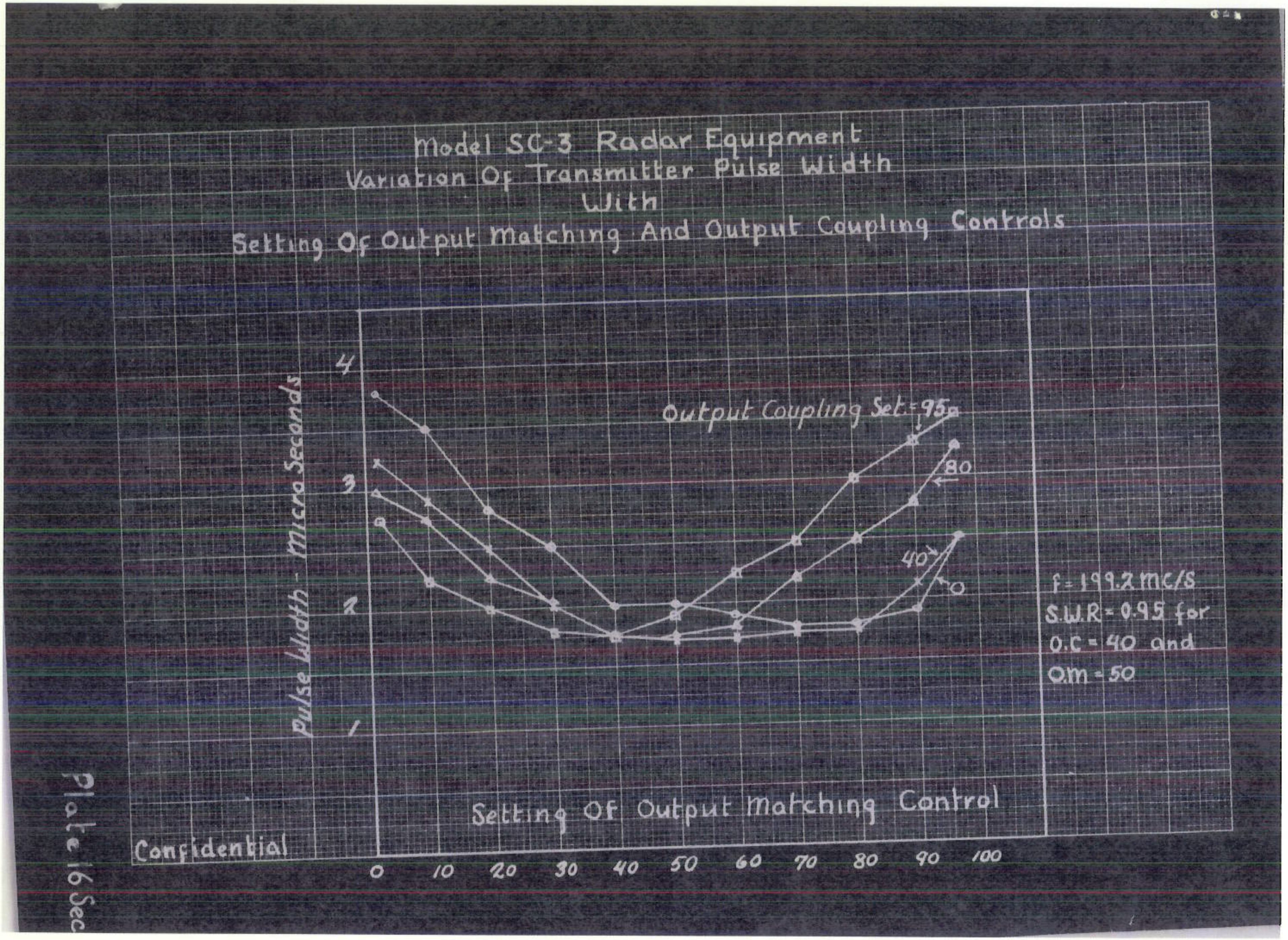

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