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SUBJECT

Test of Model YG Homing Beacon Equipment

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NAVY DEPARTMENT

Report on
Test of Model YG Homing Beacon Equipment

Contractor:
RCA Manufacturing Company

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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AUTHORIZATION

1. The tests herein reported were authorized in reference (a). As far as practicable, tests were conducted in accordance with reference (b).

Reference: (a) BuShips ltr S67/52(480H) of 13 February 1942.
(b) BuShips Specification RE 13A 528B.

OBJECT OF TESTS

2. The object of the tests was:

(a) To determine the performance characteristics of the Model YG Transmitter.

(b) To determine the ability of the transmitter to maintain satisfactory operation under the rigors of the Naval Service.

(c) To examine the equipment for suitability of design and correspondence with standard Naval radio specifications.

(d) To ascertain what modifications are necessary to make the transmitter conform to standard specifications and to insure satisfactory operation under Naval service conditions.

(e) To gather data necessary to facilitate the preparation of specifications for the purchase of similar equipment.

ABSTRACT OF TESTS

3. The tests to determine the suitability of the transmitting equipment in the phases outlined above were conducted as follows:

(a) Performance Characteristics.
(1) Measurements were made to determine the power recuired from the supply line, the power output under various conditions, and the frequency ranges of component circuits.
(2) Frequency stability of the carrier frequency and the modulator frequency was measured under the following conditions of temperature and humidity:

[redacted]

(a) Constant ambient conditions (two-hour locked key test).
(b) Ambient temperature variable from -28°C to +50°C, with low relative humidity.
(c) Variable relative humidity up to 97%, with 40°C ambient temperature.

(3) Frequency stability was measured under the conditions of inclination, vibration, and shock.
(4) Frequency stability was measured with ±10% variation of supply line voltage.
(5) The effect of changing vacuum tubes was determined.
(6) Frequency stability was measured under the conditions of continuous and intermittent keying of the modulation.
(7) The operation of the monitor was observed and its audio output measured.
(8) The quality of the emitted signals with respect to lilt, key clicks, and undesirable modulation was investigated.
(9) The accuracy of reset was determined.
(10) The effect of lost motion, backlash, and torque lash was determined.
(11) The per cent frequency variation per division of the modulator oscillator dial was measured.
(12) The vacuum tube potentials and currents were measured and compared to ratings.
(13) The range of control of the filament and plate rheostats was determined.
(14) The frequency deviation with variation of the power output control was measured.
(15) The regulation and the per cent ripple of the power supply were measured.
(16) The accuracy of reading of the wavemeter was determined.

(b) Ability to maintain satisfactory operation under the rigors of the Naval Service:

(1) Vibration, shock, and inclination tests were performed.
(2) High and low temperature and humidity tests, including a high humidity standby test, were performed.
(3) The ability of the equipment to withstand transportation was considered.
(4) The operation of the protective devices was investigated.

[redacted]

(c) The equipment was examined to determine the suitability of its design features and the degree of compliance with the governing specifications as follows:

(1) Dimensions and weight.
(2) Controls, meters, and nameplates furnished.
(3) Check of resistors for rating and dissipation during normal operation.
(4) Check of protective devices provided.
(5) Check of mechanical and physical construction and assembly, general workmanship, materials employed, corrosion resisting measures used and the adeouacy of electrical circuits to withstand operation under Naval service conditions.

[redacted]

CONCLUSIONS

1. The Model YG Homing Beacon Equipment was constructed by the R.C.A. Manufacturing Company using as a guide the drawings of the Laboratory-developed Model XAX Homing Beacon Equipment. In some instances component parts of the XAX Equipment were duplicated in the Model YG Equipment; however, this duplication was not compulsory, since it was necessary only that the outline and the general principle of the Model XAX Equipment be duplicated.

2. In order that the equipment be produced in a minimum of time, it was necessary that immediately available commercial components be used wherever possible. As a result, many commercial items, not Navy approved, were used in the Model YG Equipment.

3. From the data obtained during the tests, and the investigation of the equipment and its component parts, it is concluded that certain of the commercial components must be replaced by suitable units before the equipment meets the usual standards required in the Naval Service. None of the questionable components caused the transmitter to be completely inoperative during the tests, though it was necessary, in the case of the time delay relay, to bypass its contacts and provide manual time delay between closing of the power switch and closing of the plate switch.

4. In some details the quality of the engineering was not as high as is desirable on Navy equipment. The use of a filament transformer with too low a voltage output and with insufficient insulation, and the incorrect connection of the rectifier tubes, are examples of poor engineering, as is also the lack of sufficient insulation between the p-a variometer high-voltage and the r-f pick-up loop.

5. The accessibility of the Model YG Transmitter is, in general, good. The mounting of the modulation monitor chassis is, however, an exception. As noted in this report, the chassis is secured in the transmitter in such a manner as to require a major disassembly job in order to place it in a position which would permit access to the parts on the under side of the chassis. Later models of the YG equipment have been improved in this respect by the use of nut plates.

6. The power output of the equipment is equal to that of the Model XAX Laboratory Unit, and the general operation of the oscillator and the modulator unit was found to be satisfactory. However, the modulator p.a. did not tune to 3 per cent beyond the specified low-frequency range.

[redacted]

7. The frequency stability of the super-frequency oscillator has proved satisfactory during the various flight tests which were performed. By comparison with transmitters in the usual high-frequency communication channels, the stability is poor. It should be noted that high stability of the super-frequency oscillator is not necessary, since the receiver used must have sufficient band width to accept the 540 to 830 kc modulation, and since the beat reception is at the 540 to 830 kc frequencies.

8. As a result of the original tests, it was concluded that the equipment is sufficiently rugged to withstand the rigors of Naval service conditions, since no damage was incurred during the customary inclination, vibration, and shock tests. Subsequent to the tests herein reported, the equipment has been subjected to vibration tests of an extended duration and these have caused the breakage of the mounting of the rectifier plate transformer. It will be necessary to provide an improved mounting for this item, and it will be advisable, also, to similarly improve the mounting of the rectifier filter reactor.

9. With the exception just noted, the mechanical construction of the Model YG Transmitter is rugged and should withstand normal handling and operational conditions. The wiring presented a neat appearance, and the overall workmanship is good.

10. Tuning may be satisfactorily accomplished, since an adequate number of controls have been provided. As noted herein, the addition of a grid current meter will facilitate the adjustment of the super-frequency oscillator.

11. In general, following the correction of the defects enumerated in this report, the Model YG Equipment should perform satisfactorily under the rigorous conditions of the Naval Service. Flight tests have demonstrated that it performs the function of providing satisfactory homing beacon signal. Correction of the defects enumerated should improve the equipment so that it will provide normal operation for a satisfactory length of time.

[redacted]

RECOMMENDATIONS

It is recommended:

(1) That care be taken to insure that retainer springs are not omitted from the rest knob of the overload relay. Par. 19(1).

(2) That care be exercised to provide secure welding of the chassis stops. Par. 19(2).

(3) That the carrying case for the wavemeter be improved to prevent breakage of the mounting, damage to the charts and the instrument, and leakage of moisture and liquid past the gaskets. Par. 19(3).

(4) That the manufacturer provide a more thorough cleanup of the equipment prior to shipment. Par. 19(4).

(5) That meters of required accuracy be provided. Par. 23(1).

(6) That Navy approved capacitors be supplied in the equipment, and that the use of the Erie Resistor Corp. Model N50HS ceramic capacitor be approved as applied in the subject equipment. Par. 23.

(7) That the use of black bakelite for the shaft of the trimmer capacitor and for the coupling coil support be permitted. Par. 23(8).

(8) That the resistor mounting board be improved as noted, and that all parts made of the cloth insert type of bakelite be impregnated with a suitable wax to eliminate the absorption of moisture. Par. 23(10).

(9) That the disc and slip ring assembly of the modulator oscillator and modulator power-amplifier variometers be modified to provide at least 1/8 inch of creepage distance for the rotor potential. Par. 23(10).

(10) That greater insulation be provided between the frequency meter coupling loop and the high voltage on the modulator power-amplifier variometer. Par. 23(11).

(11) That a filament transformer which has satisfactory insulation and has sufficient output to maintain 2.5 volts at the terminals of the rectifier tubes when rated voltage is applied to the primary be provided for the plate rectifier. Par. 23(13) and 44.

[redacted]

(12) That the overload relay be adjusted so that its variable adjustment permits a setting for trip-out at 125 per cent of the normal current that it carries; that the latch spring be made of more resilient material; and that a stop be provided to prevent excessive downward motion of the reset latch lever. Pars. 37 and 79.

(13) That resistors not treated with wax be employed. Par. 41.

(14) That the notation "6.3V" be added to the nameplate for the filament voltmeter. Par. 51.

(15) That components be marked with Navy type numbers. Par. 55.

(16) That nut plates, accessibly arranged, be provided to permit easy removal of the modulation monitor. Par. 62.

(17) That the 22-ohm Ohmite Model J Filament Rheostat be replaced by a 50-ohm Model J Rheostat, and that the filament transformer be altered to provide normal filament voltage at reduced line voltages. Pars. 65 and 68.

(18) That a satisfactory time delay relay be substituted for the one now in use. Par. 78.

(19) That at least 3 per cent overlap be provided in the plate circuit of the modulator power amplifier. Par. 83.

(20) That a filter be provided to absorb the inductive kick from the keying relay and prevent the creation of radio interference from this source. Par. 88.

(21) That calibration charts of improved durability, particularly with respect to moisture, (such as sheets of milk white, rough surfaced plastic) be provided. Par. 120.

(22) That individual metering of the grid and plate circuits of the type 8025 tubes be provided. Par. 130.

(23) That a dull nickel finish be used on the door hinges and that bright reflecting surfaces be generally avoided; that door hinges be of non-ferrous material; and that care be taken in the assembly to install door stops correctly. Par. 146.

(24) That the r-f output for calibration purposes be adjusted to between 15 to 750 millivolts. Par. 152.

[redacted]

(25) That the positive output of the plate supply rectifier be connected to the cathode of the rectifier tubes rather than to the center tap of the filament transformer. Par. 157.

[redacted]

MATERIAL UNDER TEST

4. The material under test consisted of a Type CRV-52244 Model YG Transmitter Unit, Serial Number 6, and a Model CRV-60028 Frequency Meter, Serial Number 6. This equipment was manufactured by the R.C.A. Manufacturing Company under Contract NXs-820-A. A box of spare parts, including also a copy of the preliminary instructions, was included with the equipment.

5. The following vacuum tubes, also of R.C.A. manufacture, were received with the equipment:

2 - 807	No serial numbers.
2 - 836	No serial numbers.
1 - 6K8	No serial number.
2 - 8025	Serial numbers 724 and 743.

METHOD OF TEST

6. The equipment was uncrated and examined carefully immediately upon its arrival. Certain items of damage and of unsatisfactory design were noted.

7. Dimensions and weights were obtained and recorded.

8. Meters were calibrated and resistors were checked using Laboratory standards.

9. Tubes were installed in the transmitter and power applied in accordance with the preliminary instructions which were supplied with the equipment.

10. The frequency ranges of the super-frequency oscillator, the modulator oscillator, the modulator power amplifier, and the modulation monitor were determined. The frequency ranges of the super-frequency trimmer capacitor and the modulator oscillator trimmer capacitor were measured. A Laboratory constructed frequency meter was used for frequency range measurements at the super-frequencies, while the Model LM Frequency Meter was used for frequency range measurements on the modulator. The modulator oscillator and the modulation monitor were calibrated using the Model LM Frequency Meter.

11. Power output was determined by the comparison method using a photometer to measure the intensity of light from a lamp used as the dummy load. This intensity was then duplicated using 60-cycle power measured with a wattmeter. Power output was measured at the end of the four-foot section of flexible coaxial line which forms the output connection of the transmitter, and also after transmission through 190 feet

[redacted]

of 7/8-inch O.D. isolantite-insulated coaxial line. A half-wave concentric line type of matching section was used to match the lamp load to the transmission lines.

12. Frequency stability was measured at the super-frequencies by means of the type CRV-60028 frequency meter, and at the modulator frequencies by means of the Model LK Drift Indicator. Certain of the stability tests were performed using a Laboratory-developed Super-Frequency Drift Indicator. For the first stability tests the transmitter was placed in operation at normal room conditions, with key locked (modulation on). The carrier frequency, the modulation frequency, the power output and the set meters were observed during these runs. The various other stability tests at constant ambient conditions were then performed. Following these tests, the equipment was installed in the temperature control room and the frequency stability observed under the conditions of varying temperature with low relative humidity, varying humidity with constant temperature, and at very low temperatures. Three tests were conducted to determine the effect of variation of the ambient temperature upon the carrier and the modulation frequencies. For the first of these the equipment stood idle while the room temperature was reduced to -28°C (-18°F). The transmitter was then placed in operation, key locked, and data recorded on the carrier and modulation frequencies and the power output. Line voltage, plate supply voltage, filament voltage, and super-frequency oscillator plate current were observed during the tests. The temperature was maintained at -27.8°C for slightly over an hour and then raised to 0°C and maintained at that point for 40 minutes. It was then raised to 20°C and maintained there for 30 minutes, and then raised to 40°C and maintained for 45 minutes. The final step was to 50°C, and this temperature was maintained for two hours. For the second test, the room temperature was raised to 50°C, and the equipment again placed in operation. The temperature of 50°C was maintained for two hours and then dropped to 25°C, where it was held for 80 minutes. It was then dropped to 0°C and maintained at this value for two hours. A modulation frequency of 550 kc was used during these first two temperature tests. For the third temperature test the room ambient was again reduced to -28°C. The equipment was then placed in operation, using a modulation frequency of 800 kc. The temperature was maintained at -28°C for one hour and 50 minutes, when it was raised to 0°C and maintained there for one and one-half hours. It was then raised to 25°C and maintained there for one and one-half hours. It was finally raised to 50°C and maintained there for one and one-half hours. Two tests were conducted to determine the effect of variation of relative humidity. During one a modulation frequency of 600 kc was used, while for the other a modulation frequency of 800 kc was used. For these tests the equipment was placed in operation at a temperature of 40°C and a relative humidity of 17 to 20 per cent. These conditions

were maintained for one-half hour, and then changed to 40°C and 95 per cent relative humidity and maintained there for one hour. The initial conditions were then resumed and maintained for one-half hour. Following the normal humidity tests, a high humidity standby test was performed in which the equipment was first operated for one-half hour at 40°C and 20 per cent relative humidity and then shut down except for the set heater unit. The humidity was then raised to 97 per cent and maintained there for one hour, when the transmitter was started and the carrier and modulation frequencies measured. The entire equipment was then shut down, including the heaters, and the humidity maintained at 97 per cent for a period of two hours, when the set was again turned on just long enough to measure the frequencies of the super-frequency oscillator and the modulator. The equipment was again shut down and the temperature reduced as quickly as possible. The relative humidity also dropped as the temperature was reduced, the conditions at the end of the run being 19.5°C and 66 per cent relative humidity. During these tests the lamp load and matching section were located outside the temperature room and connected to the transmitter through a section of 7/8-inch O.D. copper-isolantite transmission line. The type CRV-60028 frequency meter and the photometer unit therefore remained at room ambient conditions during the tests. The Model LK Drift Indicator, located outside the temperature room, was connected to a circuit which was loosely coupled to the modulator power amplifier.

13. Following the temperature room tests, the transmitter was bolted to the deck of the test table used for inclination, vibration, and shock tests. For the inclination test the table was inclined to 45 degrees each side of vertical at a rate of 5 cycles per minute to simulate the effect of roll and pitch of a ship. The table was then vibrated in a vertical direction at frequencies from 0 to 2000 cycles per minute. Following the vibration tests, shocks were administered to the test table by a pneumatic device which imparts a momentary peak acceleration of 250 g to the table. During the above tests under the conditions of vibration and shock, the matching section and the lamp load were suspended above the set, while for the inclination test they were secured to the transmitter. In each case they were connected to the transmitter by the flexible output cable.

14. Measurements of the accuracy of reset, the effect of lost motion and backlash and the effect of change of vacuum tubes in the modulator-oscillator and power amplifier were made using the Model LK Frequency Drift Indicator. The quality of the emitted signal was checked during the tests using a Navy Type ZB-RU Receiver.

[redacted]

15. The voltage regulation of the power supply and the per cent ripple present in its output were measured using suitable Laboratory type meters. The transmitter was used in normal operation while these data were taken. Regulation was taken from key up to key down, while ripple was measured under both of these conditions.

16. Terminals are provided for the deliver of r-f voltage at the modulation frequency to a remote frequency meter. This voltage, available for calibration of the frequency of the modulator, was measured using a General Radio Type 726A Vacuum Tube Voltmeter. A three-foot section of shielded cable terminating in a 70-ohm non-inductive resistor was connected to the "Calibrate" terminals. The voltage across the resistor was then measured. A Laboratory constructed voltmeter was used to measure the voltage available at the outlet for the plug of the type CRV-60028 wavemeter.

DATA RECORDED

17. The data recorded during the tests are included in the plates and tables appended to this report.

PROBABLE ERRORS

18. Precautions were taken to minimize errors in the results obtained during the tests. Where necessary or desirable, duplicate tests were conducted to insure a greater degree of accuracy or to confirm results already obtained. The Model LK Drift Indicator may be read to two-cycle accuracy, while the Model LM Unit has a measuring accuracy of 0.02 per cent in the range used. Measurements of the carrier frequency are accurate to about 0.01 per cent. D-c and 60-cycle a-c measurements are accurate to 1 per cent, while r-f power measurements are accurate to 10 per cent.

RESULTS OF TESTS

Inspection

19. The inspection of the equipment upon its arrival disclosed the following items:

(1) The bakelite knob on the reset lever of the overload relay had fallen off. This knob ordinarily has in it a spring which prevents its dislocation from the relay; this spring was missing from the subject relay. The manufacturer's inspection should have discovered and corrected this item.

[redacted]

(2) The square stop on the right hand guide runner for the r-f chassis broke off when this unit was withdrawn from the cabinet for the first time. Secure welding of this item is necessary.

(3) The circular wooden form in which the side of the CRV-60028 frequency meter bearing the transmission line coupling rests when in the carrying case was broken on one end. Separate buffer blocks are needed to prevent end motion of the meter in the case and clamps are required to prevent the meter from falling out when the case is opened. Clamps also are needed to secure the calibration charts from movement during transportation. It was noted that the rubber gasket used to seal the lid of the carrying case to the main portion did not close tightly; several open spaces were visible between the gasket and the surface to be sealed. Better workmanship is required.

(4) A collection of brass cuttings was found on the r-f chassis runner. Better clean-up and inspection is needed prior to shipment.

20. The Model YG Equipment was constructed on Contract NXs-820 and its design in general follows that of the Model XAX Equipment built by the Naval Research Laboratory. The Model XAX Equipment was designed to perform the same functions as the Model YE Equipment, but was to be small, of easily portable size and weight, and was to require manual operation of some of the features which were automatic in the Model YE Equipment. Specifications RE 13A 528B for the Model YE Equipment, therefore, cover an equipment somewhat comparable to the YG and, since no specifications for the latter transmitter are in existence at this date, these will be used as a basis of comparison throughout this report. Paragraph references which follow refer directly to Specifications RE 13A 528B.

21. The antenna, antenna drive unit, and control unit which go to make up the complete YG Equipment are not treated in the main body of this report. Information regarding the construction and operation of these items may be found in Appendix A attached hereto.

SECTION I - INTRODUCTORY

22. Par. 1-1 to 1-3, inclusive. The general construction and design of the Model YG Transmitting Equipment conforms with the Introductory Section of the Specifications. The equipment is complete with vacuum tubes, and the trans-

[redacted]

mitter unit is capable of taking 60-cycle 115-volt power from the power mains and delivering modulated super-frequency power to the transmission line. The super-frequency oscillator may be adjusted to any frequency from 215 to 290 mc, with a carrier power of 24.5 watts at 215 mc, 21.6 watts at 246 mc, and approximately 16 watts at 290 mc. The modulator is capable of 70 to 80 per cent modulation of the carrier over the range from 540 to 830 kc. The super-frequency oscillator, modulator, and modulator heterodyne monitor are contained in one chassis, while the high vacuum rectifier which supplies plate power is contained in a separate chassis.

SECTION II - GENERAL

23. Par. 2-2. The components which go to make up the complete assembly were examined, with the following results:

Indicating Instruments

(1) All electrical indicating instruments used in the equipment bear Navy type numbers. The meters were calibrated against Laboratory standards and, as shown in Table 4, one of the five instruments failed to meet an accuracy of 2 per cent of full scale.

Capacitors

(2) The transmitter employs 44 capacitors, four of which bear Navy type numbers. These four are the tank capacitor of the modulator power amplifier and the three meter bypass capacitors. Sixteen of the remaining 40 capacitors are 315 µµf ceramic capacitors manufactured by the Erie Resistor Corporation. These capacitors have performed satisfactorily during the tests, and are operating well within their voltage rating. This application is an interesting substitution of ceramic capacitors for the usual mica dielectric type. Available space and the desirability of zero temperature coefficient capacitors made this substitution desirable from a design as well as an emergency war-time condition standpoint. It, therefore, is recommended that the use of the Erie Resistor Corporation Model N50HS ceramic capacitor be approved as applied in the subject equipment.

(3) Ten of the remaining 24 capacitors are rated 0.01 µf, working voltage 1200 volts d.c., of Faradon manufacture, designated Model NF. These bear no Navy type number.

[redacted]

(4) Four of the remaining 14 capacitors are air dielectric tuning capacitors, and two are General Electric Pyranol capacitors, Type 23F16-X.

(5) Three electrolytic capacitors, Cornell Dubilier Type UP1AJ57, rated 10 µf, 450 volts d.c., are used in the modulator monitor.

(6) Four postage-stamp type mica capacitors are used in the modulator monitor.

(7) One 0.5 µf, paper, oil-filled capacitor, marked P-72049-507, is used in the power unit as a spark suppressor.

Insulating Materials

(8) Insulating materials, where used in the field of the super-frequency oscillator, are of mycalex, except for the shaft of the oscillator trimmer capacitor and the support for the coupling loop, which are of black bakelite. Although no direct contact with metal carrying the 246 mc voltage exists in the former case, the dielectric stress is high. Contact does exist in the latter case, but the voltage is normally quite low. The use of bakelite in these instances is believed necessary in order to secure rugged construction; since satisfactory operation has also been observed, it is recommended that the use of bakelite be permitted in these applications. As a matter of record, the YG transmitter, when received, was equipped with a cloth insert, light brown bakelite shaft for the super-frequency oscillator trimmer capacitor. The dielectric stress was sufficient to blister this material and a substitute shaft made of black bakelite was supplied. Thereafter, no subsequent tendency to blister was noted.

(9) Bakelite is used in other places throughout the equipment for physical support, for d-c insulation, and also for insulation at the modulation frequencies; namely, 540 to 830 kc. Light brown bakelite of the cloth inserted type is used as a mounting base for the bleeder resistors and several voltage dropping resistors. The resistors are mounted clear of the bakelite by hexagonal metal pillars 5/8-inch long. The greatest potential gradient on this resistor mounting base exists between resistors R-112 and R-115. Here the 300-volt d-c potential difference between the

two resistors is separated by 9/32 inch of bakelite. This spacing exists between the strips which are used to interconnect the resistors and which are located on the back of the board. This spacing and potential difference represents a voltage gradient of 1007 volts per inch. Trouble has been encountered in the past with leakage through bakelite of the cloth base type. It is recommended, therefore, that this gradient be reduced by either of the following means:

(a) Mounting of R-115 clear of the board on ceramic insulation.

(b) Rearranging of resistors R-105, 111, 112, 113, 114, and 115 in such a manner as to reduce the gradient to less than 500 volts per inch. It is further recommended that all parts made of cloth-base bakelite be dipped in a suitable wax to minimize moisture absorption.

(10) A point of high gradient exists in the insulation of the collector rings of the modulator oscillator and modulator power-amplifier variometers. The rotors of these units are constructed with a metal shaft extending from the coupling end to the rear bearing. One rotor connection is carried by the shaft itself to a brush on the coupling end of the variometer, while the other connection is carried through the hollow rear portion of the shaft. This connection is insulated from the rotor shaft by a section of black spaghetti tubing. A cylindrical slip ring is mounted on a bakelite disc on the rear end of the shaft and the rear rotor connection is soldered to this slip ring. The spacing between the slip ring and the rotor shaft is approximately 1/16 inch. In the case of the modulator power-amplifier variometer, there is present an r-f potential of 110 to 120 volts r.m.s. at the point in question. This is considered to be too great a voltage for safe operation, particularly where portable equipment is concerned. Such equipment may stand idle in a humid atmosphere, with no power available for considerable periods. It is recommended, therefore, that the disc and slip ring assembly be modified to provide at least 1/8 inch of creepage distance.

Another instance of unsatisfactory insulation exists in the case of the r-f pickup loop on the modulator power-amplifier variometer. The voltage from this loop is delivered to the terminal board for connection to a remote frequency meter. In this case a spacing of only 1/16 inch exists between the bare metal of the loop and the high potential side of the modulator power-amplifier variometer. This point on the variometer carries full plate voltage (640 volts d.c.) plus the r-f output voltage of the modulator power amplifier. The voltage is sufficient to present a considerable hazard to personnel, in the event that they should come in contact with the r-f coupling at the remote frequency meter.

(12) Mycalex insulation is used to support the large banana plugs and jacks used to interconnect the power unit and the main chassis. Creepage distance at this point is 3/16 inch, resulting in a gradient of about 3400 volts per inch. It is believed that this gradient is sufficiently low to permit satisfactory operation.

(13) The transformer for the heaters of the plate rectifier vacuum tubes (type 836) is not provided with sufficient insulation to ground at the 2.5-volt secondary terminals. These terminals operate at somewhat greater than 640 volts d.c. above ground; yet, the distance from the terminal across the bakelite terminal board to ground is only 1/8 inch. This corresponds to a gradient of over 5200 volts per inch. Ceramic insulation of sufficient size should be used for these terminals. As noted in paragraph 44, the transformer is also unsatisfactory with respect to its output voltage.

Vacuum Tubes

(14) The vacuum tubes used in the Model YG Equipment are all included in the Navy approved list of 15 October 1942. A list of the vacuum tubes and their conditions of operation is presented in Table 6. All tubes are operated conservatively (except the filaments of the 836 rectifiers), and satisfactory tube life should be experienced.

Resistors

(15) No resistors of the vitreous enamel type are used in the Model YG Transmitter. One and two-watt composition resistors, Navy types -63288 and -63474, are used where these power ratings are appropriate. One 1/4-watt composition

[redacted]

resistor, not provided with a type number, is used in parallel with a space wound coil as a parasitic resistor for the super-frequency oscillator. Composition resistors of 5-watt rating, having no Navy type number, but with a manufacturer's designation (from Preliminary Instruction Book) of type D5-ST2A are used in the bleeder and voltage divider resistor bank. The results of the current and resistance checks made on the various resistors of the YG transmitter are shown in Table 5. It might be noted that two of the resistors are operating near their maximum ratings; namely, the self-bias resistor of the super-frequency oscillator, symbol R-117, with a dissipation of 3.98 watts, and bleeder resistor R-109, with a dissipation of 4.49 watts. Both of these resistors are rated at 5 watts. Comparison of the measured resistance values with the rated values discloses that all are within their tolerance rating.

Power Equipment

(16) Two filament transformers, a rectifier plate transformer, and a filter choke comprise the main elements of the YG power equipment. These units have no Navy type numbers. They appear to be of good commercial quality, are manufactured by Thordarson and are mounted in their "Style 2U" case; however, as noted in paragraphs 23-(13) and 44, the rectifier filament transformer was found to be unsatisfactory in voltage output and insulation.

Thermometers, Thermostats

(17) There are no thermometers used in the Model YG Transmitter. One thermostat is used to control the maximum temperature to which the heater unit R-203 will raise the power unit. This unit bears only the manufacturer's marking "L120-1, D2" and is manufactured by the Spencer Company.

Replacement Parts

(18) At the present time the only producer of the type 8025 tube used in the super-frequency oscillator is the R.C.A. Manufacturing Company. The 8025 was developed by R.C.A. from their type 8012 to meet the special needs of the YG transmitter.

[redacted]

(19) All other items of the YG transmitter are either of standard design already duplicated by other companies, or are possible of duplication. The "Ceramicons" used in the modulator oscillator tank circuit could be replaced by standard mica dielectric capacitors if the need arose. Frequency stability under variation of ambient temperature quite possibly would not be as good when using a standard mica dielectric capacitor, but power output would be unchanged.

24. Par. 2-3. In general, the YG transmitter is of rugged construction. Light weight aluminum alloys are used for the frame, the three chassis assemblies and the side shields. The two mounting strips which bolt to the deck and to which the shock mountings are secured are of steel. Cadmium plated steel thumb nuts are used on the side shields.

25. Par. 2-3-(1). The sliding contacts of the variometers, the keying relay, and the overload relay contacts appear heavy enough for many cycles of operation. No troubles attributable to poor contacts were encountered during the test period.

26. Par. 2-3-(2). There are no multiposition switches used in the YG transmitter. The contacts of the test switch are of the self-cleaning type. The power line switch, the plate switch and the heater switch are the ordinary commercial type of snap switch. These all operate at 115 volts, 60 cycles, a.c., except the heater switch, which operates on d.c. when only d-c power is available to energize the heaters during stand-by periods.

27. Par. 2-3-(3). Three variable resistors are used in the Model YG Transmitter. These are the filament and plate transformer primary series rheostats and the modulator monitor gain control. The former are wire wound, of "Ohmite" manufacture. The latter bears the marking V11926-284, 75,000 ohms, and is apparently not wire wound. This resistor, however, is to be eliminated on future production models of the YG, in accordance with Laboratory recommendations contained in separate correspondence.

28. Par. 2-4. Workmanship is of good quality.

29. Par. 2-5. The equipment operated continuously and satisfactorily during the tests at temperatures from -28°C to +50°C, and also at 40°C with a relative humidity of 95 per cent.

[redacted]

30. Par. 2-6. Following the humidity tests, it was noted that several taper pins showed evidence of rust. It is recommended that taper pins be of non-magnetic corrosion resisting steel as required by BuShips Specification RE 13A 554D. Set screws used in the control knobs appear to be of rust resistant steel. As noted in paragraph 24, the steel thumb nuts of the side shields are cadmium plated.

31. Par. 2-7. The use of iron or steel has been kept to the practicable minimum.

32. Par. 2-8.

(1) The r-f coil forms in use are made of bakelite; the coils operate at frecuencies below 2000 kc.

(2) Ceramic insulation is used on the variable capacitors except in the case of the super-frequency oscillator trimmer capacitor. This exception is noted above in paragraph 23-(8).

(3) Tube sockets are of ceramic material.

(4) The bleeder resistor bank is mounted on a bakelite board as noted in paragraph 23-(9) above. Resistor R-115, mounted on this board, carries 640 volts on one terminal.

33. Par. 2-9. No wood is used in the construction of the Model YG Transmitter. However, wood is used in the construction of the carrying case for the type CRV-60028 frequency meter. The carrying case is protected by a coat of gray lacquer. It was impossible to determine, in the short period covered by the tests, whether the construction would satisfactorily withstand humidity and temperature changes over extended lengths of time.

34. Par. 2-10 - General. In general, the design of the electrical circuits is liberal. Circuits which are liable to carry overloads are properly protected.

35. Par. 2-10-(1). The four fuses used in the YG transmitter are listed in Table 38. Their ratings and normal maximum currents are also listed. It is seen that they are of the renewable link type, rated 250 volts, 10 amperes, and that they are operating at about half of normal rated current. The bakelite fuse block is engraved in white letters, "250V, 10 Amp."

36. Par. 2-10-(2). No fuses are provided in the high voltage circuits.

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37. Par. 2-10-(3). An overload relay is provided in the negative lead of the 640-volt plate rectifier. Some trouble was experienced in adjusting this relay due to improper spring tension adjustments which existed when the relay was received. Once adjusted in this respect, further adjustments for operation at 125 per cent of rated current were easily made by means of a resistor which is connected in parallel with the relay current coil.

38. Par. 2-11. As noted above, one overload relay is provided. Protection for the individual vacuum tubes is afforded by series protective resistors in the cathode circuits, or in the case of the modulator oscillator tube, by series plate and screen resistors large enough to limit the current to safe values.

39. Par. 2-12. All external parts are at ground potential when the equipment is in operation. No interlocks are provided on the access doors--these were omitted in order to simplify the design and construction of the equipment. A red warning plate is attached to the tube access door of the power unit with the notation, "Voltages used in this equipment are dangerous to life. Before opening door or withdrawing chassis, set 'Line' switch in 'off' position."

40. Par. 2-13. Ample provision has been made for all necessary ventilation and cooling.

41. Par. 2-14. No evidence of the presence of a compound which would flow at temperatures below 75°C was noted during the tests except for resistor R-109, which showed a collection of wax on the lower end following the runs in the temperature room. It is suggested that resistors not treated with wax be employed.

42. Par. 2-15. No evidence of undue heating, brush discharge, corona, or sparking was discovered during the tests.

43. Par. 2-16. The antenna was short circuited, open circuited and grounded during the tests, without damage.

44. Par. 2-17. No failures of vacuum tubes occurred during the tests of the Model YG Transmitter. Conditions of operation of the various tubes are shown in Table 6. It is seen that the heaters of the type 836 high vacuum rectifier tubes are operating 6 per cent below their rated potential. This is an unsatisfactory condition of operation. An inspection of the markings on the transformer disclosed that its secondary is rated at 2.5 volts, while the primary is tapped for 105, 110, and 115 volts. There were no current markings. Since the 836 tubes normally draw 10 amperes at 2.5 volts, a

[redacted]

10-ampere load was applied to the secondary. The terminal voltage, with 110 volts applied to the 110-volt primary tap, was then 2.42 volts or 3.2 per cent below the rating. Since the voltage drop in the leads is approximately 0.10 volt, the tubes receive only 2.32 volts when 110 volts is applied to the 110-volt primary tap. The transformer, therefore, not only does not deliver its rated voltage, but also is unsatisfactory in that the rated voltage is not equal to the sum of the tube rating and the drop in the leads. It is recommended that a suitable transformer be substituted for this unit. As noted above in paragraph 23-(13), the insulation of the transformer's terminal board is also unsatisfactory. With the exception of the type 836 tube filament voltage, the other conditions of operation of the various tubes are such that good tube life should be obtained. The Model YG Equipment was subjected to several hundred hours of operation during the test period without noticeable deterioration of the first set of tubes.

45. Par. 2-18. In general, the equipment is designed so that safe operation and satisfactory performance are assured. Such exceptions as were disclosed by the tests are reported herein.

46. Par. 2-19. The equipment operated satisfactorily and without damage when secured to the test table by its base only and inclined up to 45 degrees each side of vertical at a rate of five cycles per minute.

47. Par. 2-20. The equipment withstood without damage the tests performed on the vibration and shock table. These included vibration frequencies up to 1800 cycles per minute, and maximum momentary acceleration tests, 24 in number, of 250 g, 12 imparted towards the left side and 12 towards the rear of the set. Lock washers are used to secure parts against loosening under vibration. No evidence of the use of corrosive soldering flux was discovered; soldering evidently had been done using rosin for the flux. The terminals used are provided with clamps which are crimped onto the wires for mechanical support. Composition washers are used where necessary to absorb stress in ceramic parts.

48. Par. 2-21. The vacuum tubes are not individually shock mounted, since the transmitter unit itself is shock mounted.

49. Par. 2-22. The design and control of the circuits are as simple as is practicable.

50. Par. 2-23-(1). Meters have been placed adjacent to the controls which operate the circuits being metered.

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Since the equipment was designed to use little space, the appearance of the front panel is functional rather than symmetrical. Controls are arranged for convenient operation.

51. Par. 2-23-(2). Nameplates bearing suitably descriptive markings are provided adjacent to all controls and are readable from a distance of several feet. They are of the photo-etched type requiring no filling compound. A list of nameplates is presented in Table 2. It is suggested that the filament voltmeter nameplate be marked additionally "6.3V" to indicate the proper voltage adjustment.

52. Par. 2-24. All control shafts and bushings are grounded for the protection of personnel. The handles used for withdrawing the chassis are rubber covered.

53. Par. 2-25. The plate voltmeter is a 3-1/2-inch diameter bakelite-cased instrument; all other meters are 2-1/2 inches in diameter with bakelite cases. All are equipped with antiglare glass, and are secured to the panel by means of nuts and bolts. Access to the meters is easily attained by withdrawing the chassis from the case. No thermocouple type instruments are used. Appropriate nameplates of the type which covers 120 degrees of the meter rim are used on the YG transmitter. These are convenient and space saving. A list of controls and meters is presented in Table 3.

54. Par. 2-26. The Model YG Homing Beacon Equipment nameplate and the YG transmitter nameplate are secured to the front panel of the transmitter unit. A list of nameplates is presented in Table 2.

55. Par. 2-27. The plate and filament transformers and the plate supply filter reactor and capacitors bear the manufacturer's nameplate, which states only the name of the manufacturer and the manufacturer's type number of the unit. No Navy type numbers are marked on the nameplates. Navy type numbers should be employed in all production equipments to facilitate replacement. The bakelite terminal boards on the tops of the transformers and reactor are engraved with the operating voltages, in the case of the transformers, and with the operating current and inductance in the case of the chokes.

56. Par. 2-28-(1). The spare parts were examined and found to be interchangeable with corresponding parts in the equipment. Components are properly identified by typed tags affixed to the boxes and envelopes containing the individual parts.

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57. Par. 2-29. The equipment could not be examined closely enough to ascertain that all bolts, nuts, screws, etc. were as required except by extensive disassembly. It is assumed that such inspection has been performed at the point of manufacture. No violations of this paragraph of the specifications were noted in the various inspections which were made.

58. Par. 2-30-(1). The three dials of the YG transmitter which are associated with the modulation frequency are numbered so that an increase in the numerical reading results in an increase in frequency. The trimmer capacitor of the modulator oscillator is screwdriver driven and has no stops. Therefore, it may be rotated either clockwise or counterclockwise to increase frequency. The modulator oscillator work circuit capacitor C-132 is also screwdriver controlled and is provided with end stops which prevent more than 180 degrees rotation; it rotates clockwise for increasing frequency. The super-frequency oscillator trimmer capacitor is provided with a slotted shaft for screwdriver control and in this case clockwise rotation results in a decrease of frequency.

59. Par. 2-30-(2). No verniers for dividing dial divisions are used in the Model YG Transmitter.

60. Par. 2-30-(3). The control knobs are securely fastened to their respective shafts. The modulator power amplifier and the modulation monitor tuning dials are each secured by means of one set screw and a taper pin, while all other knobs are fastened to their shafts with two set screws located 90 degrees apart.

61. Par. 2-31-(1). In general, sufficient design tolerances have been provided to accommodate tubes, resistors, etc. having the limiting dimensions permitted by applicable specifications.

62. Par. 2-31-(2). Removal of the modulation monitor, mounted in the transmitter chassis, requires extensive disassembly. This sub-chassis must be removed if components located therein are to be replaced. The sub-chassis is secured by means of bolts and nuts in the present design. It is recommended that nut-plates and screws be used for this purpose in all new production. It is understood that the necessary changes will be made to enable easy removal of the monitor sub-chassis in future production of the Model YG Equipment.

63. Par. 2-31-(3). All toggle and snap switches may be replaced without removing adjacent switches. The leads connecting to toggle switch S-102 are long enough to reach to the side of the chassis and permit unsoldering of the leads.

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While the leads to "Line" switch S-201 may be unsoldered without removing other switches, easier access will be had by first removing, from the mounting bracket only, the heater switch S-202. This requires the removal of only two screws and is easily accomplished. In order to replace any of the switches noted, it is necessary to partially withdraw the chassis from the case.

64. Par. 2-32 and 2-33. The weights of the Model YG Transmitter and the wavemeter, as well as the various dimensions, are shown in Table 1. It is seen that the transmitter may be passed through doors or hatches of the limiting dimensions specified without disassembly.

65. Par. 2-34. It was found possible to operate the transmitter under conditions involving plus or minus 10 per cent variations in the normal line voltage (115 volts) without noticeable damage to the components or the tubes. However, it was impossible to maintain the reading of the filament voltmeter at the normal 6.3-volt reading with line voltage variations beyond the limits of minus 6.1 per cent and plus 7.4 per cent. Similarly, it was impossible to maintain the "key open" plate voltage at 640 volts during variations beyond the limits of minus 6.1 per cent and plus 17.8 per cent. The limitation on the adjustment of the plate voltage is not considered serious, but the inability to obtain the correct filament voltage will force operation under conditions detrimental to tube life. In addition to the changes mentioned in paragraphs 23-(13) and 44, it will therefore be necessary to reduce the turns ratio of the transformer so that normal filament voltage will be available at line voltages 10 per cent below normal. This will, in turn, necessitate the use of a higher resistance rheostat in the primary circuit in order to provide sufficient control at line voltages higher than normal. It is suggested that a 50-ohm Ohmite Model J Rheostat be substituted for the present 22-ohm unit in this application. The effects of voltage change upon the frequency of the superfrequency oscillator and the modulator are discussed in paragraphs 98 and 107.

66. Par. 2-35. Satisfactory symbol numbers marked adjacent to component parts have been provided, and each tube position is marked with the type of vacuum tube required. Resistor symbol numbers and resistance values are marked adjacent to the resistors, but no markings of Navy type numbers are provided.

67. Par. 2-36. The transmitter shock mountings are installed in such a manner as to permit easy replacement.

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68. Par. 2-37. As previously noted, the design of the Model YG Transmitter does not provide sufficient range in the voltage controls to permit maintaining filament and plate potentials at rated values for plus or minus 10 per cent variation of the supply voltage.

69. Par. 2-38. No lifting eyes are provided on the Model YG Transmitter.

70. Par. 2-39-(1). The Model YG Transmitter is provided with a grey wrinkle finish.

71. Par. 2-39-(2). All external surfaces of aluminum or aluminum alloy are painted as noted in paragraph 70.

72. Par. 2-39-(3). The thumb nuts on the transmitter shields are apparently cadmium plated.

73. Par. 2-39-(4). Interior surfaces of aluminum or aluminum alloy appear to have been acid dipped.

74. Par. 2-40. No indicator lights are used on the Model YG Transmitter.

75. Par. 2-41. Capacitors C-301, C-311, and C-312 are of the electrolytic type. They are rated at 10 µf, 450 volts d.c. working voltage. Normal operating voltages are under 200 volts. Two of these are used as additional filter capacitors in the plate supply of the modulation heterodyne monitor, and one is used as a cathode resistor by-pass capacitor.

76. Par. 2-42 and 2-43. Foil-paper capacitors were not disassembled to ascertain their internal construction. Discussion of the capacitors is contained in paragraph 23-(2) through (7).

77. Par. 2-44 to 2-49, inclusive. Transformers and reactors were not disassembled to ascertain their internal construction.

78. Par. 2-50. The time delay relay which is provided in the Model YG Transmitter to permit proper heating of the filaments of the rectifier tubes before application of plate voltage proved to be unsatisfactory. This relay utilizes a coil of resistance wire wound on a bi-metallic strip which carries the time delay contact. Application of power causes the strip to be heated and the contact to close, thus actuating a relay which closes the plate transformer primary circuit and opens the circuit to the heater. During tests on this type of relay, approximately 60 per cent failures occurred, due to

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breakage of the very fine resistance wire of the heater coils. A small vane-type motor-driven relay which has been undergoing tests at the Laboratory will be substituted by the Contractor.

79. The overload relay did not perform satisfactorily when the transmitter was received. It was necessary to alter the armature spring tension and the contact spacing of the relay before operation at 125 per cent of rated current could be obtained. The reset latch spring also required readjustment. The spring is of soft material and is easily distorted if the reset button is struck accidentally. It is recommended that the relay be properly adjusted before shipment, that the latch spring be made of more resilient material, and that a stop be provided to prevent excessive downward motion of the reset latch lever.

80. <u>Par. 2-51</u>. This paragraph of the specifications was covered in paragraph 2-25 above.

SECTION III

81. <u>Par. 3-1 - General</u>. The Model YG Transmitter is designed to deliver approximately 20 watts of power at a carrier frequency of 246 mc to a single 70-ohm concentric transmission line, and to provide 70 to 80 per cent modulation of this carrier at radio frequencies from 540 to 830 kc. The 246 mc carrier is generated by a pair of RCA type 8025 tubes operating in a push-pull self-excited oscillator circuit. The modulation is provided by one type 807 tube operating as an electron coupled oscillator, and one type 807 tube operating as an amplifier-modulator.

82. <u>Power Output</u>.

(1) The data taken during the power output tests are presented in Tables 11, 12, and 13. The power output in the key up or unmodulated condition is presented in Table 11. It may be noted that the output at the end of the four-foot section of coaxial line which forms the output terminal of the transmitter is approximately 21 watts at 246 mc. This table also shows the increase of oscillator grid drive which may be accomplished by lengthening the filament frame and shortening the grid frame. It should be noted that the plate supply voltage during this test was 625 volts. In normal operation the plate supply voltage is adjusted to 640 volts with the key up by means of a rheostat in series with the primary of the plate transformer. The plate supply voltage drops to approximately 570 volts when the key is closed and modulation is applied. The actual <u>carrier</u> power during modulation is therefore about 19 watts.

(2) The data of Table 12 show the transmitter output power in the modulated or key down condition, when modulated

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at various frequencies throughout the frequency range of the modulator. This power was measured at the end of the transmitter four-foot coaxial cable terminal, using a half-wave concentric line matching section to match the lamp load to the cable. The power output in the modulated condition is approximately 25 watts, remaining fairly constant across the modulator frequency range.

(3) The data of Table 13 show the transmitter output, unmodulated and modulated, as measured at the transmitter terminals and as measured at the end of 190 feet of 7/8-inch copper-isolantite coaxial transmission line. These data show that the increase in power output due to modulation of the carrier is not so great at the end of the 190-foot line as when the power is delivered directly to the dummy load. In fact, the power output at the end of the 190-foot line actually decreased for the modulation frequency of 800 kc, compared to the cw or carrier power. It is believed that the selectivity of the matching section, i.e., the fact that it provided a good match for the carrier frequency and a poorer match for the side band frequencies, caused the high attenuation at the 800 kc modulation frequency. This attenuation of the sidebands will occur when operating into an antenna, although it is probable that the effect will be less.

83. <u>Frequency Ranges and Overlaps</u>. The frequency range of the super-frequency oscillator and its trimmer capacitor is shown in Table 7. The range was limited by the distance through which the grid shorting bar could be moved without having it extend beyond the guide rail. At each extreme frequency the edge of the shorting bar was flush with the end of the guide rail. The filament bar was then adjusted for proper oscillator tube grid current. It is apparent that the oscillator may be adjusted between the limits of 214.8 mc and 290.0 mc, and that the trimmer capacitor has a range of 5.95 mc or 2.36 per cent. The modulator oscillator and modulator power-amplifier frequency ranges are shown in Table 8. It is seen that the modulator oscillator has more than 3 per cent overlap on each end of the range, but that the power amplifier, while having 10.4 per cent overlap on the low-frequency end of the range, actually lacks meeting the high-frequency end of the range by 0.3 per cent. In order to determine the cause of this lack of overlap, the power-amplifier tank capacitor was removed and measured. It was found to be within 1.1 per cent of rated value. It appears, therefore, that the variometer inductance is too great. It is recommended that 3 per cent overlap be provided on all future equipments. The range of the modulator oscillator reset capacitor is shown in Table 9. It is seen that a total frequency variation of 36.96 kc or 6.34 per cent was obtained. This should be sufficient for all reset purposes. The frequency range of the modulator monitor is shown in Table 10.

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It is seen that the range of this unit far exceeds 3 per cent overlap on the required 540 to 830 kc range. The accuracy with which the super-frequency oscillator may be adjusted to an assigned frequency by means of the trimmer capacitor was investigated. It was found that the frequency change for 10 degrees of rotation varied from 7 kc with the capacitor at wide spacing, to 33 kc with the capacitor near the maximum capacity. Assuming that an operator can adjust this screw-driver control to within 2 degrees of a desired setting, a minimum adjustment accuracy of plus or minus 6 kc is obtainable. This is sufficiently accurate in view of the variations in frequency which occur from other causes in normal operation. The frequency range of the CRV-60028 wavemeter was measured and found to be 234 to 260 mc. Resonance curves were plotted on this instrument to determine the backlash present in the mechanism and the possible accuracy of reading. These curves indicated that the transmitter could be adjusted to within 20 to 30 kc of 246 mc by setting the wavemeter and tuning the transmitter to resonance by observing the wavemeter resonance indication (0-200 microampere instrument). It was found that approximately 0.5 division backlash exists in the mechanism.

84. Par. 3-2. Keying of the carrier frequency is not provided. The modulation frequency may be keyed at 20 words per minute without appreciable "clipping" of the characters.

85. Par. 3-3. No provision has been made for the reduction of harmonics in the 246 mc output of the super-frequency oscillator. It is possible that a 738 mc (3rd harmonic) signal is present in the antenna radiation. However, this harmonic frequency should be greatly attenuated by the poor match presented to the transmission line by the antenna at this frequency.

86. Any harmonic content in the output of the modulator power amplifier will appear along with the fundamental modulation frequency in the output of the Model YG Transmitter, due to the direct coupling from the anode of the modulator power amplifier to the super-frequency oscillator anodes. These harmonics of the modulation frequency will be of small moment, however, since any receiver which picks up the 246 mc modulated carrier would introduce enough harmonic distortion into the 540 to 830 kc modulation to cause the reception of harmonic responses of greater magnitude than those which originally existed in the modulation.

87. The energy radiated from the 246 mc antenna on the modulation frequencies is extremely small. Great attenuation of the modulation frequency takes place between the anodes of the super-frequency oscillator and their grounded

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filament frame. Then, additionally, one side of the coupling loop is grounded, and the 246 mc dipoles of the antenna are also grounded. Assuming that no radiation takes place from the 115-volt power supply circuit, it should be impossible to pick up the modulation frequency 100 yards from a ship using the Model YG Transmitter. During an actual test performed at the Laboratory, a field intensity of 70 microvolts per meter at either a 540 or 830 kc modulation frequency was measured at a distance of 150 feet from the YG antenna. It was found that disconnecting the output transmission line plug from the YG outlet jack on the transmission line to the antenna had no effect on this signal, indicating that the radiation was taking place from the power circuits in the Laboratory building.

88. Almost no trace of lilt or key clicks was noticeable in the keyed output of the Model YG Transmitter. However, considerable local interference is caused by the inductive kick from the coil of the 115-volt keying relay; it is recommended that a suitable filter be incorporated to eliminate the effect.

89. Par. 3-4. The residual audio frequency modulation of the 246 mc carrier of the Model YG Transmitter was found to be 0.42 per cent.

90. Par. 3-5. A minimum number of front panel controls have been provided to control the frequency and resonate the circuits of the Model YG Transmitter. A list of the controls and meters is presented in Table 3. The only critical ones are those for the modulator oscillator tuning and the super-frequency oscillator trimming, designated respectively "A" and "D." The plate or "work" circuit of the modulator oscillator is pretuned to 685 kc by a screwdriver controlled trimmer capacitor and the capacitor is then locked in this position. A test was made in which the grid current of the modulator power amplifier was measured across the range from 540 to 830 kc. The results of this test are shown in Table 40. It may be seen that at the end of the band the power-amplifier grid current drops to 62 per cent of the maximum at 685 kc, or from 2.29 ma to 1.42 ma. Since the type 807 tube used in the power amplifier is lightly loaded, these grid current values represent sufficient grid drive across the frequency range.

Carrier Frequency Stability

91. Par. 3-6-(1). Two-Hour Locked Key Tests (Carrier). The two-hour locked key frequency drifts of the carrier and the modulation frequencies at room ambient temperature and humidity are shown in Tables 14, 15, and 16. Table 14 lists

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the data for the unmodulated carrier, while Tables 15 and 16 show the carrier drift measured with, respectively, 550 and 800 kc modulation applied. The drift of the modulating frequencies is also shown on Tables 15 and 16; curves of these data will be found on Plates 1 and 2. These tests were conducted without preheating of the transmitter; i.e., plate voltage was applied immediately following the closing of the filament-to-plate 40-second time delay relay. The modulator key was locked directly after the plate voltage was applied when the tests with modulation were conducted.

92. Par. 3-6-(1). The test for unmodulated carrier drift, recorded in Table 14, was carried on for one hour instead of the usual two hours, since the carrier frequency became stable during the first half hour. It may be observed that the drift was 0.22 mc or 0.089 per cent in the first five minutes, and 0.10 mc or 0.0406 per cent in the remainder of the test. The carrier drift (modulator key open) was observed on three other occasions during the course of the tests, with drifts during warmup of 0.25, 0.52, and 0.30 mc observed before the carrier stabilized. It appears, therefore, that a carrier drift (carrier only, without modulation) of 0.3 mc or 0.122 per cent may ordinarily be expected when the super-frequency oscillator is "warming up," and that most of this drift will occur in the first 30 minutes of operation. The power output was observed to drop 2.7 per cent during the first 30 minutes of operation, and to remain constant during the following 30 minutes.

93. Par. 3-6-(1). The data of Table 15 show the carrier drift and the modulator drift with the modulator key locked, modulation being at 550 kc. During this run the maximum carrier deviation took place in the first 40 minutes. The data of Table 16 duplicate that of Table 15, except that the modulation frequency is 800 kc instead of 550 kc. During this run the carrier frequency drifted a maximum of 0.30 mc, or 0.122 per cent. It appears from these tests that the frequency drift is not ordinarily affected by the presence or absence of modulation, and that a carrier drift of 0.30 mc or 0.122 per cent may be expected whenever the transmitter is operated from a cold start.

94. Par. 3-6-(2). Tube Change (Carrier). No group of production tubes was available to make a normal test on the effect of change of the tubes in the super-frequency oscillator. It will undoubtedly be necessary to adjust the trimmer capacitor each time a tube is changed.

95. Par. 3-6-(3). Variation of Ambient Temperature (Carrier). The results of the three tests which were conducted to determine the effect of the variation of the ambient tempera-

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ture upon the carrier and the modulation frequencies of the Model YG Transmitter are shown in Tables 21, 22, and 23, and Plates 4, 5, and 6. It is seen that the carrier frequency decreased with increasing temperature, drifting 0.32 mc in the test of Table 21, when the temperature was reduced from 50°C to 0°C, and drifting, respectively, 0.28 and 0.36 mc in the tests of Tables 22 and 23 for the change in temperature from 0°C to 50°C. It may also be noted in Tables 22 and 23 that the carrier drift caused by raising the temperature from -28°C to 0°C amounted to 0.07 and 0.12 mc, respectively. Using the values of greatest drift, the deviation amounts to 0.00175 per cent per degree Centigrade when raising the ambient temperature from -28°C to 0°C, and 0.0029 per cent per degree Centigrade when raising the ambient temperature from 0°C to 50°C. Therefore, it will be necessary to adjust the super-frequency oscillator trimmer capacitor during periods when the ambient temperature is undergoing variations of the order of 20°C or greater. This "trimming" may be done without producing a noticeable effect at the receiving point, since "beat" reception is on the modulation frequency.

96. <u>Par. 3-6-(4). Variation of Relative Humidity (Carrier).</u> The results of the tests performed to determine the effect of variation of the relative humidity are shown in Tables 24, 25, and 26, and Plates 7, 8 and 9. These show that a decrease in the carrier frequency is caused by a change from low to high humidity, and that an extreme excursion of about 100 kc or 0.04 per cent may be expected.

97. <u>Par. 3-6-(5). Effect of Inclination (Carrier).</u> Because of limitations in the measuring equipment, it was impossible to continuously monitor the super-frequency oscillator frequency during the inclination test. However, measurements were made at the beginning and end of each run. Except for one run in which a jump in frequency occurred due to a change in the dummy load circuit, the oscillator frequency at the end of the run was the same as at the beginning. Frequency variation of the super-frequency oscillator during inclination is not expected to be of sufficient magnitude to be noticeable at the receiving point.

98. <u>Par. 3-6-(6). Effect of Vibration (Carrier).</u> The data obtained during the vibration tests are presented in Table 28. During the first test, with modulation at 550 kc, the carrier behaved erratically, taking a maximum excursion of 750 kc or 0.305 per cent from the 246 mc initial frequency. A side-to-side inclination test followed the first vibration test. During the inclination test the super-frequency oscillator deviated 700 kc; during succeeding vibration and inclination tests no further excursions of this magnitude took place. It was discovered subsequently that the fault existed

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in the dummy load circuit and these abnormal excursions are therefore disregarded. During the second vibration test, with modulation at 800 kc, a deviation of 50 kc or 0.02 per cent took place. This appears to be the order of magnitude of deviation which may be encountered during vibration. It should be noted that the grid and filament frame shorting bars must be clamped securely to the frames or very great changes in frequency will be encountered.

99. Par. 3-6-(7). Effect of Shock (Carrier). The results of the shock tests are shown on Table 29. Only one modulation frequency was used during the application of the 24 shocks; namely, 800 kc. The carrier frequency in general remained nearly constant with occasional deviations as great as 0.04 mc or 0.016 per cent, but with one deviation of 0.44 mc, or 0.179 per cent. This latter deviation is believed to be abnormal and caused by the dummy load circuit, as noted in the preceding paragraph. Following shock number 15, the load circuit was readjusted, after which no further deviations in the frequency of the carrier took place. It appears that deviations of the order of 0.016 per cent may be expected during shocks imparting accelerations of 250 g to the equipment, providing that no large changes occur in the load circuit. If large changes do occur in the load circuit, considerably greater excursions of the super-frequency oscillator frequency may be expected.

100. Par. 3-6-(8). Effect of Line Voltage Variation (Carrier). The deviation of the carrier frequency and the modulation frequencies with variation of the supply line voltage was determined using the following percentages and sequences of supply line voltage change and the following modulation frequencies:

	Voltage Change (Per Cent)	Time for Change (Minutes)	Modulation Frequency (Kc)
(a)	-10 to +10	5	550
(b)	-10 to +10	1	550
(c)	- 5 to + 5	5	550
(d)	- 5 to + 5	1	550
(e)	-10 to +10	5	800
(f)	-10 to +10	1	800
(g)	- 5 to + 5	5	800
(h)	- 5 to + 5	1	800
(i)	+10 to -10	1	600
(j)	+10 to -10	1	650
(k)	+10 to -10	1	700
(l)	+10 to -10	1	750

(Continued)

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(m) Normal to -10% in 10 minutes to +10% in 5 minutes, 600 kc modulation frequency.

(n) Normal to -10% in 10 minutes to +10% in 5 minutes, 650 kc modulation frequency.

(o) Normal to -10% in 10 minutes to +10% in 5 minutes, 700 kc modulation frequency.

(p) Normal to -10% in 10 minutes to +10% in 5 minutes, 750 kc modulation frequency.

(q) Normal to -10% in 10 minutes to +10% in 5 minutes, 800 kc modulation frequency.

During tests (a) to (l) inclusive, both the carrier frequency and the modulation frequency were observed, while during the remainder of the tests, only the modulation frequency was observed. The results of the variation of line voltage tests are presented in Table 20. The maximum deviation of the carrier frequency occurred in the "-5% to +5% in five minutes" voltage change. It amounted to 0.17 mc, or 0.069 per cent and departed in the direction of decreasing frequency with increasing voltage.

101. Par. 3-6-(9). Unmodulated Carrier to Keyed Modulation. The results of the test to determine the effect upon the super-frequency oscillator frequency of applying keyed modulation to the carrier are shown in Table 30. It is seen that the carrier frequency decreased slowly during the 45 minutes of 23 words-per-minute keying to a total maximum deviation of 0.039 kc or 0.0156 per cent.

102. Par. 3-6-(9). Effect of Power Output Control. The deviation of the carrier frequency was measured as the plate supply voltage was varied over the range provided by the plate-transformer primary rheostat. Data were taken without modulation, and with modulation at each of two frequencies; namely, 550 kc and 800 kc. The data obtained are presented in Table 19. The carrier frequency deviations were 0.0152 per cent, 0.0407 per cent and 0.0346 per cent with, respectively, no modulation, 550 kc modulation, and 800 kc modulation.

103. Par. 3-6-(9). Carrier Drift with Keyed Modulation. In order to determine the magnitude of the carrier frequency drift which will occur in normal keyed operation of the Model YG Transmitter, the test recorded in Table 17 was performed. The measurements of carrier frequency drift with keyed modulation were obtained by means of the Laboratory-developed super-frequency drift indicator. Since the transmitter had been in operation for some time preceding the run in which 800 kc modulation was used, and since the run with 800 kc modulation was followed one hour later by the run with 550 kc modulation, the transmitter was rather well warmed up for both runs. As a result, these tests give optimistic values

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for the frequency drift, compared to the drift which may be encountered in actual practice. Under the latter condition, the equipment will probably be turned on and modulation applied shortly thereafter. The drift indicated by the data of Table 17 is about 0.05 mc or 0.02 per cent. The key-locked tests from a cold start indicate a drift of 0.30 mc or 0.122 per cent. The drift which will undoubtedly be encountered in service will therefore lie between these values, probably at 0.10 or 0.15 per cent.

Modulator Frequency Stability.

104. Par. 3-7-(1). Two-Hour Locked Key Tests (Modulator). The two-hour locked key frequency drift of the modulator is shown in Table 15 for a frequency of 550 kc and in Table 16 for a frequency of 800 kc. These data are also shown in graphic form in Plates 1 and 2. It is seen that the frequency tended to increase and then return towards the starting point for the 550 kc run and to decrease and return to the initial point for the 800 kc run. The deviations during the first five minutes were 5 cycles, or 0.001 per cent for the 550 kc run, and 6.5 cycles, or 0.00081 per cent for the 800 kc run, while the maximum deviations during the remainder of the runs from the frequencies at the end of the first five minutes were 18 cycles (0.00327 per cent) at 500 kc and 8.5 cycles (0.00106 per cent) at 800 kc. The frequencies at the ends of the periods were 8 cycles (0.0016 per cent) at 500 kc, and 4 cycles (0.0005 per cent) at 800 kc from the starting frequencies.

105. Par. 3-7-(2). Change of Tubes (Modulator). The results of the tests to determine the effect of changing tubes in the modulator oscillator and the modulator power amplifier are presented in Table 31. These tests indicate a maximum deviation of 0.028 per cent from the mean frequency in changing the m-o tube, and a maximum deviation of 0.006 per cent from a mean frequency in changing the p-a tube. It should be noted, however, that the m-o circuit is provided with a trimmer capacitor by means of which the m-o frequency may be reset to a calibrated point.

106. Par. 3-7-(3). Variation of Ambient Temperature (Modulator). The data obtained during the variation of ambient temperature tests are presented in Tables 21, 22, and 23, and in the form of curves in Plates 4, 5, and 6. In general, the frequency of the modulator decreased with increase of temperature, the rate being 0.00048 per cent per degree Centigrade at 550 kc, and 0.00055 per cent per degree Centigrade at 800 kc, within the temperature range of 0 to 50°C. The rate of change between -28°C and 0°C was apparently somewhat less than this figure.

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107. Par. 3-7-(4). Variation of Relative Humidity (Modulator). As indicated by the data of Table 24, the modulation frequency decreases with an increase in relative humidity. The deviations recorded were 109 cycles or 0.0182 per cent at 600 kc and 236 cycles or 0.0295 per cent at 800 kc for the change from less than 30 per cent to 95 per cent relative humidity. Curves of these variations with humidity are shown on Plates 7 and 8.

108. In addition to the usual variation of humidity tests, a high-humidity standby test was conducted as described in paragraph 12 above. The data for this test are presented in Table 26 and in curve form in Plate 9. It is seen that during the two-hour period from 0910 to 1110 while the equipment was shut down except for the heater power supply, the modulator frequency decreased 278 cycles, or 0.046 per cent compared to a decrease in frequency of 0.018 per cent during the normal humidity test with the equipment in operation throughout the test. The frequency decreased further in the period from 1115 to 1325, when the heaters also were shut off, causing the entire transmitter to be in the idle condition. The total change was then 443 cycles, or 0.072 per cent. In the next period, when the temperature was reduced from 40°C to 19.5°C and the relative humidity to 66 per cent, the modulation frequency increased to within 48 cycles, or 0.008 per cent of the frequency at 0900. This recovery indicates that no damage to the modulator was caused by the high-humidity standby test.

109. Par. 3-7-(5). Effect of Inclination (Modulator). The results of the inclination tests are shown in Table 27. It may be observed that the amount of swing of the modulation frequency varied from a minimum of 0.00125 per cent (10 cycles) at 800 kc with front to back inclination, to a maximum of 0.0044 per cent (24 cycles) at 550 kc with side to side inclination. The maximum change from the starting frequency was 28 cycles (0.0035 per cent) at 800 kc, occurring with side to side inclination.

110. Par. 3-7-(6). Effect of Vibration (Modulator). As noted in Table 28, very little or no modulation of the modulator frequency was caused by the vibration. During the test at 550 kc, the modulation frequency suddenly jumped 98 cycles at the end of 15 minutes vibration; from that time until the end of the run the greatest change noted was 30 cycles, or 0.0055 per cent. The greatest change which occurred during the vibration run with 800 kc modulation was 40 cycles, or 0.005 per cent. In service, therefore, frequency deviations or "sets" of 0.006 per cent may be expected during vibration. In connection with the test with a modulation frequency of

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550 kc, it is pointed out that the maximum deviation from the frequency at the start of the run, including the jump in frequency, was 95 cycles, or 0.0173 per cent.

111. Par. 3-7-(7). Effect of Shock (Modulator). The results of the shock tests are shown in Table 29. Only one modulation frequency was used during the application of the 24 shocks; namely, 800 kc. The frequency deviation of the modulator followed the usual pattern during successive shocks, the frequency taking a large set at the first shock and smaller random deviations at succeeding shocks. Thus, the initial change was 60 cycles, or 0.0075 per cent, with a maximum deviation thereafter of 28 cycles, or 0.0035 per cent.

112. Par. 3-7-(8). Effect of Line Voltage Variation (Modulator). A summary of the conditions of the tests to determine the effect of line voltage variation is given in paragraph 98, while the results of the tests are presented in Table 20. In general, the deviations recorded were of the order of 0.01 per cent of the modulator frequency. However, one point was encountered at 650 kc at which the deviation was 213 cycles, or 0.033 per cent. This occurred when the line voltage was changed from 10 per cent above to 10 per cent below the normal value.

113. Par. 3-7-(9). Continuously Keyed to Intermittently Keyed. The data for this test are recorded in Table 18. It is seen that the frequency drifted 6 cycles or 0.00109 per cent at 550 kc, and 4 cycles or 0.0005 per cent at 800 kc during the 20-minute standby period in which the carrier remained "on" while the modulation was "off."

114. Effect of Power Output Control. The deviation of the modulation frequency was measured as the plate supply voltage was varied over the range provided by the plate-transformer primary rheostat. Data taken at frequencies of 550 and 800 kc are presented in Table 19. Frequency deviations amounted to 5 cycles or 0.00091 per cent at 550 kc, and 15 cycles or 0.00187 per cent at 800 kc. The minimum power output was 56 per cent of full power in each case.

115. Par. 3-8. A summary of the frequency stability tests is given in Table 32. It is seen that the carrier frequency may vary 0.42 per cent through the variation of operating conditions represented by the tests performed, while the modulation frequency may vary 0.113 per cent. It will, therefore, be necessary to check and, if necessary, readjust the carrier and modulation frequencies frequently.

116. Par. 3-9. No provision is made in the YG transmitter for adjusting or reading the percentage of modulation.

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117. Par. 3-10. A single-tube modulation monitor is provided in the YG transmitter. This unit delivers an audio beat note to a jack on the transmitter panel and to a pair of terminals on the transmitter terminal board. Its frequency range between dial readings of 0 and 80 is shown in Table 10. The audio output level into a 5000-ohm load at a 1000-cycle beat note was measured and found to be 8 microwatts at 550 kc, and 3.9 microwatts at 800 kc. This corresponds respectively to -28.8 db and -31.9 db levels referred to a 6 mw zero level.

118. Par. 3-11. Remote control operation of the Model YG Transmitter has not been provided. Power line and plate power switches are mounted on the front panel of the power unit. A test key is mounted on the transmitter front panel and is connected in the circuit of the modulator keying relay. A pair of terminals on the transmitter terminal board is connected in parallel with the test key; these are used in carrying the keying circuit to the antenna control unit.

119. Par. 3-12. Controls on the transmitter are suitably identified by nameplates. A list of all nameplates is given in Table 2.

120. Par. 3-13. A metal holder mounted on the front panel of the transmitter contains one calibration chart. Spaces are provided on this chart for five modulator frequencies. A thin sheet of celluloid protects the cardboard calibration chart. The assembly is not moisture proof. It is suggested that the calibration chart could be greatly improved in durability, especially with respect to moisture, if it were made of rough surface milk-white plastic. Three or four thin sheets of this material would fit in the place of the present cardboard and would provide space for the calibration of fifteen frequencies.

121. Par. 3-14. Table 33 shows the results of the tests to determine the speed and accuracy of reset of the modulator. It may be seen that the modulator frequency may be reset within 18 seconds to an average accuracy not less than 0.0064 per cent, and with no one reset poorer than 0.0086 per cent.

122. Par. 3-15. Table 34 shows the effect of lost motion, backlash, and torque lash in the controls of the modulator oscillator. It is seen that the maximum average deviation of 0.00324 per cent occurred at 550 kc, while the maximum departure from the initial frequency was 0.00764 per cent, also occurring at 550 kc.

123. Par. 3-16. Positive gear driven vernier dials are provided on the modulator oscillator, modulator power amplifier,

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and modulator monitor controls. The calculated kilocycles per division of the modulator oscillator dial taken at frequencies near each end of the frequency range is shown in Table 35. It is apparent that the maximum kilocycles per division occurs at the high-frequency end of the band, being 0.526 kc, or 0.075 per cent per division at 700 kc. This value exceeds that permitted in the Model YE Equipment but is considered satisfactory for the service intended.

124. Par. 3-17. A friction type locking device is provided on the modulator master-oscillator and power-amplifier dials, and on the monitor dial. A screwdriver controlled lock is provided on the modulator oscillator reset control, which is screwdriver controlled itself. The super-frequency oscillator trimmer capacitor and the super-frequency oscillator coupling control have no locks; however, sufficient friction exists in their threaded horizontal lead-screw drives to maintain their position. The effect of the modulator oscillator and modulator power-amplifier dial locks is shown in Table 36. It may be noted that the dial locks have a considerable effect upon the frequency, the maximum amount noted being 0.0125 per cent or 100 cycles at 800 kc. When tightly screwed down, the locks prevent accidental movement of the dials. No sharp edges are exposed which might endanger the operator's hand when the dial is being manipulated.

125. Par. 3-18. A modulator oscillator trimmer capacitor is provided to permit resetting the calibration of the modulator oscillator calibration when tubes are changed.

126. Par. 3-19. Shifting of the modulation frequency may be done without making any adjustments other than the modulator oscillator and modulator power-amplifier dials.

127. Par. 3-20. There are no continuously rotating parts in the Model YG Transmitter. Radio interference is caused by the contacts which operate the keying relay. A spark suppressor should be incorporated to eliminate this interference, as noted in paragraph 88 above.

128. Par. 3-25. Table 37 shows the results obtained by operation of the power output control. It is possible by means of this control (R-202) to reduce the modulated output of the transmitter to 56 per cent of the normal full power output. Rectifier type power equipment is provided, but no front-of-panel step control is provided. R-202 is connected in the primary circuit of the plate transformer and is intended for use in adjusting the plate voltage to rated value rather than as a means of reducing the transmitter power output.

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129. Par. 3-26. No indicator lamps are provided.

130. Par. 3-27. A list of the meters used in the Model YG Transmitter is contained in Table 3. During the various tests performed on the equipment, it has been found advantageous to have a grid current meter in the super-frequency oscillator grid circuit. Therefore, it is recommended that the Model YG Transmitter be equipped with a suitable grid current meter, preferably of 0-50 ma range. The metering circuit should be arranged in such a manner that the grid current does not pass through the cathode current meter; the latter will then indicate the plate current of the type 8025 tubes.

131. Par. 3-28. All tubes are rated at less than 500 watts; hence, no tube life meters are provided.

132. Par. 3-29. The transmitter consists of two separate chassis mounted in the same cabinet. These consist of an r-f chassis and a power unit, which slide on runners into the case. The chassis are positioned by two heavy centering pins at the rear of each deck. The overall dimensions of the transmitter are shown in Table 1.

133. Par. 3-30. The transmitter is complete in itself and will fit in the space noted in Table 1. However, space must also be provided at the point of installation to accommodate the type CRV-60028 frequency meter. This unit will be employed each time the transmitter is used.

134. Par. 3-31. As noted above, the transmitter is completely contained in a single unit.

135. Par. 3-32. Adeouate shielding of integral circuits has been provided. Lead covered wire is not used because of the weight and space limitations of the transmitter.

136. Par. 3-33. Three indicating instruments in the YG transmitter are provided with bypass capacitors, while two, namely, the filament voltmeter and the super-frecuency oscillator plate current meter, are merely enclosed in shield cans. No trouble was experienced with the shielded, non-bypassed meters.

137. Par. 3-34. Vacuum tube filaments are energized from the a-c supply by means of filament transformers. The non-suitability of the rectifier filament transformer is discussed in paragraphs 23-(13) and 44. The primary windings are provided with taps for 105, 110, and 115-volt operation, but not for 220-volt operation. The Model YG Equipment is designed to operate from 115 volts a.c. only and no provision has been made for 220-volt operation.

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138. Par. 3-35. The transformers performed satisfactorily during the tests, except for the low voltage output of the rectifier filament transformer.

139. Par. 3-36. No regulation of the filament supply, other than that introduced by the power supply regulation itself, was noted during keying of the transmitter.

140. Par. 3-37-(1). Provision is made at the rear of the transmitter for the installation of terminal tubes through which the power and control cables are to be run. With this exception, the transmitter may be installed with its back flush against a bulkhead.

141. Par. 3-37-(2). The transmitter is so constructed that its foundation pedestal may be bolted to the deck to provide ample strength for installation afloat.

142. Par. 3-37-(3). The terminal boards are mounted at the rear of the transmitter case and are accessible by removal of the chassis from the case. The center line of the terminal tube holes is 3-1/2 inches above the lower surface of the mounting strips. It will be necessary, in order to secure convenient operation, to mount the Model YG Transmitter on a table, since its height is only 31-5/8 inches. The bottom of the transmitter case is about 1-5/8 inches above deck level. Suitable terminal lugs with wings for clamping the wires are provided on the external connections terminal board.

143. Par. 3-37-(4) and (5). Vacuum tubes may be replaced through the front access doors. Servicing of relays can best be accomplished by partial withdrawal of the chassis, though all the relays are mounted near the access doors, and their operation can be observed conveniently.

144. Par. 3-37-(6). The output terminal of the YG transmitter consists of a 2-1/2-foot section of flexible cable terminating in an Amphenol "93 series" plug. The transmission line to the antenna, therefore, must be located within reach of the 2-1/2-foot cable, or anywhere along the right side of the set.

145. Par. 3-38. The two side shields are provided with horizontal louvers which are 2-3/4 inches long and present a 1/8-inch opening towards the deck. Each shield has six groups of these louvers, seven louvers to each group, or a total of 42 louvers per shield. The two shields are secured by means of "Dzus" rotating lock catches. These have thumb nuts which, although very difficult to lock by hand, are equipped with screwdriver slots, and may be turned easily with a screwdriver. No other removable shields are provided.

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146. Par. 3-39. There are no access doors in the sides of the set. The three doors on the front of the set are provided with piano type hinges with a bright nickel finish. The hinges on the access doors to the super-frequency oscillator tubes and to the plate rectifier tubes are of ferrous material, while the hinge on the access door to the modulator tubes is of non-ferrous material. It is suggested that the bright nickel finish be changed to a dull nickel finish to avoid the reflection of light. Suitable door stops are provided. It was noted that one of the stops was installed so that it struck the side of the compartment before the door was closed, thus exerting undue pressure on the door and making it difficult to close the door.

147. Par. 3-40. Tubes may be replaced through the front access doors. The rectifier tube access door is perforated, but the modulator and super-frequency oscillator doors are not. Since the Model YG Transmitter may be operated above decks or in the open where it is important to screen all lights for purposes of security, it is suggested that the provision requiring perforations for viewing the tubes be disregarded. All hinged doors overlap the front panel by a suitable amount.

148. Par. 3-41. Small rubber-covered hand rails are provided on the YG chassis to facilitate removal of the chassis. The utility of the rails as a support for the operator in heavy weather depends to a considerable extent on the ability of the transmitter shock mounts to withstand the added strain. These mounts are designed to support only the 190-pound weight of the unit but are considered to be sufficiently strong to withstand the additional strain caused by the operator.

149. Par. 3-42. The design and construction of the antenna coupling is such as to prevent high potential d.c. from reaching the antenna.

150. Par. 3-43-(1). Coupling facilities and terminals are provided for delivering an r-f potential to a suitable external frequency meter for adjustment of the modulator to uncalibrated frequencies.

151. Par. 3-43-(2). The pick-up circuit is coupled to the modulator power amplifier, since the simplicity of the equipment requires that both master oscillator and power amplifier operate simultaneously. Hence, by coupling to the power amplifier, it is possible to remove any influence which the coupling circuit might have on the oscillator frequency. A switch on the transmitter panel permits connection of the front panel phone jack to either the modulation monitor or a pair of terminals on the main terminal board.

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152. Par. 3-43-(3). The output voltage of the r-f pick-up was measured across a 70-ohm resistor connected to the coupling terminals through three feet of shielded cable. It was found to range between 0.98 volt at 800 kc and 0.88 volt at 550 kc. It is recommended that the coupling be adjusted to provide a calibration voltage of 15 to 750 millivolts to insure satisfactory operation and avoid damage to the frequency meter.

153. Par. 3-43-(4). The output phone jack is located on the left side of the panel near the top, and is suitable for use with the Navy types 49001 and 49034 shielded plugs.

154. Par. 3-43-(5). The coupling terminals are identified on the schematic diagram as "R.F. Freq. Meter Output." The terminal board is unmarked except for numbers. The phone jack is identified by the nameplate, "Phones."

155. Par. 3-44. In addition to the Amphenol plug outlet for the transmitter antenna terminal, a fitting equipped with a gas-tight seal and a gas admission valve is supplied with the Model YG Transmitter. This fitting accepts the Amphenol plug on one end and may be soldered or coupled with flexible couplings to 7/8-inch concentric line on the other end.

156. Par. 3-45. No means is provided for indicating the output of the Model YG Transmitter.

SECTION VI - POWER EQUIPMENT

157. Par. 6-1. The power equipment of the Model YG Transmitter is designed to assure safe operation and satisfactory performance except in the details as herein reported. Information concerning the performance of the plate voltage rectifier is shown in Table 39. It is seen that the regulation is 5.94 per cent with 115 volts applied to the line terminals. Since the plate voltage is adjusted by means of a rheostat in series with the primary of the plate transformer, the regulation will become poorer with higher line voltages. The per cent ripple at full load was measured as 0.325 per cent. This value can probably be reduced somewhat by properly connecting the negative output terminal of the rectifier to the cathodes of the type 836 rectifier tubes. In the equipment submitted for test this lead was connected to the center tap of the filament transformer.

158. Par. 6-2. The power supply specified for the Model YG Equipment was 115 volts, 60 cycles a.c.

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159. Par. 6-3. The equipment functioned satisfactorily without apparent damage to the tubes during variations of supply line voltage of plus or minus 10 per cent, with the exception that filament and plate voltages could not be maintained at normal value during the changes. As noted above in paragraph 65, it is recommended that additional control be provided in the filament circuit to permit control of this voltage.

160. Par. 6-4. The power equipment is designed for continuous operation and performed satisfactorily during several hours operation in an ambient temperature of 50°C.

161. Par. 6-5. The total power required by the YG transmitter is a minimum in accordance with good engineering practice. The power drain from the supply line for various conditions of operation is shown in Table 41. It is seen that the total line input for the transmitter alone (heaters off) with key closed is 255 watts at 0.944 PF, and that the antenna equipment requires 91 watts at 0.265 PF. The total drain, with the equipment in normal operation but with the heaters off is, therefore, 346 watts at 0.64 PF. Addition of the heater load of both the transmitter and the antenna units brings the total maximum power drain from the supply line up to 815 watts, at a power factor of 0.89.

162. Par. 6-6. All power, filament and plate alike, is obtained from the 115-volt supply line. Provision is made for separately energizing the heaters from a d-c source in case a-c power is not available under stand-by conditions.

163. Par. 6-7 to 6-36, inclusive. These paragraphs refer to motor generator and motor specifications. The Model YG Transmitter uses neither. The Model YG Antenna Control Unit and Antenna utilize small motors. However, this equipment is the subject of a separate report.

164. A summary of the defects noted in the Model YG Equipment and such items as do not conform to good engineering practice or Navy specifications are listed below. At the end of each comment, reference is made to the paragraph number of this report which discusses the item in detail.

(1) The retainer spring was missing from the reset knob of the overload relay when the equipment was received (19-1).

(2) The square stop on the right hand side of the r-f chassis broke off the first time the chassis was withdrawn (19-2).

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(3) The circular wooden form which supports the wavemeter in the carrying case was broken, and the carrying case gaskets did not provide a tight seal between the lid and the body of the case (19-3).

(4) A collection of brass cuttings was found on the r-f chassis runner (19-4).

(5) The super-frequency oscillator plate milliammeter M-104 was off calibration by greater than 2 per cent of full scale (23-1).

(6) Forty capacitors in the YG transmitter do not have Navy type numbers (23-1 to 7, inclusive).

(7) Bakelite insulation is used in the field of the super-frequency oscillator, for the shaft of the trimmer capacitor, and as a support for the coupling coil (23-8).

(8) Excessive voltage gradient exists on the mounting board of the resistor bank (23-9).

(9) Excessive voltage gradient exists on the collector rings of the modulator power-amplifier variometer (23-10).

(10) Insufficient insulation exists between the frequency meter coupling loop and the high voltage on the modulator power-amplifier variometer (23-11).

(11) The filament transformer for the plate rectifier is unsatisfactory with respect to both insulation and output (23-13 and 44).

(12) The plate overload relay could not be adjusted, as received, to trip at 125 per cent of the normal current that it carries (37 and 79).

(13) The filament voltmeter nameplate does not note the normal voltage to which the circuit is to be adjusted (51).

(14) The chassis of the modulation monitor is secured with inaccessible bolts and nuts (62).

(15) It is impossible to maintain the filament voltage at the rated 6.3 volts for variations of line voltage of plus or minus 10 per cent (65 and 68).

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(16) The filament to plate time delay relay has proved unsatisfactory (78).

(17) The modulator power-amplifier plate circuit does not have 3 per cent overlap at each end of the frequency range (83).

(18) Radio interference of considerable magnitude is created by the inductive kick from the keying relay (88).

(19) Space for only five calibration frequencies is provided on the calibration chart and only one chart was furnished (120).

(20) No grid current meter is provided for the super-frequency oscillator (130).

(21) Bright nickel plating is used on the door hinges (135).

(22) The positive output of the plate supply rectifier is connected to the center tap of the filament transformer rather than to the number 4 filament connection (157).

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APPENDIX A

References

(a) NRL ltr C-F42-1/69H(380) of 18 August 1942.

(b) NRL ltr C-F42-1/69H(380-HRJ) of 28 September 1942.

(c) NRL ltr C-F42-1/69H(380-HRJ) of 30 September 1942.

(d) NRL ltr C-F42-1/69H(380-HRJ) of 12 October 1942.

(e) NRL ltr C-F42-1/69H(380-HRJ) of 29 October 1942.

(f) NRL ltr C-F42-1/69H(380-HRJ) of 2 November 1942.

(g) NRL ltr C-F42-1/69H(380-HRJ) of 17 November 1942.

Operational Tests of the Model YG Equipment

1. In view of the urgent need of the Naval Service for the Model YG Equipment, the necessity for dispensing with exhaustive tests of a preliminary model arose. This necessary omission was later rectified by making available to the Naval Research Laboratory two complete Model YG Equipments, Serial Numbers 5 and 6. The model YG Equipment is composed of the Navy Type CRV-52244 Radio Transmitter Unit, the Type CRV-23271 Antenna Control Unit and the Type CRV-66037 Antenna Drive Unit with antenna assembly. The Type CRV-52244 Transmitter Unit, Serial Number 6, was tested individually and the results of these tests comprise the main body of this report. One complete Model YG Equipment, Serial Number 5, was subjected to operational life tests after having been installed in a manner simulating service conditions.

2. The purpose of the Model YG Equipment is to transmit predetermined code signals indicating the instantaneous true course for aircraft equipped with the necessary receiving

[redacted]

equipment and flying at the required elevation. The code signals representing points of the compass are transmitted over a beam during the time interval in which the beam is pointed to each integral sector of the compass. To accomplish such action exact synchronism between the rotation of the antenna radiating system and the rotation of the keying mechanism disc is required. In the Model YG Equipment use is made of two 1800 r.p.m. synchronous motors to obtain the required synchronism. The initial synchronization and correction of synchronization during operation is accomplished by suitable interlocking switches and a brake.

3. After the Model YG Equipment, Serial Number 5, was installed, it was desired especially to determine the effectiveness of the synchronizing circuit in maintaining the required relation between the rotation of the antenna system and that of the keying mechanism. The initial functioning of the synchronizing circuit was found to be satisfactory. Synchronous operation at two r.p.m. was maintained between the antenna and keyer with the necessary synchronizing action, when either unit was thrown out of its synchronous position. However, satisfactory operation did not continue for periods longer than 24 hours. Investigation of the functioning of the equipment revealed that the drag brake, provided on the shaft of the antenna driving motor to insure against the motor coasting through the synchronizing contacts, had worn out of adjustment. Several unsuccessful attempts were made to obtain a satisfactory adjustment of the brake, but it was found that the wear of the brake lining as a result of its continuous drag on the brake drum was sufficient to destroy the adjustment in less than 30 hours of running. This brake assembly was so ineffective that it was removed and the circuit rearranged in such a manner that the antenna motor now runs continuously throughout the operating period, while synchronism is maintained by controlling only the rotation of the keying mechanism located in the Control Unit. The circuit changes were accomplished by completely removing the lead from Terminal 1 of Terminal Board "H" to Contact "4" of Contactor S-502, and also applying a jumper between Terminals 1 and 4 of Board "H" (See RCA Manufacturing Company's Drawing P-721240). With this modification, the operation of the equipment is such that a lag introduced by a slowing of the antenna rotational speed results in holding the keying mechanism at the synchronizing point during the time required for the antenna system to reach this point. Both then start in synchronism. On the other hand, a lag introduced by a slowing of the keying mechanism speed also holds the keying mechanism at the synchronizing point, but for the length of time required by the antenna system to turn one revolution minus the lag. This modified circuit arrangement has been in successful operation for a period of over three months and it is believed

[redacted]

that it will prove successful under all operating conditions with a minimum interruption to the homing signal, since in the majority of cases weather conditions will result in the slowing of the antenna rotation rather than the keying rotation. Thus, as explained above, only a momentary interruption to the keying will be necessary to restore synchronism between the antenna rotation and the keying.

4. The over-the-bow signal lamp circuit as provided in the Model YE Homing Equipment was such that the instantaneous keying of the transmitter was indicated on the signal lamp. It was found that this circuit in the Model YG Homing Equipment was so constituted that the signal lamp remained illuminated throughout the 30-degree arc of the over-the-bow contact. A study of the circuit wiring revealed that the lead from the signal lamp I-401 was connected to Terminal 1 of Board "G" in the Control Unit, whereas for proper functioning of the indicator, this lead must be connected to Terminal 3 of the same board. This modification was incorporated in the equipments at hand and found to work satisfactorily.

5. After having operated for a period of 163 hours, the Antenna Drive Unit of Equipment Serial Number 5 became fouled and stalled the driving motor, resulting in damage to the motor starting winding. Investigation revealed the fouling to have resulted from a fin in the water-lock labyrinth breaking and jamming in its passageway. Evidence of aluminum dust in the passageway was noted, indicating the possibility of dust accumulation in the passageway and ultimate fouling of the fins. It was believed that the dust was produced by surface wear between the fin and the sides of the passageway due to the close clearance of 1/64 inch provided between the two surfaces. Repetition of this difficulty was guarded against by increasing the clearance between all the moving surfaces of the labyrinth to 1/16 inch. The damage suffered by the motor, as a result of being stalled under power for a considerable period of time, suggests the need for a protective device in the motor circuit. The damage to the motor resulted from current flowing through the starting winding for a period of time greatly in excess of the normal starting time. In view of this, it is believed that a protective overload of the delayed thermal type should prove effective in guarding the motor from damage when stalled by ice formations or other causes. It is understood that the manufacturer of the equipment is modifying the antenna drive motor circuit to include a suitable protective device with a reset feature.

6. Other defects of minor nature were found in the Model YG Equipment during the course of the operational tests, but since such failures have been reported to the Bureau of Ships in references (a) through (g), inclusive, they will not

[redacted]

be recapitulated in this report. The operational defects discussed in the preceding paragraphs were also reported in the same references, but are included in this report, since they are defects of a more serious nature.

7. Numerous flight tests have been made using the Model YG Homing Equipment installation to determine the effectiveness of the equipment as a whole in guiding aircraft. Satisfactory operation was obtained on all flights. The keying was distinct and the output power proved adequate for the purpose intended. The directivity of the antenna, while slightly broad, was found to be sufficiently sharp to give a clear homing indication in each sector.

8. Aircraft homing with this equipment is accomplished through the medium of beam transmission. To indicate the width of the beam and the degree of extraneous radiation from the Model YG Antenna System, a beam pattern is presented as Plate 10. This curve represents the relative field strength of the radiation taken in 10-degree steps in a horizontal plane around the antenna system. The beam width at the half-energy level is approximately 43 degrees. As pointed out in paragraph 7 above, this beam was sufficiently sharp to permit satisfactory homing of aircraft.

<u>Ambient Temperature Variation Tests -
Antenna Control and Drive Units of Model YG Equipments.</u>

9. The Model YG Homing Equipment includes a Type CRV-23271 Antenna Control Unit and a Type CRV-66037 Antenna Drive Unit with antenna assembly. These two units were subjected to tests independent of those conducted on the Type CRV-52244 Radio Transmitter Unit to determine, to some degree, the temperature range over which satisfactory operation of the units may be expected. The nature of the Antenna Drive Unit is such that it will be required to operate exposed to the weather at all times. The Control Unit may be mounted in a sheltered location, but its weather-proof construction permits its exposure to all weather conditions. On the other hand, the transmitter has not been made weather-proof and, therefore, must be sheltered in all installations. Performance tests of the Type CRV-52244 Radio Transmitter under conditions of varying ambient temperature are discussed in the main body of this report. The Antenna Control and Antenna Drive Units were subjected to such ambient temperature variation tests as were possible using the test equipment available. Since each main unit of the equipment is provided with a dehumidifying heater, these units were tested first with the heaters de-energized and then energized.

[redacted]

10. After the necessary interconnecting cables were in place, the Antenna Control Unit and Antenna Drive Unit were subjected to an ambient temperature variation test, ranging from -28°C to +55°C. For the 12-hour period prior to the test, the heaters and driving motors of the two units remained de-energized. The ambient temperature of the refrigerating chamber was reduced to -28°C at the start of the test, having been below -18°C for the five hours just prior to the start. This ambient temperature was held for one hour. At the end of the period, the motor circuit of each unit was energized and the operation observed. The Antenna Drive Unit failed to rotate, as did the Control Unit. However, the synchronizing circuit of the equipment is such that operation of the Control Unit is dependent upon rotation of the Antenna Unit and, therefore, the Control Unit may have been free to rotate had the Antenna Drive Unit rotated. The temperature was increased in 10°C steps at one-hour intervals. As the ambient temperature reached -12°C, the Antenna Unit was able to turn slowly. When the Antenna passed the synchronizing point, operation of the Control Unit was obtained. By the time the ambient temperature had reached -2°C, both units were running freely. The test was continued, as the temperature was raised in steps, until an ambient of +55°C was reached. Both units operated satisfactorily at this temperature for a period of one hour. At the end of the test, no indication of grease or oil leakage was observed. The chief limitation of the equipments, as discovered by this test, was the inability of the Antenna Drive and Control Units to operate as a whole at ambient temperatures below -2°C as a result of a drag on the driving motor, apparently due to the congealing action of the gear lubricants.

11. The ambient temperature test described in paragraph 10 above was repeated, but the test conditions varied slightly in that the heater in each unit was energized for the 12-hour period just prior to the test and throughout the test. An ambient temperature of -30°C was held for a period of two hours. At the end of this time, both units rotated freely upon being energized, indicating, in the case of the Antenna Unit, that the drag of the gear lubricants upon the drive motor had been relieved by maintaining some degree of heat within the unit. An indication of the effectiveness of the heaters in maintaining the internal temperatures of the Units is obtained from a study of the data taken during the tests. For the condition in which the heaters were de-energized, an ambient temperature of -28°C resulted in lowering the internal temperature of the Control Unit to -23°C and that of the Drive Unit to -27.8°C. On the other hand, when the heaters were energized, an ambient temperature of -30°C lowered the temperature in each unit to a value of only -12°C. It is evident, therefore, that the heaters contributed to the satisfactory operation of

[redacted]

the equipment in the low temperature region, in that they maintained the internal temperature of the units considerably above the ambient temperature and thus maintained the gear lubricants in a more fluid state.

12. Since the Antenna Drive Unit was successfully operated at a temperature of -30°C, as a result of the action of the heater, an effort was made to determine, within the limitations of the test equipment, to what lower ambient temperature the heater would insure operation of this unit. The ambient, therefore, was reduced to the limit of -34.5°C and held for one hour. During this time the heater was de-energized and at the end of the period the motor failed to rotate the antenna. Then the heater was energized and after a period of 45 minutes, with no change in ambient, the heater had increased the internal temperature of the unit to such a degree that the oil became sufficiently fluid and allowed the motor to rotate. Only the Antenna Drive Unit, and not the Control Unit, was subjected to the -34.5°C ambient test, since it alone contains gears operating in an oil bath and therefore suffers to a greater degree from the dragging action of the oil at the low temperatures.

13. In view of the fact that difficulty was experienced with the gear lubricants of this equipment during the ambient temperature tests, a brief description of the gear system is given. Rotation of the antenna assembly is accomplished by an 1800 r-p-m synchronous motor working through two speed-reducers. One reducer is integral with the motor frame assembly and reduces the speed to 30 r.p.m. A second speed-reducer, built into a gear box within the antenna pedestal casing, performs the final speed reduction to 2 r.p.m. The output shaft of this reducer drives the antenna assembly. Each reducer employs a worm and worm-wheel gear set to accomplish the reduction in speed. The lubricant provided in the motor speed reducer is Navy type 14L3 grease, while Navy type 6135 oil (Commercial 600W oil) is employed in the gear box. It is believed that the congealing of these lubricants at the lower temperatures was responsible for stalling of the antenna drive motor as reported in paragraph 11 above.

14. Of interest in the performance of this equipment is the operation of the de-humidifying heaters at the high ambient temperatures. During an ambient temperature test, ranging from 0°C to +55°C, the operation of the heater circuits was observed by means of line ammeters and the internal temperatures of the Antenna Control and Drive Units recorded by suitable maximum and minimum thermometers. At the ambient temperature of +55°C, the internal heat in each unit was sufficient to maintain the thermostats in the "open" position. The Control Unit thermostat remained open while the ambient

[redacted]

was held above +28°C. Its heat cycle at this temperature was 5 minutes "on" and 20 minutes "off." The cycle gradually changed, as the ambient was reduced, until at an ambient temperature of 0°C the heat cycle was 15 minutes "on" and 6 minutes "off." The Antenna Drive Unit heater remained "off" while the ambient temperature exceeded +29.5°C. At this temperature the heater thermostat closed and never reopened as the ambient temperature was reduced to 0°C. The maximum internal temperatures recorded at an ambient of +55°C were +57°C in the Control Unit and +72°C in the Antenna Drive Unit. Conversely, at an ambient temperature of -30°C, equal minimum internal temperatures of -12°C were recorded in the Antenna Control and Drive Units when the heaters were operating.

15. In view of the possible operation of this equipment under ambient temperature conditions considerably below -34°C, additional tests were conducted to determine ways and means of improving the action of the Antenna Drive Unit gear lubricants. There became available at this time a quantity of WS-334 grease produced by the Standard Oil Company of New Jersey. Data obtained regarding the performance of the WS-334 grease indicated the possibility of satisfactory operation with this grease down to temperatures of -40°C and -50°C. This grease, therefore, was substituted for the type 6135 oil in the gear box of the Antenna Drive Unit, after which the unit was subjected to an ambient temperature of -50°C for a period of two hours. During the chilling period, the drive motor and heater were de-energized. With the unit thoroughly chilled, the motor was energized and rotated after first overcoming an internal drag. Thus, it was evident that the use of the WS-334 in the gear box of the Antenna Drive Unit greatly reduced the dragging action suffered by the motor when Navy type 6135 oil was employed at low temperatures. As explained in paragraph 13 above, the motor speed-reducer was provided with Navy type 14L3 grease. Then at an ambient temperature of -50°C the Antenna Drive Motor started immediately and ran freely. This test was repeated later after the gear box cover had been removed to expose the gearing and lubricant for observation. Satisfactory lubrication of the worm and worm-wheel gears was noted. Little tendency for the grease to channel was observed and the grease maintained a soft consistency with an oily appearance at the -50°C temperature. A similar test was made at an ambient temperature of +50°C and suitable lubrication also was observed and it was noted that the WS-334 grease maintained a firm consistency with an oily texture. In making the above tests the Antenna Drive Unit was operated for periods of four hours at each temperature. After the completion of these tests, the unit was partially disassembled to permit examination of the ball bearings employed in the gear box. No trace of wear or corrosion was in evidence on the gears or bearing. The bearings and gears had been in contact with the

[redacted]

WS-334 grease for a period of three weeks and during this time the unit was operated for approximately 30 hours. In the light of the known performance of the WS-334 grease in the Antenna Drive Unit, in which it was employed for the lubrication of worm gearing and slow speed shafts running on ball bearings, it should prove superior to the Navy type 6135 oil and Navy type 14L3 grease used in the Model YG Equipment.

Icing Tests of the Model YG Antenna Drive Unit

16. In addition to operating under conditions of adverse ambient temperatures, the nature of the Antenna Drive Unit is such that it may be exposed to severe icing conditions. The constructional design of the unit requires that the antenna assembly rotate in respect to the pedestal at a rate of 2 r.p.m. Formation of an ice coating over the outer surface of the pedestal and the antenna base plate presents the danger of the unit becoming ice-bound, resulting in retardation of the rotation and even stopping the antenna rotation. With this possibility in mind, icing tests of the Antenna Drive Unit were conducted to determine to what extent the operation of the unit may be impaired by ice coatings of various thicknesses.

17. The icing tests of the Antenna Drive Unit were performed in the temperature-controlled chamber at a low ambient temperature. Water was introduced in the form of a fine spray from a nozzle, thus permitting the spray to be applied to any part of the antenna unit. At the start of the test, the Antenna Drive Unit was rotating and the heater energized. After establishing a -30°C ambient condition, the unit was sprayed with water from the nozzle. Care was taken to concentrate the spray on the throat formed by the antenna base plate and the pedestal casing, since at this point two large parallel surfaces were presented. The turning of the antenna resulted in a relative motion between these surfaces. As the two surfaces were horizontal, water accumulated on the upper and fell to the lower. In so doing, a stalactite-stalagmite formation was developed. The growth of the ice formation from the two surfaces continued until contact was made. The rotational motion between the antenna base and the pedestal resulted in a shearing action on the contacting ice formations, generating a multitude of flat sliding surfaces. The ice formations developed more rapidly near the outer periphery of the antenna base and thus formed a protective screen, retarding the development of the ice formation in the area beneath. The temperature of the spray water as it left the nozzle was 15°C to 20°C. Under the ice conditions described above, the antenna continued to rotate at synchronous speed while the spray was maintained and the heater energized. The removal of either the spray or the heat, while not actually stopping the rotation, resulted in a severe

[redacted]

binding action between the ice surfaces, sufficient to reduce the motor speed below the synchronous speed of 1800 r.p.m. From the performance of the unit observed during the test, it was assumed that the combined action of the heater and the warm spray resulted in maintaining a lubricating water film between the sliding ice surfaces. Under service conditions where the spray temperature may be near freezing, the lubricating film may not be present and stoppage of the antenna rotation may result. However, should the ice formation develop after the antenna is started rotating, satisfactory operation may be expected if the binding action between the ice surfaces does not become too severe.

18. The test reported in paragraph 17 above indicates that, under certain icing conditions, the antenna rotation will continue after having once started. To determine the ability of the motor to start under these conditions, after being momentarily stopped, the icing tests were continued. To insure against the two ice masses freezing together, the spray was removed and all water frozen before the antenna rotation was stopped. The motor started normally upon energizing, indicating no tendency for the ice surfaces to freeze together in the absence of the spray. However, a light spray applied to the unit while inoperative was sufficient to freeze the ice formation into a solid block which locked the motor. The extent of the ice mass was such as required one man to work for six minutes before sufficient ice was chipped away to free the antenna. After completely removing the ice from the throat of the unit, this surface was sprayed lightly with water to permit the formation of an ice coating. Coatings of approximately one-half inch thickness, extending roughly 180 degrees around the throat was sufficient to lock the antenna beyond the power of the motor to break the ice coating. However, thinner ice coatings were easily broken.

19. The outstanding fact disclosed by the icing tests was the inadequacy of the Antenna Drive Unit design to minimize the development of ice formations which may interfere with the operation of the unit. The large parallel surfaces present on the surface of the unit are detrimental from this standpoint in that they permit the formation of a large compact ice mass within the intervening space. This ice mass presents an effective braking action on the rotation of the antenna, and may result in slowing the rotational speed or actually stopping the antenna rotation.

20. In general, land based equipment not subjected to spray will experience most severe icing conditions at temperatures ranging from 0°C to -10°C. At these temperatures the dehumidifying heaters will to some extent prevent solid ice formations and if the antenna is kept rotating uninterrupted

[redacted]

operation may be possible. On board ship, however, where the antenna may be exposed to spray, ice formations may accumulate at lower temperatures and the rotational equipment may be stalled. If the location of the Antenna Unit is such that frequent servicing is possible, the use of anti-freeze or ice inhibiting compounds should prove practicable. The Naval Research Laboratory has developed compounds of this type, both in liquid and in paste form. The paste form, heated before application and applied with a brush, should prove to be more suitable. The periods of renewal will depend largely on the local conditions encountered. It is suggested that consideration be given to supplying anti-freeze compounds to such installations as may be subject to frequent icing troubles.

[redacted]

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Table 1

Model YG Transmitting Equipment

LIST OF DIMENSIONS AND WEIGHTS

<u>Transmitter Unit</u>

Height:	31-5/8" (Overall)
Width:	20" (Overall)
Depth:	19-7/8" (Overall)
Weight (with tubes):	190-1/2 Lbs.

<u>Frequency Meter Box</u>

Height:	8-1/4" (Overall)
Width:	18-1/4" (Overall)
Depth:	6-5/8" (Overall)
Weight (including Freq. Meter):	14-1/2 Lbs.
Weight of Freq. Meter:	6-1/2 Lbs.

<u>Spare Parts Box</u>

Height:	9-1/2" (Overall)
Width:	29-1/8" (Overall)
Depth:	13-1/2" (Overall)
Weight (including spare parts):	34 Lbs.

<u>Antenna Control Unit</u>

Height:	15-1/4" (Overall)
Width:	16-7/8" (Overall)
Depth:	10-3/8" (Overall)
Weight (Listed on nameplate):	65 Lbs.

<u>Antenna Drive Unit and Assembly</u>

Height:	46-7/8" (Overall)
Width:	41" (Overall)
Turning Radius:	21-13/16" (Overall)
Weight (Listed on nameplate):	187 Lbs.

[redacted]

Table 2

Model YG Transmitting Equipment

NAMEPLATE DATA

1. (Size: 3-1/2 by 3 inches. Placed on door at lower left of transmitter.)

Model YG
Homing Beacon Equipment

Output	Emission	Carrier Frequency
25 Watts	MCW (A2)	246 Mc

Supply: 115V 1ϕ 60~ Serial 6

Equipment Consists of Accessories and the Following:
1 CRV-23271 Antenna Control Unit
1 CRV-52244 Radio Transmitter
1 CRV-66037 Antenna Assembly

SEE LICENSE NOTICE INSIDE

NAVY DEPARTMENT
BUREAU OF SHIPS

CONTRACTOR:
RCA MANUFACTURING CO., INC.
CAMDEN, NEW JERSEY

Contract Number	Contract Date
NOs-820A	______

- -

(Continued)

Table 2 (Cont'd)

2. (Size: 3 by 2 inches, Placed on door at top-right of transmitter.)

Type CRV-52244
Radio Transmitter
Carrier Frequency: 246 Mc
Supply: 115 Volts 1 Phase 60 Cycles
187 Pounds Serial 6
A Unit of Model YG Radio Equipment
Manufactured For
Navy Department - Bureau of Ships
By Contractor:
RCA Manufacturing Co., Inc.
Camden New Jersey
Contract Number Contract Date
NOs-820A ____________

- -

3. (Size: 3 by 1-1/2 inches, Placed in center of door at lower-left of transmitter. Has red background.)

----WARNING----
VOLTAGES USED IN THIS EQUIPMENT
ARE DANGEROUS TO LIFE. BEFORE
OPENING DOORS OR WITHDRAWING
CHASSIS, SET "LINE" SWITCH
IN "OFF" POSITION

- -

Table 3

Model YG Transmitting Equipment

LIST OF CONTROLS AND METERS

Control Letter	Control Marking	Dial Marking	Dial Rotation to Effect Increase in Numerical Reading
A	Mod. Osc. Tuning	0-1200	Clockwise
B*	Mod. Osc. Trimmer	None	
C	Mod. Amp. Tuning	0-90	Clockwise
D*	H-F Osc. Trimmer	None	
E	Monitor Tuning	0-90	Clockwise
F*	Output Coupling	None	

* Controls B, D, and F are slotted shafts recessed in front panel, and are adjusted by screwdriver.

TEST KEY:	Toggle Type. Down: Momentary on. Horizontal: Off. Up: Lock on.
CALIBRATE-MONITOR SWITCH:	Toggle Type. Down: Monitor. Up: Calibrate.
PLATE SWITCH:	Toggle Type. Down: Off. Up: On.
LINE SWITCH:	Toggle Type. Down: Off. Up: On.
OVERLOAD RESET BUTTON:	Push Button Type. Single button for resetting.

Filament Voltage Rheostat - Increase clockwise.
Plate Voltage Rheostat - Increase Clockwise.
Monitor Volume Rheostat - Increase clockwise.
Calibration Chart - Mod. Freq.
Carrier Frequency-Meter Output Coupling.
Keying Monitor Phone Jack.

(Continued)

Table 3 (Cont'd)

METERS

All Westinghouse manufactured with anti-glare glass.

Nameplate Marking	Range	Type	Serial No.
Main Plate Voltage	0-750-V, D.C.	NX-35	None
Mod. Osc. Plate Current	0-50 ma, D.C.	NX-33	None
Filament Voltage	0-10-V, A.C.	NA-33	None
H-F Osc. Plate Current	0-300 ma, D.C.	NX-33	None
Mod. Amp. Plate Current	0-300 ma, D.C.	NX-33	None

Table 4

Model YG Transmitting Equipment

CALIBRATION OF METERS

Plate Voltmeter 0-750-V d.c. (M201)		Filament Voltmeter 0-10-V a.c. (M103)	
Reads	Actual	Reads	Actual
100	95	2.0	1.90
300	290	4.0	3.95
500	490	6.0	6.00
650	635	8.0	8.00
750	740	10.0	10.00
Max. Error = 15-V or 2% of F.S.		Max. Error = 0.1-V or 1% of F.S.	

S-F Osc. Plate MA 0-300 ma d.c. (M104)		Mod. Osc. Plate MA 0-50 ma d.c. (M101)		Mod. P-A Plate MA 0-300 ma d.c. (M102)	
Reads	Actual	Reads	Actual	Reads	Actual
50	53.5	10	9.4	50	52.5
100	106.0	20	19.7	100	103.0
150	158.0	30	29.8	150	154.0
200	211.0	40	39.4	200	204.0
250	260.0	50	50.2	250	251.0
300	312.0			300	305.0
Max. Error = 12 ma or 4.0% of F.S.		Max. Error = 0.6 ma or 1.2% of F.S.		Max. Error = 5 ma or 1.7% of F.S.	

Table 5

Model YG Transmitting Equipment

CHECK OF RESISTORS

Res. Symbol No.	Navy Type No.	Mfr's Type	Mfr's Rating Res. (Ohms)	Mfr's Rating Max. Watts	Measured Values Ohms	Measured Values Ma	Measured Values Watts
R-101	63474	BT-2	15000	2	14200.	3.	0.128
R-102	None	D5-ST2A	22000	5	22400.	8.2	1.51
R-103	63288	BT-2	22000	2	22640.	2.3	0.120
R-104	None	D5-ST2A	200	5	201.8	83.	1.39
R-105	None	D5-ST2A	50000	5	53300.	5.75	1.77
R-106	None	D5-ST2A	2500	5	2299.	38.	3.32
R-107	None	D5-ST2A	6500	5	6278.	9.6	0.578
R-108	None	D5-ST2A	12000	5	13170.	9.2	1.115
R-109	None	D5-ST2A	12000	5	11690.	19.6	4.49
R-110	None	D5-ST2A	1000	5	982.4	19.6	0.379
R-111	None	D5-ST2A	1000	5	993.3	19.6	0.383
R-112	None	D5-ST2A	2500	5	2733.	29.3	2.35
R-113	None	D5-ST2A	2500	5	2664.	29.3	2.29
R-114	None	D5-ST2A	2500	5	2670.	29.3	2.29
R-115	None	D5-ST2A	2500	5	2599.	29.3	2.23
R-116	63474	BT-2	47000	2	48900.	1.10	0.059
R-117	None	D5-ST2A	200	5	202.8	140.	3.98
R-118	None	D5-ST2A	200	5	214.7	85.	1.55
R-119	63288	BT-1	56000	2	56400.	Negligible	
R-120	None	None	56	1/2	55.5	Negligible	
R-201	None	Model K	25	100 (2-A)	25.85	1580.	62.5 Max.
R-202	None	Model J	22	50 (1.5-A)	23.03	700.	11.3 Max.
R-203	None	G.E. Cat. 51X334	-----	150	80.6	1400.	158.
R-302	None	BW	220	1			
R-303	63288	BT-1	180000	1			
R-304	63288	BT-1	68000	1			
R-305	63288	BT-1	22000	1			
R-306	None	CP	75000	(Potentiometer)			
R-307	63474	BT-2	100000	2			

Note: (1) Resistance and currents of R-302 to R-307, incl. were not measured, due to their inaccessibility.
(2) Types BT-1 and BT-2 are IRC metallized resistors.
(3) Type D5-ST2A is ceramic insulated composition resistor.

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Table 6
Model YG Transmitting Equipment
VACUUM TUBE POTENTIALS AND CURRENTS

Tube Element	Super-freq. Oscillator V-103 & V-104		Modulator Oscillator V-101		Modulator Amplifier V-102		Monitor V-301		Rectifier	
	Key Up	Key Down	Key Up	Key Down	Key Up	Key Down	Key Up	Key Down	Key Up	Key Down
Voltages										
Plate Supply	---	---	---	---	---	---	175	115	640	585
Plate to Ground	640	585	430	123	640	585				
Screen to Ground	---	---	430	280	640	281				
Grid to Ground	-90	-86	0	-52	0	-48.4				
Cathode to Ground	28	26	80	0	82	31				
Peak Inverse Voltage									1970	
Plate to Cathode	612	559	350	123	558	554				
Screen to Cathode	---	---	350	280	558	250				
Grid to Cathode	-118	-112	-80	-52	-82	-79.4				
Filament		6.33		6.3		6.28				2.35
Currents (Ma)										
Plate	110	103	0.1	6.9	0.5	67.9			140	220
Screen	---	---	0	10.7	0	5.9				
Grid	36	34.5	0	3.6	0	2.2				
Cathode	146	138	0.1	21.2	0.5	76	9.0	5.5		
D-C Inputs (Watts)										
Plate	67.2	57.5(1)	---	0.85	---	37.6				
Screen	---	---	---	3.00	---	1.5				

(1) Does not include modulation power.

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Table 7

Model YG Transmitting Equipment

FREQUENCY RANGE OF SUPER-FREQUENCY OSCILLATOR AND SUPER-FREQUENCY OSCILLATOR TRIMMER CAPACITOR

Oscillator Frequency Range

Distance from Forward Edge of Shorting Bar to Forward Edge of Grounded End of Frame: Grid Frame	Filament Frame	Freq. (Mc)	Carrier Power (Watts)
1-20/32"	1-17/32"	214.8	24.5
3-13/32"	2-29/32"	246.0	20.7
5-5/32"	4-8/32"	290.0	16.0

Trimmer Capacitor Frequency Range

Capacitor Setting	Freq. (Mc)	Capacitor Range: Mc	Capacitor Range: Per Cent
Min. Cap.	248.35		
Max. Cap.	242.45	5.90	2.41

Table 8

Model YG Transmitting Equipment

FREQUENCY RANGE AND OVERLAP OF
MODULATING OSCILLATOR AND POWER AMPLIFIER

Control Designation	Dial Reading	Frequency (Kc)	Spec. Freq. Limit	Overlap (Kc)	Mean Frequency (Kc)	Overlap (%)
A	0	486.71	540.00	53.29	513.36	10.4
(M.O.)	1100	855.85	830.00	25.85	842.93	3.07
	1200	827.68*				
C	9.5**	486.71	540.00	53.29	513.36	10.4
(P.A.)	90.0	827.49	830.00	-2.51	828.74***	-0.303

Note: * (1) Frequency of modulating oscillator decreases above a dial setting of 1100 because the variometer goes beyond the point of minimum inductance.

** (2) Limited by lowest frequency of M.O.

*** (3) P.A. lacks overlap.

Table 9

Model YG Transmitting Equipment

RANGE OF MOD. OSCILLATOR RESET CAPACITOR

Osc. Dial Setting	Trimmer Capacitor Setting	Freq. of Mod. Osc. (Kc)
500	Original	582.54
500	Minimum Capacity	608.22
500	Maximum Capacity	571.26

Maximum upward variation from original frequency:
25.68 kc; 4.41 per cent.

Maximum downward variation from original frequency:
11.28 kc; 1.93 per cent.

Total frequency variation, maximum to minimum:
36.96 kc; 6.34 per cent.

Table 10

Model YG Transmitting Equipment

CALIBRATION OF MODULATING OSCILLATOR
AND
HETERODYNE MONITOR

Osc. Dial Reading	Freq. (Kc)	Modulating Oscillator Dial Settings	Monitor Dial	Freq. (Kc)
000	486.77	223.0	0	508.0
100	493.15	317.5	10	527.0
200	505.93	417.5	20	553.0
300	523.20	503.3	30	583.0
400	547.84	584.9	40	617.0
500	581.93	669.0	50	669.0
600	625.83	767.1	60	711.0
700	677.11	897.5	70	779.0
800	729.70	-----	80	875.0
900	781.64			
1000	832.15			
1100	855.17			

Notes: (1) Standard - LM-2 Freq. Indicator.

(2) Monitor dial calibrated by zero beat method using signal from previously calibrated modulating oscillator.

Table 11

Model YG Transmitting Equipment

CARRIER POWER OUTPUT

	1	2	3	4
Plate Supply Voltage	625.	626.	626.	625.
Plate Voltage	596.	594.	591.	594.
Plate Ma	110.	117.	130.	117.
Grid Ma	34.5	42.0	47.0	40.0
Input Watts	65.5	69.5	76.7	69.5
Output Watts	21.5	22.0	23.8	21.9
Efficiency (%)	32.8	31.7	31.4	31.5
Shorting Bar Spacing From Ground End.				
Grid Bar	3-12/32"	3-14/32"	3-19-32"	3-14/32"
Filament Bar	2-20/32"	2-16/32"	2-12/32"	2-16/32"
Coupling Loop Spacing From Front End of Slot.	30/32"	23/32"	1-12/32"	1-16/32"

Notes: (1) Plate Voltage Noted =

$$(\text{Plate Supply Voltage}) - \left[(I_p + I_g) \times R_{Cathode}\right]$$

(2) For the data of columns 1, 2, and 3 the power output was measured at the end of the four-foot section of flexible coaxial cable which forms the output terminal of the transmitter.

(3) For the data of column 4 the power output was measured at the end of a 20-1/2-foot section of 7/8-inch copper-isolantite coaxial transmission line.

Table 12

Model YG Transmitting Equipment

POWER OUTPUT WITH MODULATION "ON"

Plate Supply Voltage	Super Freq. Osc. Plate (Volts)	Super Freq. Osc. Plate (Ma)	Super Freq. Osc. Grid (Ma)	Mod. Freq. (Kc)	Modulator Osc. Cathode (Ma)	Modulator P-A Cathode (Ma)	Power Output (Watts)	Per Cent Mod.
565	536	105	39	500	20.5	66.0	24.5	81
565	536	106	39	550	20.2	67.5	24.5	81
565	536	106	40	600	19.6	70.1	24.7	77
563	533	106	39	650	19.5	77.5	24.5	76
563	533	106	39	700	19.7	81.0	24.5	76
552	522	105	38	750	20.0	83.0	23.8	75
548	520	104	38	800	20.7	85.0	23.2	72

Note: (1) Carrier frecuency - 246 mc.
(2) Per cent modulation determined by measuring the trapezoidal pattern produced by applying the modulating voltage and the carrier voltage to the plates of a cathode-ray oscillograph.

Table 13

Model YG Transmitting Equipment

COMPARISON OF POWER OUTPUT AT TRANSMITTER TERMINAL AND AT END OF 190-FEET OF 7/8-INCH COPPER-ISOLANTITE COAXIAL TRANSMISSION LINE

Unit	Power Output Measured at Transmitter Terminal		Power Output Measured at End of 190-Foot Line	
	Unmodulated	Modulated	Unmodulated	Modulated
Modulation Freq.	-----	550 Kc	-----	550 Kc
Plate Supply Voltage	625.	625.	625.	625.
Super Freq. Osc.				
Plate Voltage	594.	534.	594.	537.
Plate Ma	115.	104.	108.	98.
Grid Ma	39.	36.	45.	42.
Modulator				
Osc. Cathode Ma	-----	20.3	-----	20.8
P-A Cathode Ma	-----	68.	-----	63.
Power Output	19.0	21.5	12.	12.5
Db Attenuation	-----	-----	2.0	2.4
Modulation Freq.	-----	800 Kc	-----	800 Kc
Plate Supply Voltage	625.	625.	625.	625.
Super Freq. Osc.				
Plate Voltage	584.	520.	594.	525.
Plate Ma	118.	105.	115.	98.
Grid Ma	36.	33.	41.	42.
Modulator				
Osc. Cathode Ma	-----	20.0	-----	21.3
P-A Cathode Ma	-----	85.	-----	75.
Power Output	20.	21.	12.5	10.8
Db Attenuation	-----	-----	2.0	2.9

Table 14

Model YG Transmitting Equipment

CARRIER FREQUENCY DRIFT FROM A COLD START (NO MODULATION)

Time	Carrier Frequency (Mc)	Change in Frequency Mc	Change in Frequency Per Cent	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Super-Freq. Oscillator Grid (Ma)	Power Output (Watts)
1035	246.12	----	------	640	111	36.	22.5
1040	245.90	0.22	0.0893	640	111	36.	22.1
1045	245.88	0.24	0.0974	640	112	36.	22.5
1055	245.84	0.28	0.1140	643	112	37.	22.4
1105	245.80	0.32	0.1300	640	111	36.5	21.9
1115	245.80	0.32	0.1300	640	112	36.0	21.9
1125	245.80	0.32	0.1300	638	111	36.5	21.9
1135	245.80	0.32	0.1300	640	112	37.0	21.9

Note:
(1) Deviation during the first five minutes: 0.22 mc, or 0.089 per cent.
(2) Maximum deviation during the remainder of the run from the freouency at the end of five minutes: 0.10 mc, or 0.0406 per cent.
(3) Deviation from beginning to end of run: 0.32 mc, or 0.130 per cent.
(4) Decrease in power output: 0.6 watts or 2.7 per cent.
(5) Antenna: 15-watt, 32-volt lamp matched load.

Table 15

Model YG Transmitting Equipment

TWO-HOUR LOCKED KEY TEST

Time	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Super-Freq. Oscillator Grid (Ma)	Modulator Osc. Cathode (Ma)	Modulator P-A Cathode (Ma)	Power Output (Watts)
0930	246.00	550,500	580	107	37.0	20.8	70	25.2
0935	------	550.505	---	---	----	----	--	----
0940	246.00	550,519	578	107	38.5	20.8	70	25.1
0950	246.00	550.515	575	106	37.0	20.5	70	25.1
1000	246.00	550.522	575	106	36.5	20.5	70	25.0
1010	245.92	550.523	572	105	36.5	20.2	70	24.9
1020	245.92	550.518	575	105	37.0	20.5	70	24.9
1030	245.92	550.515	570	105	37.0	20.5	70	24.8
1040	245.90	550.515	572	106	37.0	20.5	70	24.9
1050	245.90	550.510	575	106	37.5	20.8	70	25.0
1100	245.90	550.509	575	106	37.5	20.8	70	24.9
1110	245.90	550.508	570	106	37.0	20.5	69	24.7
1120	245.90	550.508	570	105	37.0	20.5	69	24.5
1130	245.90	550.508	572	105	37.0	20.5	69	24.7

Note:
(1) Maximum carrier frequency drift: 0.10 mc, or 0.041 per cent.
(2) Modulator deviation during the first five minutes: 5 cycles, or 0.001 per cent.
(3) Modulator maximum deviation during the remainder of the run from the frequency at the end of five minutes: 18 cycles, or 0.00327 per cent.
(4) Modulator deviation from beginning to end of run: 8 cycles, or 0.0016 per cent.
(5) Decrease in power output: 0.5 watt, or 2.0 per cent.
(6) Antenna: 32-volt, 15-watt lamp.

Table 16

Model YG Transmitting Equipment

TWO-HOUR LOCKED KEY TEST

Time	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Super-Freq. Oscillator Grid (Ma)	Modulator Osc. Cathode (Ma)	Modulator P-A Cathode (Ma)	Power Output (Watts)
0920	246.00	800.698	570	105	37.0	21.6	81.0	25.5
0930	245.82	800.685	575	108	38.0	22.0	82.0	26.0
0940	245.78	800.685	578	109	38.5	22.0	82.0	26.0
0950	245.75	800.695	575	109	38.0	21.8	82.0	25.5
1000	245.75	800.700	575	109	37.5	21.8	82.0	25.0
1015	245.70	800.698	575	108	37.5	21.8	82.0	25.2
1020	245.75	800.699	570	108	37.5	21.8	81.0	24.8
1030	245.75	800.698	575	108	37.8	21.8	81.0	24.8
1040	245.72	800.696	570	108	37.8	21.8	81.0	24.8
1050	------	800.692	570	108	37.8	21.8	81.0	24.8
1100	------	800.691	571	108	37.8	21.8	81.0	24.8
1110	------	800.695	570	107	37.5	21.8	80.0	24.0
1120	------	800.694	573	108	38.0	21.8	80.0	24.8

Note:
(1) Maximum carrier frequency change: 0.30 mc, or 0.122 per cent.
(2) Modulator deviation during the first five minutes: 6.5 cycles, or 0.00081 per cent.
(3) Modulator maximum deviation during the remainder of the run from the frequency at the end of five minutes: 8.5 cycles, or 0.00106 per cent.
(4) Modulator deviation from beginning to end of run: 4 cycles, or 0.0005 per cent.
(5) Decrease in power output: 0.7 watt, or 2.7 per cent.

Table 17

Model YG Transmitting Equipment

CARRIER FREQUENCY DRIFT WITH KEYED MODULATION
KEYING SPEED - 23 W.P.M.

Time	Amb. Temp. (°C)	Carrier Frequency (Mc)	Super-Freq. Oscillator Plate (Ma)	Super-Freq. Oscillator Grid (Ma)	Output (Watts)
		Modulation Frequency - 550 Kc			
1315	31.5	250.222	100	32.5	19.8
1325	31.5	250.188	100	32.5	19.5
1335	32.5	250.179	100	32.5	20.0
1345	----	250.168	100	32.5	19.8
1355	32.7	250.173	100	32.5	19.8
1405	32.8	250.167	100	32.5	19.8
1415	32.8	250.179	101	34.0	20.4

Carrier deviation during the first ten minutes:
0.034 mc or 0.0136 per cent.
Carrier maximum deviation during the remainder of the run:
0.020 mc or 0.0080 per cent.
Carrier deviation from beginning to end of run:
0.043 mc or 0.0172 per cent.

Time	Amb. Temp. (°C)	Carrier Frequency (Mc)	Super-Freq. Oscillator Plate (Ma)	Super-Freq. Oscillator Grid (Ma)	Output (Watts)
		Modulation Frequency - 800 Kc			
1130	30.8	250.215	100	32.0	20.0
1140	30.8	250.190	100	32.0	20.0
1150	31.2	250.170	100	32.0	20.0
1200	31.2	250.170	100	32.0	20.0
1210	32.0	250.173	100	32.0	20.0
1215	32.2	250.172	100	32.0	20.0

Carrier deviation during the first ten minutes:
0.025 mc or 0.0100 per cent.
Carrier maximum deviation during the remainder of the run from the frequency at the end of ten minutes: 0.020 mc or 0.0080 per cent.
Carrier deviation from beginning to end of run: 0.043 mc or 0.0172 per cent.

Note: Keying was interrupted momentarily to permit measurements of carrier frequency.

Table 18

Model YG Transmitting Equipment

FREQUENCY DRIFT OF MODULATING FREQUENCY IN CHANGING FROM CONTINUOUSLY-KEYED TO INTERMITTENTLY-KEYED CONDITIONS

Frequency at End of 30 Minutes Continuous Keying (Mc)	Frequency at End of 10-Second Dash after 20-Minute Pause (Mc)	Frequency Change (Cycles)	Frequency Change (%)
550.520	550.514	6	0.00109
800.688	800.692	4	0.00050

Keying speed 23 w.p.m.

Table 19

Model YG Transmitting Equipment

FREQUENCY DEVIATION WITH OPERATION OF THE POWER OUTPUT CONTROL

Plate Supply Voltage	Per Cent Normal Voltage	Power Output (Watts)	Per Cent Normal Output	Carrier Frequency (Mc)	Modulator Frequency (Kc)
		Carrier Only			
670	105	22.0	119	250.095	-------
640	100	18.5	100	250.077	-------
600	94	15.0	81	250.059	-------
560	87	11.8	64	250.039	-------

Maximum deviation, carrier frequency: 0.038 mc or 0.0152 per cent.

Modulation Frequency - 550 Kc

587	100	26.6	100	246.00	550.500
550	94	23.5	88	245.98	550.496
550	85	19.0	72	245.95	550.495
451	77	15.0	56	245.90	550.499

Maximum deviation, carrier frequency: 0.10 mc or 0.0407 per cent.
Maximum deviation, modulation frequency: 5 cycles or 0.00091 per cent.

Modulation Frequency - 800 Kc

575	100	25.0	100	246.02	800.808
550	96	23.0	92	246.00	800.800
500	87	18.3	73	245.98	800.793
445	77	13.9	56	245.93	800.795

Maximum deviation, carrier frequency: 0.09 mc or 0.0346 per cent.
Maximum deviation, modulation frequency: 15 cycles or 0.00187 per cent.

Note: In each case the lowest voltage in the group of four readings is the minimum obtainable by operation of the plate voltage control.

Table 20

Model YG Transmitting Equipment

VARIATION OF LINE VOLTAGE

Line Volts	Filament Volts	Plate Supply Voltage	Modulated Output (Watts)	Modulator Frequency (Kc)	Change in Modulator Frequency Cycles	Change in Modulator Frequency Per Cent	Carrier Frequency (Mc)	Change in Carrier Freq. Mc	Change in Carrier Freq. Per Cent
Minus 10 Per Cent to Plus 10 Per Cent in 5 Minutes									
103.5	5.5	518	21.0	550.577	--	-------	246.05	----	------
115.0	6.2	585	26.0	550.555	22	0.0040	246.00	0.05	0.0203
126.5	6.45	640	31.2	550.540	37	0.0067	245.92	0.13	0.0528
Minus 10 Per Cent to Plus 10 Per Cent in 1 Minute									
103.5	5.6	525	20.5	550.615	--	-------	245.68	----	------
115.0	---	---	----	550.598	17	0.00309	245.60	0.08	0.0326
126.5	6.46	649	31.0	550.590	25	0.00455	245.54	0.14	0.0570
Minus 5 Per Cent to Plus 5 Per Cent in 5 Minutes									
109.2	5.9	555	23.0	550.572	--	-------	245.62	----	------
115.0	6.2	585	26.0	550.555	17	0.00309	245.52	0.10	0.0407
120.8	6.6	615	28.5	550.535	37	0.00673	245.45	0.17	0.0691
Minus 5 Per Cent to Plus 5 Per Cent in 1 Minute									
109.2	5.95	560	24.6	550.555	--	-------	245.58	----	------
115.0	6.25	590	27.3	550.549	6	0.00109	245.50	0.08	0.0327
120.8	6.28	615	29.0	550.542	13	0.00236	245.48	0.10	0.0408

(Continued)

Table 20 (Cont'd)

Line Volts	Filament Volts	Plate Supply Voltage	Modulated Output (Watts)	Modulator Frequency (Kc)	Change in Modulator Frequency Cycles	Change in Modulator Frequency Per Cent	Carrier Frequency (Mc)	Change in Carrier Freq. Mc	Change in Carrier Freq. Per Cent
Minus 10 Per Cent to Plus 10 Per Cent in 5 Minutes									
103.5	5.65	522	20.0	800.478	--	-------	245.55	----	------
115.0	6.25	578	25.1	800.437	41	0.00512	245.50	0.05	0.0203
126.5	6.48	635	30.0	800.390	88	0.0110	245.42	0.13	0.0528
Minus 10 Per Cent to Plus 10 Per Cent in 1 Minute									
103.5	5.60	520	19.5	800.518	--	-------	245.58	----	------
115.0	6.30	580	25.9	800.508	10	0.00125	245.55	0.03	0.0122
126.5	6.45	632	30.2	800.485	33	0.00413	245.48	0.10	0.0407
Minus 5 Per Cent to Plus 5 Per Cent in 5 Minutes									
109.2	5.9	545	22.0	800.463	--	-------	245.60	----	------
115.0	6.3	580	25.5	800.434	29	0.00363	245.55	0.05	0.0203
120.8	6.6	605	27.6	800.421	42	0.00525	245.45	0.15	0.0610
Minus 5 Per Cent to Plus 5 Per Cent in 1 Minute									
109.2	5.9	549	22.8	800.448	--	-------	245.68	----	------
115.0	6.25	578	25.8	800.431	17	0.00213	245.60	0.08	0.0325
120.8	6.52	608	28.2	800.410	38	0.00475	245.55	0.13	0.0528

(Continued)

Table 20 (Cont'd)

Deviation of Modulation Frequency Only

Line Volts	Filament Volts	Plate Volts	Modulation Frequency (Kc)	Change in Frequency Cycles	Change in Frequency Per Cent
Plus 10 Per Cent to Minus 10 Per Cent in 1 Minute					
126.5	6.95	645	600.672	--	-------
115.0	6.20	585	600.665	7	0.00116
103.5	5.60	520	600.620	52	0.00867
126.5	6.90	645	650.665	--	-------
115.0	6.25	585	650.580	85	0.01307
103.5	5.60	525	650.452	213	0.0328
126.5	6.95	630	700.645	--	-------
115.0	6.25	570	700.630	15	0.00214
103.5	5.60	515	700.622	23	0.00384
126.5	6.95	635	750.558	--	-------
115.0	6.20	579	750.542	16	0.00213
103.5	5.60	520	750.530	28	0.00467

(Continued)

DECLASSIFIED

Table 20 (Cont'd)

Deviation of Modulation Frequency Only

Line Volts	Filament Volts	Plate Volts	Modulator Output (Watts)	Modulation Frequency (Kc)	Change in Frequency Cycles	Change in Frequency Per Cent
Normal to Minus 10 Per Cent in 10 Minutes to Plus 10 Per Cent in 5 Minutes						
115.0	6.3	585	27.0	600.665	--	-------
103.5	5.6	525	21.0	600.668	3	0.0005
126.5	6.9	645	31.0	600.648	17	0.00283
115.0	6.25	585	26.2	650.579	--	-------
103.5	5.58	525	21.0	650.590	11	0.001689
126.5	6.90	640	31.0	650.575	4	0.00061
115.0	6.30	578	25.8	700.694	--	-------
103.5	5.65	520	20.5	700.684	10	0.00143
126.5	6.95	638	30.9	700.712	18	0.00257
115.0	6.30	580	26.0	750.755	--	-------
103.5	5.65	520	20.5	750.738	17	0.00226
126.5	6.90	632	30.5	750.769	14	0.00186
115.0	6.30	580	22.0	800.662	--	-------
103.5	5.70	525	20.5	800.641	21	0.00262
126.5	7.00	640	31.0	800.670	8	0.0010

Table 21

Model YG Transmitting Equipment

VARIATIONS IN AMBIENT TEMPERATURE
Modulation Frequency - 550 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
0900	49.0	9	246.05	550.609	560	92.0	14.2	118.0
0910	50.0	9	246.00	550.582	565	92.0	14.2	119.0
0920	49.0	9	246.00	550.590	565	92.0	14.2	119.0
0930	49.0	9	246.00	550.560	568	92.5	14.8	119.0
0940	49.0	10	245.98	550.558	555	91.5	14.5	118.0
1000	49.0	9	245.98	550.549	560	91.5	14.5	118.5
1010	51.0	8	245.98	550.538	560	91.5	14.5	119.0
1020	50.0	9	245.98	550.532	560	91.8	14.5	119.0
1030	49.5	9	245.98	550.522	560	92.0	14.8	119.0
1040	49.0	9	245.98	550.519	560	92.0	14.8	119.0
1050	49.5	9	245.98	550.515	560	91.8	14.8	119.0
1100	50.0	9	245.98	550.522	560	91.8	14.8	119.0
1110	39.0	13	245.98	550.536	560	92.0	14.8	119.0
1120	32.3	17	245.98	550.559	560	91.8	14.8	119.0
1130	27.8	17	246.00	550.551	560	92.0	15.0	119.0
1140	25.0	17	246.02	550.561	565	93.0	15.0	120.0
1150	24.0	20	246.08	550.569	560	92.0	15.0	119.5
1200	24.5	19	246.08	550.569	565	92.0	14.8	119.0
1210	24.8	19	246.08	550.585	565	92.0	14.8	119.8
1220	24.8	19	246.10	550.592	565	92.0	14.5	119.8
1230	24.8	19	246.08	550.600	560	91.0	14.5	119.0
1240	24.0	20	246.12	550.608	560	91.0	14.8	118.5
1250	25.0	20	246.10	550.609	560	91.0	14.2	119.0
1300	24.5	22	246.12	550.611	565	92.0	14.8	120.0
1310	21.7	23	246.08	550.599	565	92.0	15.0	120.0
1320	12.8	26	246.12	550.601	565	92.0	15.0	120.0
1330	9.0	37	246.15	550.611	565	91.0	15.0	119.5

(Continued)

Table 21 (Cont'd)

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
1340	0.0	--	246.20	550.619	570	90.5	14.8	120.0
1350	0.5	--	246.20	550.658	575	90.5	14.8	120.5
1400	-1.0	--	246.25	550.662	575	90.5	14.5	121.0
1410	0.0	--	246.25	550.661	575	90.0	14.2	121.0
1420	0.0	--	246.28	550.662	575	90.0	14.2	121.0
1430	0.0	--	246.28	550.660	575	89.8	14.2	120.5
1440	0.0	--	246.28	550.659	575	89.8	14.0	120.5
1450	0.0	--	246.28	550.655	575	90.0	14.0	120.8
1500	0.0	--	246.29	550.652	575	89.5	14.0	120.0
1510	0.0	--	246.29	550.655	575	90.0	14.1	120.5
1520	0.0	--	246.29	550.655	575	89.5	14.0	120.0
1530	0.0	--	246.29	550.654	575	89.5	14.0	120.0
1540	0.0	--	246.30	550.655	575	89.5	14.0	120.8
1541	0.0	--	Equipment shut down.					
1550	0.0	--	Equipment shut down.					
1600	0.0	--	Equipment shut down.					
1610	0.0	--	Equipment shut down.					
1620	0.0	--	246.58	550.700	585	85.0	12.3	121.0

Summary of Frequency Deviations
with Variations in Ambient Temperature
Modulation Frequency - 550 Kc

Deviations During the Stabilizing Periods

Temp. (°C)	Carrier Frequencies		Carrier Deviation		Modulation Frequency		Modulation Deviation	
	Maximum	Minimum	Mc	Per Cent	Maximum	Minimum	Cycles	Per Cent
50	246.05	245.98	0.07	0.0284	550.609	550.515	94	0.0171
25	246.12	246.02	0.10	0.0407	556.611	550.561	50	0.0092
0	246.30	246.20	0.10	0.0407	550.662	550.619	43	0.0078

(Continued)

Table 21 (Cont'd)

Deviations Due to Temperature Change

Temp. Change (°C)	Carrier Deviation Per 25°C (Mc)	Carrier Deviation Per °C (%)	Modulation Deviation Per 25°C (Cycles)	Modulation Deviation Per °C (%)
50 to 25	0.140	0.00228	89	0.000648
25 to 0	0.180	0.00293	44	0.000320
Average Deviation per °C:		0.00260%		0.000484%

Table 22

Model YG Transmitting Equipment

VARIATIONS IN AMBIENT TEMPERATURE
Modulation Frequency - 800 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
0820	-28.0	--	246.32	800.478	545	89.0	14.2	116.0
0830	-29.0	--	246.31	800.465	545	89.0	14.2	115.5
0840	-27.8	--	246.30	800.470	555	91.0	14.8	118.0
0850	-28.0	--	246.25	800.472	550	90.5	14.8	117.5
0900	-27.8	--	246.28	800.481	555	91.5	14.8	118.5
0910	-28.0	--	246.27	800.484	560	91.5	15.0	118.9
0920	-28.0	--	246.25	800.488	555	91.0	14.8	118.5
0930	-28.0	--	246.25	800.488	560	92.0	15.0	119.0
0940	-27.8	--	246.25	800.488	557	91.5	15.0	118.8
0950	-27.8	--	246.23	800.488	560	92.0	15.0	120.0
1000	-27.5	--	246.23	800.488	545	89.9	14.2	116.0
1010	-27.5	--	246.25	800.488	545	89.5	14.5	116.0
1020	-16.0	--	246.30	800.518	545	89.0	14.0	116.0
1030	-11.0	--	246.28	800.524	545	90.0	13.8	116.5
1040	0	--	246.25	800.550	545	90.0	13.4	116.0
1050	+ 1.1	--	246.25	800.571	545	90.5	13.1	116.0
1100	+ 0.5	--	246.23	800.579	545	91.5	13.1	116.5
1110	+ 1.1	--	246.25	800.581	540	90.5	12.5	115.5
1120	0	--	246.22	800.576	540	90.5	12.5	116.0
1130	0	--	246.22	800.571	535	89.5	12.5	116.0
1140	0	--	246.21	800.569	540	91.0	12.5	116.5
1150	0	--	246.21	800.568	545	91.5	12.8	117.0
1200	0	--	246.20	800.566	545	91.5	12.8	117.0
1210	0	--	246.18	800.565	545	91.5	12.8	117.0
1220	+11.1	29	246.18	800.581	545	91.0	12.5	116.5
1230	+25.0	--	246.18	800.591	545	91.0	12.3	117.0
1240	+23.9	27	246.10	800.585	540	89.9	11.9	116.5
1250	+27.2	32	246.10	800.600	545	90.0	11.6	117.0
1300	+26.0	39	246.09	800.585	545	90.5	12.3	117.0
1310	+25.5	39	246.09	800.570	545	90.5	13.1	117.0
1320	+25.0	39	246.09	800.581	540	89.0	13.1	116.0
1330	+26.0	34	246.09	800.581	540	88.0	12.9	116.0
1340	+25.5	34	246.06	800.540	540	89.0	12.9	116.0

(Continued)

Table 22 (Cont'd)

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
1350	23.4	36	246.06	800.520	540	89.0	12.9	116.0
1400	25.0	39	246.06	800.515	540	89.5	12.9	116.0
1410	26.6	38	246.02	800.515	540	90.0	12.9	116.0
1420	27.6	33	246.03	800.513	540	90.0	12.9	116.5
1430	32.2	31	246.01	800.510	540	90.0	12.5	116.0
1440	37.2	32	246.01	800.515	540	90.0	12.5	116.0
1450	49.5	24	246.00	800.490	535	89.0	12.3	115.0
1500	51.1	22	245.99	800.461	540	90.0	11.9	116.0
1510	51.1	23	245.95	800.455	535	89.0	11.6	116.0
1520	50.0	26	245.95	800.440	535	88.9	11.2	115.0
1530	51.1	23	245.90	800.410	535	89.0	10.8	116.0
1540	50.0	26	245.90	800.380	540	90.0	11.2	117.0
1550	50.0	26	245.90	800.370	540	89.5	10.8	117.0
1600	50.0	26	245.92	800.358	540	90.0	11.2	117.0
1610	50.0	26	245.92	800.350	540	90.0	11.2	116.5
1620	51.1	23	245.90	800.345	540	91.0	11.2	118.0

Summary of Frequency Deviations
with Variations in Ambient Temperature
Modulation Frequency - 800 Kc

Deviations During the Stabilizing Periods

Temp.	Carrier Frequencies		Carrier Deviation		Modulation Frequency		Modulation Deviation	
(°C)	Maximum	Minimum	Mc	Per Cent	Maximum	Minimum	Cycles	Per Cent
-27.8	246.32	246.23	0.09	0.0366	800.488	800.465	23	0.00288
0	246.25	246.18	0.07	0.0284	800.581	800.550	31	0.00388
25	246.10	246.03	0.07	0.0284	800.600	800.513	87	0.0109
50	246.00	246.90	0.10	0.0407	800.490	800.345	145	0.0181

(Continued)

Table 22 (Cont'd)

Deviations Due to Temperature Change

Temp. Change (°C)	Carrier Deviation Per Indicated Temp. Change (Mc)	Carrier Deviation Per °C (%)	Modulation Deviation Per Indicated Temp. Change (Cycles)	Modulation Deviation Per °C (%)
-28 to 0	0.07	0.00102	77	0.000344
0 to 25	0.15	0.00244	52	0.000260
25 to 50	0.13	0.00211	168	0.000840
Average deviation per °C:		0.00186		0.000481

Table 23

Model YG Transmitting Equipment

VARIATION IN AMBIENT TEMPERATURE
Modulation Frequency - 550 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
0855	-27.8	--	246.62	550.565	525	87.0	12.8	115.0
0905	-27.8	--	246.90	550.562	530	88.0	12.8	116.5
0915	-27.8	--	247.15	550.565	540	82.0	12.6	117.0
0925	-27.8	--	247.15	550.562	535	82.0	11.9	116.0
0935	-27.8	--	247.10	550.561	538	82.0	12.3	116.0
0945	-27.8	--	247.10	550.560	530	81.0	12.3	115.0
0955	-27.8	--	247.10	550.561	530	81.5	12.3	115.0
1005	-27.8	--	247.10	550.560	530	82.0	12.3	115.0
1015	-13.8	--	247.06	550.586	535	83.0	12.6	115.5
1025	- 6.7	--	247.00	550.605	535	83.5	12.6	116.0
1035	0	--	247.00	550.610	530	84.0	12.6	116.0
1045	0	--	247.00	550.610	530	84.0	12.8	115.0
1055	- 0.5	--	246.98	550.600	530	84.5	12.8	115.0
1105	1.1	--	246.98	550.599	530	85.0	12.8	116.0
1115	0.4	--	246.94	550.590	533	85.0	13.1	116.5
1125	20.0	30	246.90	550.602	530	85.5	13.1	116.5
1135	20.0	30	246.88	550.595	530	86.0	13.1	116.0
1145	20.5	30	246.84	550.564	525	87.0	13.4	116.0
1155	21.0	30	246.88	550.552	535	88.0	13.7	117.5
1205	36.5	30	246.79	550.550	530	88.0	13.7	117.0
1215	41.1	30	246.75	550.542	530	88.0	13.7	117.0
1225	40.6	30	246.72	550.544	525	88.0	13.7	117.0
1235	41.1	30	246.70	550.531	525	87.0	13.7	116.0
1245	39.5	30	246.68	550.522	525	88.0	13.7	116.5
1255	34.5	30	246.68	550.510	525	88.0	13.7	116.5
1300	40.0	31	246.68	550.511	525	88.0	14.0	116.5
1305	48.9	20	246.68	550.515	525	87.0	13.8	115.5
1315	50.0	8	246.65	550.500	525	83.5	11.2	116.0
1325	50.5	8	246.70	550.489	530	83.0	10.8	116.5
1335	51.0	8	246.67	550.481	525	82.5	11.6	115.5

(Continued)

Table 23 (Cont'd)

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
1345	51.0	8	246.65	550.475	530	83.5	11.6	116.5
1355	50.0	8	246.63	550.483	538	85.0	12.3	118.5
1405	49.0	9	246.62	550.492	535	84.5	12.3	118.0
1415	50.0	8	246.62	550.465	535	84.0	12.3	118.0
1425	50.0	8	246.62	550.465	530	84.0	11.9	118.0
1435	50.0	8	246.62	550.466	530	84.0	11.9	117.0
1445	50.0	8	246.62	550.463	525	84.0	11.6	117.0
1455	50.0	8	246.62	550.466	530	84.0	11.9	117.5
1505	50.0	8	246.62	550.466	525	84.0	11.9	117.0
1515	41.0	11	246.62	550.481	535	85.0	12.3	119.0
1525	33.6	13	246.65	550.501	535	85.0	11.9	119.0
1535	23.4	15	246.70	550.519	540	84.0	12.3	119.5
1545	22.8	17	246.72	550.550	540	85.0	12.3	120.0
1555	23.4	23	246.75	550.590	545	85.0	12.3	120.5
1605	20.5	28	246.75	550.585	545	83.8	11.9	120.0
1615	19.4	30	246.80	550.600	545	83.0	11.6	119.5
1625	20.0	25	246.80	550.625	545	83.0	11.6	120.0
1635	21.0	20	246.82	550.630	550	83.5	11.2	120.0

Summary of Frequency Deviations
with Variations in Ambient Temperature
Modulation Frequency - 550 Kc

Deviations During the Stabilizing Periods

Temp. (°C)	Carrier Frequencies		Carrier Deviation		Modulation Frequency		Modulation Deviation	
	Maximum	Minimum	Mc	Per Cent	Maximum	Minimum	Cycles	Per Cent
-27.8	247.15	246.62	0.53	0.214	550.565	550.560	5	0.00091
0	247.00	246.98	0.02	0.0081	550.610	550.599	11	0.0020
20	246.90	246.84	0.06	0.0244	550.602	550.552	50	0.0091
40	246.75	246.68	0.07	0.0284	550.542	550.510	32	0.0058
50	246.70	246.62	0.08	0.0325	550.515	550.475	40	0.0073

(Continued)

Table 23 (Cont'd)

Deviations Due to Temperature Change

Temp. Change (°C)	Carrier Deviation Per Indicated Temp. Change (Mc)	Carrier Deviation Per °C (%)	Modulation Deviation Per Indicated Temp. Change (Cycles)	Modulation Deviation Per °C (%)
-27.8 to 0	0.120	0.00175	39	0.000250
0 to 20	0.100	0.00203	47	0.000427
20 to 40	0.200	0.00406	41	0.000373
40 to 50	0.060	0.00244	45	0.000818
Average deviation per °C:		0.00257		0.000467

Table 24

Model YG Transmitting Equipment

VARIATION IN HUMIDITY
Modulation Frequency - 600 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
1340	39.5	21	245.90	600.602	565	93.5	17.2	119.5
1350	40.2	20	245.90	600.604	565	93.5	17.4	120.0
1400	40.2	20	245.90	600.608	565	93.5	17.2	119.5
1410	40.0	21	245.90	600.608	565	94.0	17.2	120.0
1420	40.2	77	245.87	600.550	570	93.0	17.2	120.0
1430	40.2	92	245.85	600.499	570	92.5	17.2	120.0
1440	41.1	93	245.83	600.489	565	93.0	17.2	120.0
1450	40.5	93	245.83	600.491	565	92.5	16.9	119.5
1500	40.2	95	245.83	600.491	565	91.0	16.5	119.0
1510	40.0	93	245.83	600.489	570	91.0	16.7	120.0
1520	40.0	93	245.83	600.489	570	91.5	16.7	120.0
1530	40.0	93	245.82	600.489	570	91.5	16.7	120.0
1540	38.4	65	245.83	600.518	570	93.0	17.2	120.5
1550	39.5	39	245.85	600.555	575	94.0	17.4	121.5
1600	41.2	24	245.85	600.568	575	93.5	17.4	121.0
1610	40.5	21	245.83	600.572	575	94.0	17.4	121.0
1620	33.3	21	245.86	600.608	575	94.0	17.4	121.0

arrier frequency at end of first test period: 245.90 mc.
arrier frequency of greatest subsequent change: 245.82 mc.
laximum frequency change: 0.08 mc or 0.0325 per cent.

lodulation frequency at end of first test period: 600.608 kc.
odulation frequency of greatest subsequent change: 600.489 kc.
aximum frequency change: 119 cycles or 0.0198 per cent.

Table 25

Model YG Transmitting Equipment

VARIATION IN HUMIDITY
Modulation Frequency - 800 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
0940	38.4	17	245.94	800.614	555	94.0	17.2	118.0
0950	38.4	17	245.95	800.614	555	94.0	17.2	118.0
1000	38.4	17	245.94	800.614	550	93.5	17.2	117.5
1010	39.5	17	245.94	800.616	555	94.0	16.7	118.0
1020	39.5	17	245.92	800.606	550	93.0	16.7	117.5
1030	40.5	10	245.92	800.582	550	93.0	16.7	117.5
1040	37.8	86	245.90	800.450	550	93.0	16.7	117.5
1045	39.8	96	245.90	800.380	550	92.8	16.7	117.5
1055	40.0	96	245.90	800.356	555	94.0	16.9	118.5
1105	40.0	93	245.88	800.379	550	93.0	17.2	118.0
1115	40.0	96	245.88	800.379	555	93.5	17.2	118.5
1125	40.0	96	245.88	800.379	555	93.0	16.7	118.5
1135	39.8	96	245.88	800.375	560	94.0	17.4	119.5
1145	40.0	96	245.87	800.375	565	94.5	17.4	120.0
1155	39.8	96	245.87	800.381	565	94.5	17.5	120.5
1205	40.0	93	245.87	800.380	560	94.5	17.5	120.0
1215	39.5	96	245.82	800.385	565	95.0	17.2	121.0
1225	37.2	76	245.85	800.411	560	94.5	17.2	120.5
1235	38.4	44	245.85	800.470	555	94.0	17.2	120.0
1245	39.5	31	245.85	800.482	560	94.0	17.2	119.5
1255	39.5	24	245.88	800.489	560	94.0	17.4	120.0
1305	40.0	23	245.88	800.496	560	94.0	17.2	119.5
1315	40.0	23	245.90	800.500	560	94.0	17.2	120.0

Carrier frequency at end of first test period: 245.94 mc.
Carrier frequency of greatest subsequent change: 245.82 mc.
Maximum frequency change: 0.12 mc, or 0.0488 per cent.

Modulation freouency at end of first test period: 800.616 kc.
Modulation frequency of greatest subsequent change: 800.356 kc.
Maximum frequency change: 260 cycles, or 0.0325 per cent.

Table 26

Model YG Transmitting Equipment

HIGH HUMIDITY STANDBY TEST
Modulation Frequency - 600 Kc

Time	Amb. Temp. (°C)	Rel. Hum. (%)	Carrier Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Super-Freq. Oscillator Plate (Ma)	Power Output (Watts)	Line Volts
0830	41.7	20	245.75	600.623	530	89.5	15.5	117.0
0840	40.0	18	245.75	600.635	530	90.0	15.5	118.0
0850	40.0	18	245.72	600.630	530	90.0	15.5	118.0
0900	40.0	18	245.72	600.628	540	90.5	15.5	119.0
0910	40.0	80						

0910 to 1110 inclusive, equipment completely shut down except for heater unit. Humidity raised to 97% and maintained there. Equipment examined at 1100.

1115	40.0	97	245.90	600.350	530	89.0	15.5	117.0

1116 to 1324 inclusive, equipment and heater completely shut down. Humidity maintained at 97%. Equipment examined at 1325.

1325	40.0	97	245.80	600.185	530	88.5	15.0	117.5

1326 to 1409 inclusive, equipment and heater completely shut down. Ambient temperature reduced and humidity maintained as high as possible.

1410	19.5	66	246.00	600.580	530	90.0	15.5	118.0

Note: At no time was there any evidence of condensation anywhere in the transmitter.

Carrier frequency at start of idle period (heater on): 245.72 mc.
Carrier frequency at end of idle period: 245.90 mc.
Drift due to idle period and humidity: 0.18 mc, or 0.0732 per cent.

Carrier frequency at start of idle period (heater off): 245.90 mc.
Carrier frequency at end of idle period (heater off): 245.80 mc.
Drift due to idle period and humidity: 0.10 mc, or 0.0407 per cent.

(Continued)

Table 26 (Cont'd)

Carrier frequency at start of idle period while ambient conditions were changed: 245.80 mc.
Carrier frequency at end of this idle period: 246.00 mc.
Drift due to idle period and ambient change: 0.20 mc, or 0.0814%.

Modulation frequency at start of idle period (heater on): 600.628 kc.
Modulation frequency at end of idle period (heater on): 600.350 kc.
Drift due to idle period and humidity: 0.278 kc, or 0.0463%.

Modulation frequency at start of idle period (heater off): 600.350 kc.
Modulation frequency at end of idle period (heater off): 600.125 kc.
Drift due to idle period and humidity: 0.225 kc, or 0.0375%.

Modulation frequency at start of ambient condition change: 600.125 kc.
Modulation frequency at end of ambient condition change: 600.580 kc.
Drift due to idle period and changing ambient: 0.455 kc, or 0.0759%.

Table 27

Model YG Transmitting Equipment

INCLINATION TEST

Time	Modulation Frequency (Mc) Maximum	Modulation Frequency (Mc) Minimum	Super-Freq. Oscillator Frequency (Mc)	Test Condition
		Inclination:	Front to Back	
1120	550.690	-------	245.65	Stationary
1121	550.670	-------	------	Inclination
1130	550.685	550.674	------	Inclination
1140	550.690	550.680	------	Inclination
1150	550.692	550.683	------	Inclination
1155	550.691	-------	245.62	Stationary

Maximum frequency variation during a single inclination cycle: 11 cycles; 0.0020 per cent.
Maximum change during the test from the frequency at the start of the test: 20 cycles; 0.0036 per cent.

Time	Maximum	Minimum	Super-Freq. Oscillator Frequency (Mc)	Test Condition
1320	800.558	-------	246.15	Stationary
1321	800.545	800.535	------	Inclination
1330	800.535	800.528	------	Inclination
1340	800.535	800.528	------	Inclination
1350	800.534	800.526	------	Inclination
1355	800.538	-------	246.15	Stationary

Maximum frequency variation during a single inclination cycle: 10 cycles; 0.00125 per cent.
Maximum change during the test from the frequency at the start of the test: 30 cycles; 0.0038 per cent.

(Continued)

Table 27 (Cont'd)

Time	Modulation Frequency (Mc) Maximum	Minimum	Super-Freq. Oscillator Frequency (Mc)	Test Condition
		Inclination:	Side to Side	
1020	550.681	-------	246.70	Stationary
1021	-------	-------	------	Inclination
1030	550.670	550.646	------	Inclination
1040	550.670	550.646	------	Inclination
1050	550.675	550.651	------	Inclination
1055	550.688	-------	246.00	Stationary

Maximum frequency variation during a single inclination cycle: 24 cycles; 0.0044 per cent.
Maximum change during the test from the frequency at the start of the test: 24 cycles; 0.0044 per cent.

Time	Maximum	Minimum	Super-Freq. Oscillator Frequency (Mc)	Test Condition
1405	800.548	-------	246.12	Stationary
1408	800.538	800.520	------	Inclination
1415	800.538	800.520	------	Inclination
1425	800.548	800.520	------	Inclination
1435	800.544	800.528	------	Inclination
1438	800.538	-------	246.12	Stationary

Maximum frequency variation during a single inclination cycle: 28 cycles; 0.0035 per cent.
Maximum change during the test from the frequency at the start of the test: 28 cycles; 0.0035 per cent.

Table 28

Model YG Transmitting Equipment

VIBRATION TEST

Time	Vibration Frequency (C.P.M.)	Super-Freq. Oscillator Frequency (Mc)	Modulator Frequency (Kc)	Plate Supply Voltage	Remarks
0840	Stationary	246.00	550.590	590	
0850	900	245.80	550.587	590	
0855	1300	------	550.685	---	Mod. freq. jumped.
0900	1050	246.30	550.680	605	
0910	900	246.75	550.675	600	
0920	890	246.70	550.674	605	Transmitter vibrating 1/4" range of motion front to back.
0930	1250	246.70	550.672	600	
0940	1150	246.70	550.660	600	
0950	1910	246.71	550.655	600	Vibration amplitude of set is slight above 1300 c.p.m.
0952	Stationary	246.71	550.670	600	

Maximum change of carrier frequency during test: 0.75 mc, or 0.305%. (This large deviation later found to be caused by poor connection in dummy antenna.)
Maximum change of modulation frequency during test: 95 cycles, or 0.0173%.
Modulation of 550 kc signal by vibration was very slight.

1450	Stationary	246.15	800.528	600
1451	Vibration	246.15	800.575	600
1510	Vibration	246.20	800.565	600
1520	Vibration	246.20	800.566	600
1530	Stationary	246.20	800.568	600

Maximum change of carrier frequency during test: 0.05 mc, 0.028%.
Maximum change of modulation frequency during test: 40 cycles, 0.005%.
No modulation of the 800 kc carrier was noted during the vibration.

Table 29

Model YG Transmitting Equipment

SHOCK TEST

Shock No.	Acceleration Imparted to Transmitter	Super-Freq. Oscillator Frequency (Mc) Before Shock	After Shock	Deviation	Modulator Frequency (Kc) Before Shock	After Shock	Deviation (Cycles)
			Shock Towards Left Side of Set				
1	Less than 20g	246.12	246.12	0.00	800.523	800.583	60(1)
2	Less than 20g	246.12	246.15	0.03	800.585	800.581	4
3	20g	246.15	246.15	0.00	800.585	800.592	7
4	30g	246.15	246.12	0.03	800.589	800.592	3
5	40-50g	246.12	246.12	0.00	800.585	800.585	0
6	20g	246.12	246.12	0.00	800.582	800.585	3
7	40-50g	246.12	246.12	0.00	800.582	800.585	3
		Next Day (Conditions Unchanged)					
8	40g	246.25	246.21	0.04(2)	800.560	800.580	20
9	40g	------	------	----	800.580	800.592	12
10	40g	------	------	----	800.590	800.601	11
11	40g	------	------	----	800.602	800.600	2
12	40g	------	246.18	----	800.600	800.590	10
			Shock Towards Rear of Set				
13	20g	246.19	245.75	0.44(4)	800.560	800.545	15
14	Less than 20g	------	------	----	800.560	800.565	5
15(5)	Less than 20g	------	245.86	----	800.540	800.515	25
16	Less than 20g	245.90	245.90	0.00	800.530	800.558	28(3)
17	20g	245.90	------	----	800.580	800.600	20
18	20g	------	------	----	800.600	800.620	20
19	20g	------	------	----	800.619	800.610	9
20	Less than 20g	------	------	----	800.610	800.610	0
21	Less than 20g	------	------	----	800.604	800.604	0
22	Less than 20g	------	------	----	800.600	800.605	5
23	Less than 20g	------	------	----	800.610	800.615	5
24	20g	------	245.90	----	800.615	800.619	4

Note: (1) Maximum deviation of modulation frequency caused by shock towards left side: 60 cycles; 0.0075 per cent.
(2) Maximum deviation of carrier frequency caused by shock towards left side: 0.04 mc; 0.016 per cent.
(3) Maximum deviation of modulation frequency caused by shock towards rear: 28 cycles; 0.0035 per cent.

(Continued)

Table 29 (Cont'd)

Note: (4) Maximum deviation of carrier frequency caused by shock towards rear: 0.44 mc; 0.179 per cent.

(5) Dummy load circuit was readjusted following shock number 15.

(6) Maximum momentary acceleration of test table for all of above tests: 250 g.

Table 30

Model YG Transmitting Equipment

DEVIATION OF CARRIER FREQUENCY WITH CHANGE FROM UNMODULATED CARRIER TO CONTINUOUSLY KEYED MODULATION

Time	Carrier Frequency (Mc)	Deviation (Mc)	Deviation (%)	Power Output (Watts)	Operating Condition
1340	250.0602	------	------	17.4	Unmodulated
1355	250.0580	------	------	17.1	Unmodulated
1355	250.0580	------	------	20.5	Modulated
1410	250.0340	0.0240	0.0096	20.5	Modulated
1425	250.0280	0.0300	0.0120	20.5	Modulated
1440	250.0190	0.0390	0.0156	20.1	Modulated

Note: (1) Maximum deviation during 45 minutes of keyed modulation: 39 kc, or 0.0156 per cent.
(2) Modulating frequency 800 kc keyed at 23 w.p.m.
(3) Transmitter preheated 10 minutes with 640 volts on high-frequency oscillator plates before starting this test.

Table 31

Model YG Transmitting Equipment

EFFECT OF CHANGE OF VACUUM TUBES

Trial Number	Manufacturer	Frequency (Kc)	Deviation from Mean Frequency Cycles	Per Cent
		Type 807 Master-Oscillator Tube		
		550 Kc Modulation		
Original	R.C.A.	550.370	151	0.0274
1	R.C.A.	550.675	154	0.0280
2	R.C.A.	550.600	79	0.0144
3	Westinghouse	550.506	15	0.0027
4	Westinghouse	550.558	37	0.0067
5	Hytron	550.418	103	0.0187
	Mean:	550.521	90	0.0163
		800 Kc Modulation		
Original	R.C.A.	800.535	150	0.0187
1	R.C.A.	800.852	167	0.0209
2	R.C.A.	800.815	130	0.0162
3	Westinghouse	800.725	40	0.0050
4	Westinghouse	800.651	34	0.0042
5	Hytron	800.522	163	0.0204
	Mean:	800.685	114	0.0142
		Type 807 P-A Tube		
		550 Kc Modulation		
Original	R.C.A.	550.475	18	0.0033
1	R.C.A.	550.449	8	0.0015
2	R.C.A.	550.451	6	0.0011
3	Westinghouse	550.451	6	0.0011
4	Westinghouse	550.454	3	0.0005
5	Hytron	550.462	5	0.0009
	Mean:	550.457	7.7	0.0014

(Continued)

Table 31 (Cont'd)

Trial Number	Manufacturer	Frequency (Kc)	Deviation from Mean Frequency Cycles	Deviation from Mean Frequency Per Cent
		Type 807 P-A Tube		
		800 Kc Modulation		
Original	R.C.A.	800.650	19	0.0024
1	R.C.A.	800.710	41	0.0051
2	R.C.A.	800.675	6	0.0008
3	Westinghouse	800.675	6	0.0008
4	Westinghouse	800.678	9	0.0011
5	Hytron	800.622	47	0.0059
	Mean:	800.669	21.3	0.0027

Note: M-O trimmer capacitor was left untouched during these tests.

Table 32

Model YG Transmitting Equipment

SUMMARY OF CARRIER AND
MODULATION FREQUENCY STABILITY TESTS

Test	Specs. RE 13A 528 (Paragraph)	Maximum Frequency Variation (%) Modulator 550 Kc	Modulator 800 Kc	Carrier 246 Mc
Locked Key (5 Min.)	3-7-1	0.0010	0.0008	0.073
(Remainder)	3-7-1	0.0033	0.0011	0.049
Change of Tubes (M.O.)	3-7-2	0.0163	0.0142	
(P.A.)	3-7-2	0.0014	0.0027	
Variation of Ambient Temperature	3-7-3	0.00065	0.00084	0.0029
Variation of Humidity	3-7-4	0.0198*	0.0325	0.0488
Inclination**	3-7-5	0.0044	0.0035	
Vibration	3-7-6	0.0173	0.0050	0.028
Shock	3-7-7		0.0075	0.0179
Variation of Line Voltage	3-7-8	0.0067	0.0110	0.069
Continuous to Intermittently Keyed	3-7-9	0.0011	0.0005	
Total:		0.0720	0.0796	

Note: * Taken at 600 kc.
** Values based on deviation during a single cycle of inclination.

Table 33

Model YG Transmitting Equipment

ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCY

Trial Number	Frequency (Kc)	Time (Seconds)	Deviation of Frequency Cycles	Per Cent
Original	550.455	--	--	------
1	550.410	18	45	0.0082
2	550.410	7	45	0.0082
3	550.450	7	5	0.0009
4	550.408	6	47	0.0086
5	550.420	8	35	0.0064
	Average Deviation:		35	0.0064
	Maximum Deviation:		47	0.0086
Original	800.765	--	--	------
1	800.792	8	27	0.0034
2	800.750	7	15	0.0019
3	800.735	10	30	0.0038
4	800.740	5	25	0.0031
5	800.705	8	60	0.0075
	Average Deviation:		31	0.0039
	Maximum Deviation:		60	0.0075

Table 34

Model YG Transmitting Equipment

TEST FOR LOST MOTION, BACKLASH AND TORQUE LASH

Test as per paragraph 3-15 of Specifications RE 13A 528B

Trial No.	Frequency When Approached From a Clockwise Direction	Frequency When Approached From a Counterclockwise Direction	Deviation (Cycles)	Deviation (%)	Position of Dial Lock
1	550.460	550.448	12	0.00218	Not in use
2	550.485	550.464	21	0.00382	Not in use
3	550.464	550.450	14	0.00255	Not in use
4	550.435	550.449	14	0.00255	Not in use
5	550.498	550.470	28	0.00509	Not in use
		Average:	17.8	0.00324	
1	550.469	550.470	1	0.00018	In use
2	550.481	550.511	30	0.00545	In use
3	550.497	550.509	12	0.00218	In use
4	550.473	550.485	12	0.00218	In use
5	550.509	550.510	1	0.00018	In use
		Average:	11.2	0.00204	
1	800.660	800.665	5	0.00063	Not in use
2	800.672	800.644	28	0.00350	Not in use
3	800.624	800.614	10	0.00125	Not in use
4	800.668	800.635	33	0.00413	Not in use
5	800.705	800.707	2	0.00025	Not in use
		Average:	15.6	0.00195	
1	800.785	800.795	10	0.00125	In use
2	800.789	800.799	10	0.00125	In use
3	800.775	800.819	44	0.00550	In use
4	800.751	800.761	10	0.00125	In use
5	800.760	800.781	21	0.00263	In use
		Average:	19	0.00238	

(Continued)

Table 34 (Cont'd)

DEVIATION AT 550 KC, DIAL LOCKS NOT USED:
Initial Frequency 550.460 kc.
Frequency of Maximum Departure: 550.498 kc.
Difference: 38 cycles, or 0.00692 per cent.
Average Difference of Five Trials: 0.00324 per cent (17.8 Cycles)

DEVIATION AT 550 KC, DIAL LOCKS USED:
Initial Frequency: 550.469 kc.
Frequency of Maximum Departure: 550.511 kc.
Difference: 42 cycles, or 0.00764 per cent.
Average Difference of Five Trials: 11.2 cycles, or 0.00204 per cent.

DEVIATION AT 800 KC, DIAL LOCKS NOT USED:
Initial Frequency: 800.660 kc.
Frequency of Maximum Departure: 800.707 kc
Difference: 47 cycles, or 0.00588 per cent.
Average Difference of Five Trials: 15.6 cycles, or 0.00195 per cent.

DEVIATION AT 800 KC, DIAL LOCKS USED:
Initial Frequency: 800.785 kc.
Frequency of Maximum Departure: 800.819 kc.
Difference: 34 cycles, or 0.00425 per cent.
Average Difference of Five Trials: 19 cycles, or 0.00238 per cent.

Table 35

Model YG Transmitting Equipment

KILOCYCLES PER DIVISION OF MODULATOR OSCILLATOR DIAL

Dial Setting	Frequency (Kc)	Frequency Difference (Kc)	Kc per Division	Per Cent per Division
300	523.20			
400	547.84	24.64	0.246	0.046
700	677.11			
800	729.70	52.59	0.526	0.075

Table 36

Model YG Transmitting Equipment

EFFECT OF DIAL LOCKS

Control No.	Circuit Controlled	Direction of Approach	Frequency in Kilocycles		Frequency Change	
			Not Locked	Locked	Cycles	Per Cent
A	M.O.	Clockwise	550.441	550.480	39	0.00709
		Counterclockwise	550.430	550.481	51	0.00927
A	M.O.	Clockwise	800.660	800.760	100	0.01250
		Counterclockwise	800.615	800.731	116	0.01450
C	P.A.	Clockwise	550.469	550.465	4	0.00072
		Counterclockwise	550.481	550.479	2	0.00036
C	P.A.	Clockwise	800.739	800.738	1	0.00013
		Counterclockwise	800.741	800.741	0	0.

Table 37
Model YG Transmitting Equipment
OPERATION OF POWER OUTPUT CONTROL

Modulated Power (Watts)	Power %	Plate Supply Voltage	Modulation: Modulator Frequency (Kc.)	Modulation: Change in Frequency Cycles	Modulation: Change in Frequency Per Cent	Carrier: Carrier Freq.(mc)	Carrier: Change in freq. Mc.	Carrier: Change in freq. Per Cent
26.6	100.0	587	550.500	-	-	246.00	-	-
23.5	88.3	550	.496	4	0.00072	245.98	0.02	0.00813
19.0	71.5	500	.495	5	0.00091	.95	0.05	0.02030
15.0	56.4	(1)451	.499	1	0.00018	.90	0.10	0.04065
25.0	100.0	575	800.808	-	-	246.02	-	-
23.0	92.0	550	.800	8	0.00100	.00	0.02	0.00813
18.3	73.2	500	.793	15	0.00187	245.98	0.04	0.01540
14.2	56.8	450	.795	13	0.00163	.93	0.09	0.03460
13.9	55.6	(1)445	.795	13	0.00163	.93	0.09	0.03460

Carrier frequency measured by RCA Type CRV 60028 frequency meter for above data.
Modulating frequency measured on LK Frequency Drift Indicator.

Unmodulated Power (Watts)	Power %	Plate Supply Voltage	Modulator Frequency (Kc.)	Change in Frequency Cycles	Change in Frequency Per Cent	Carrier Freq.(Mc)	Change in freq. Mc.	Change in freq. Per Cent
18.5	100	640	-	-	-	250.077	-	-
15.0	81.0	600	-	-	-	.059	0.018	0.0072
11.8	63.8	(1)560	-	-	-	.039	0.038	0.0152
22.0	119.0	670	Max. Plate Voltage obtainable			.095	0.018	0.0072

Notes:
(1) Lowest voltage obtainable with plate rheostat.
(2) Carrier frequency drift measured on super-frequency drift indicator for above data.
(3) Line voltage maintained at 115 V.
(4) Antenna: Matched 32 V 15 watt lamp.
(5) The above range of power output was obtained by varying plate voltage control R 201 from maximum to minimum resistance positions.

Table 38
Model YG Transmitting Equipment
LIST OF FUSES

Symbol No.	Function	Manufacturer	Rating Volts	Rating Amps	Operating Conditions Volts	Operating Conditions Amps	Type
F-201	Mainline	Economy Fuse and Mfg. Co.	250	10	115	4.90	Renewable link
F-202	Mainline	Economy Fuse and Mfg. Co.	250	10	115	4.90	Renewable link
F-203	Heater	Economy Fuse and Mfg. Co.	250	10	115	4.10	Renewable link
F-204	Heater	Economy Fuse and Mfg. Co.	250	10	115	4.10	Renewable link

Ferrule length 1/2 inch.
Ferrule diameter 9/16 inch.

Operating conditions measured with antenna and control units rotating.

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Table 39

Model YG Transmitting Equipment

VOLTAGE REGULATION AND PER CENT
RIPPLE OF PLATE SUPPLY RECTIFIER

Condition	Output Voltage (Volts)	Output Current (Ma)	Rectifier Output (Watts)	R-F Output (Watts)
Key up	640	157	100.3	21.8
Key down	602	238	143.5	27.0

Regulation: 38 volts, or 6.3 per cent.
Transmitter fully loaded into a special 25-watt, 70-ohm lamp.
Line voltage maintained at 115 volts.

Per Cent Ripple in Rectifier Output

Condition	D-C Output Voltage (Volts)	Ripple Voltage (Volts)	Ripple Voltage (%)	D-C Output Current (Ma)	Rectifier Output (Watts)	Transmitter Output (Watts)
Key up	644	1.77	0.275	160	100.3	21.5
Key down	600	1.95	0.325	238	143.0	26.2

Line voltage maintained constant at 115 volts.
Transmitter fully loaded into a special 25-watt 70-ohm lamp.

Table 40

Model YG Transmitting Equipment

VARIATION IN MODULATOR AMPLIFIER
RECTIFIED GRID CURRENT OVER FREQUENCY RANGE

Dial Reading	Frequency (Kc)	Modulator Amplifier Grid Current (Ma)	Variation of Grid Current	
			Ma	Per Cent
718	685	2.29	----	-----
0	487	1.42	0.87	38.0
100	493	1.43	0.86	37.5
200	506	1.46	0.83	36.2
300	523	1.50	0.79	34.4
400	548	1.61	0.68	29.8
500	582	1.81	0.48	20.9
600	626	2.09	0.20	8.73
700	677	2.27	0.02	0.87
800	730	2.19	0.10	4.37
900	782	1.89	0.40	17.4
1000	832	1.46	0.83	36.2

Oscillator plate circuit tuning peaked at 685 kc.

Table 41
Model YG Transmitting Equipment
Power Required From Supply Line

Sequence of Operation And Resulting Conditions	Power Required Volts	Amps	PF	Watts
Antenna and Antenna Control Disconnected				
1. Line Switch Closed				
Heaters "Off"; Key Open				
All Filaments and Time Delay Relay "On"	115	0.74	0.976	83
2. Plate Switch Closed				
Heaters "Off"; Key Open				
All Filaments and Time Delay Relay "On"				
Plate "On" Modulation "Off"	115	1.76	0.939	190
3. Key Closed				
Heaters "Off"				
All Filaments and Time Delay Relay "On"				
Plate "On" Modulation "On"	103.5	2.10	0.943	205
	115.0	2.35	0.944	255
	126.5	2.60	0.934	307
4. Heater Switch Closed				
Heaters "On"				
All Filaments and Time Delay Relay "On"				
Plate "On" Modulation "On"	103.5	3.30	0.967	330
	115.0	3.68	0.969	410
	126.5	4.00	0.978	495
Antenna and Antenna Control Connected				
5. Heaters "On"				
All Filaments and Time Delay Relay "On"				
Plate "On" Modulation "On"				
Antenna in Operation	103.5	7.05	0.886	648
	115.0	7.66	0.888	815
	126.5	8.87	0.882	991
6. Heater Switch Opened				
Heaters "Off"				
All Filaments and Time Delay Relay "On"				
Plate "On" Modulation "On"				
Antenna in Operation	115.0	4.72	0.637	364
7. Antenna and Antenna Control Alone				
Other Equipment Disconnected	115	2.98	0.265	91

Note: (1) S.F. Oscillator loaded to 140 MA cathode current at 640V Plate Supply Voltage.

(2) No readjustments of Filament and Plate Rheostats were made during above measurements at 90 and 110% normal line voltage.

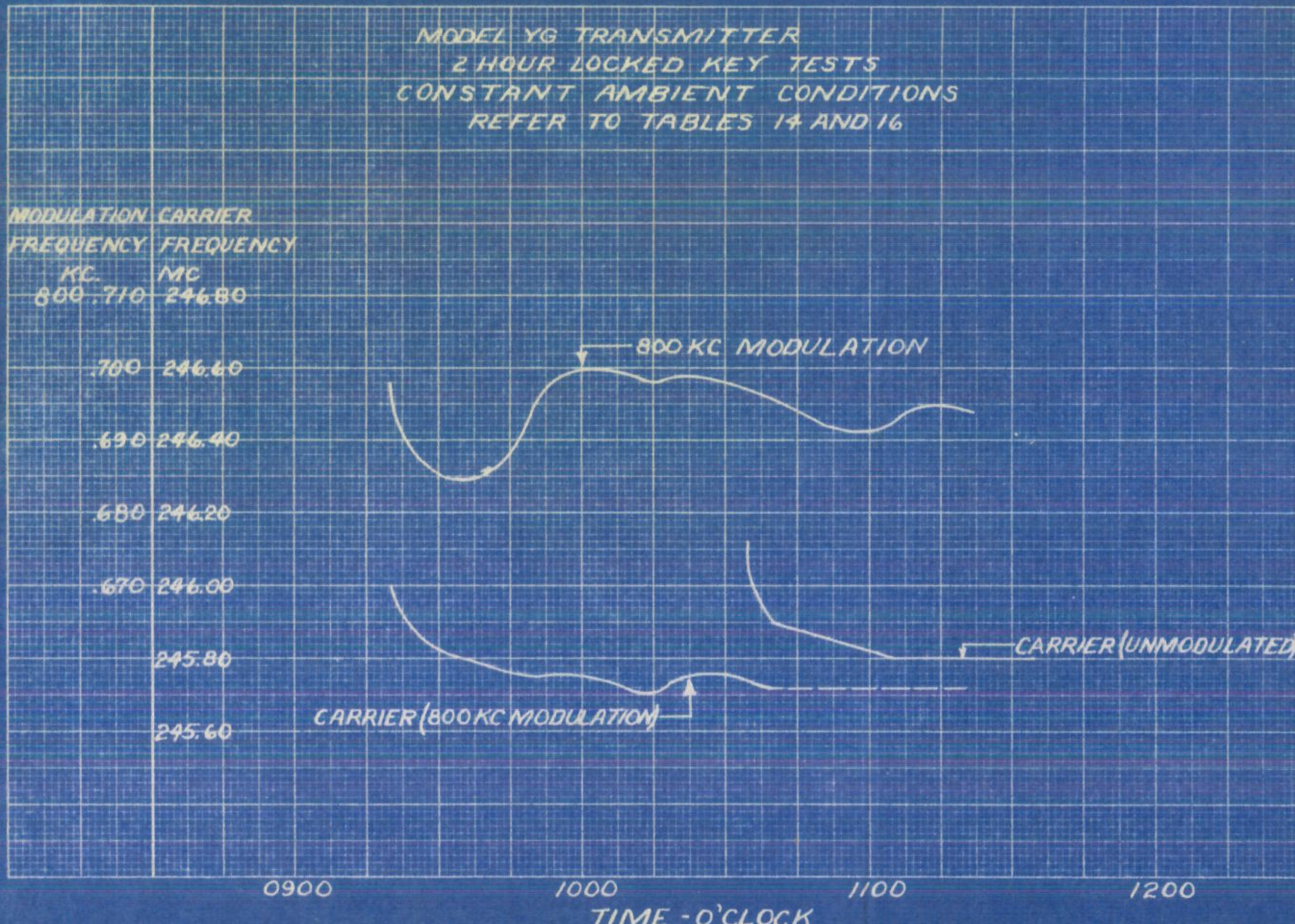

PLATE I

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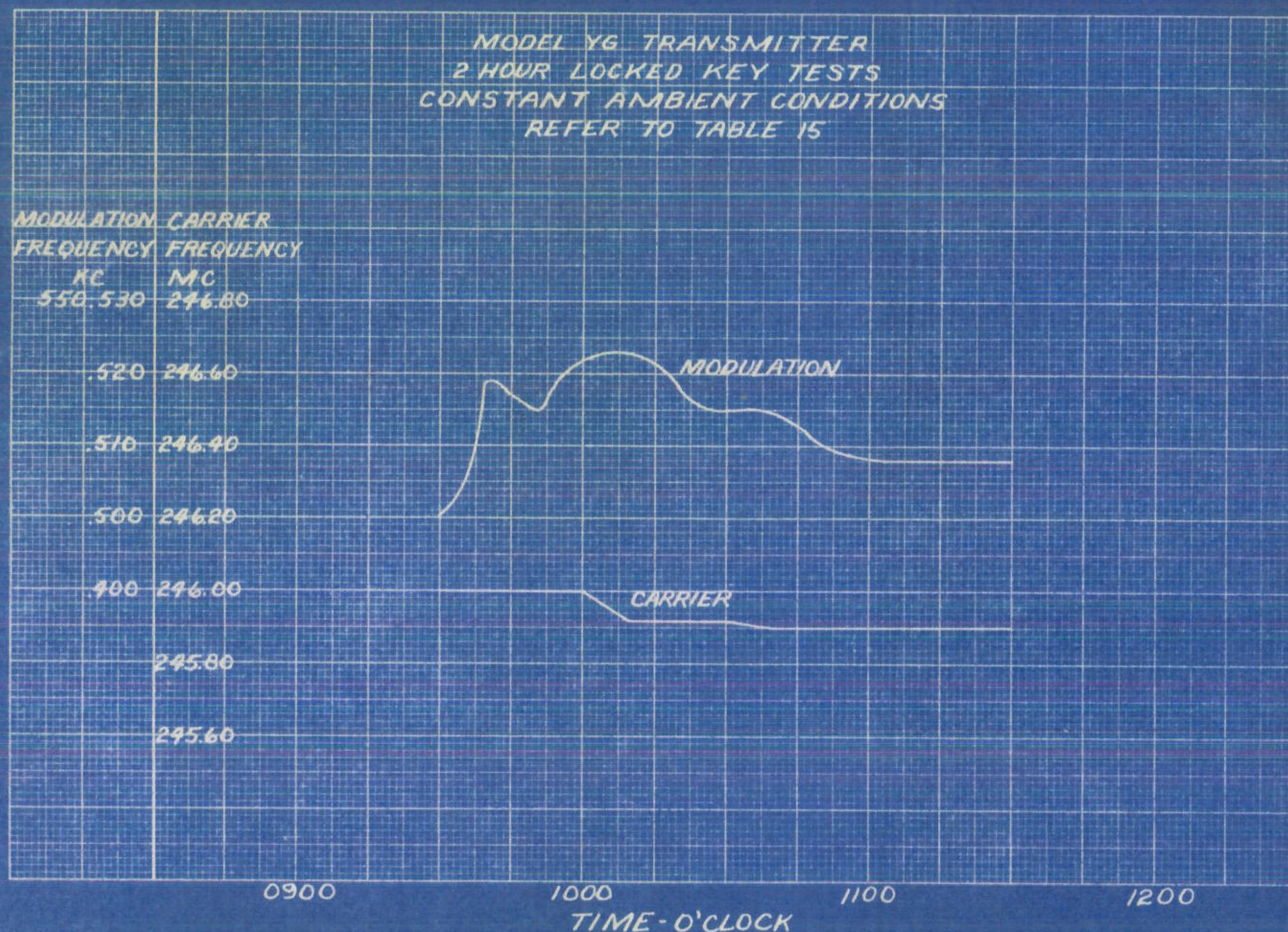

PLATE 2

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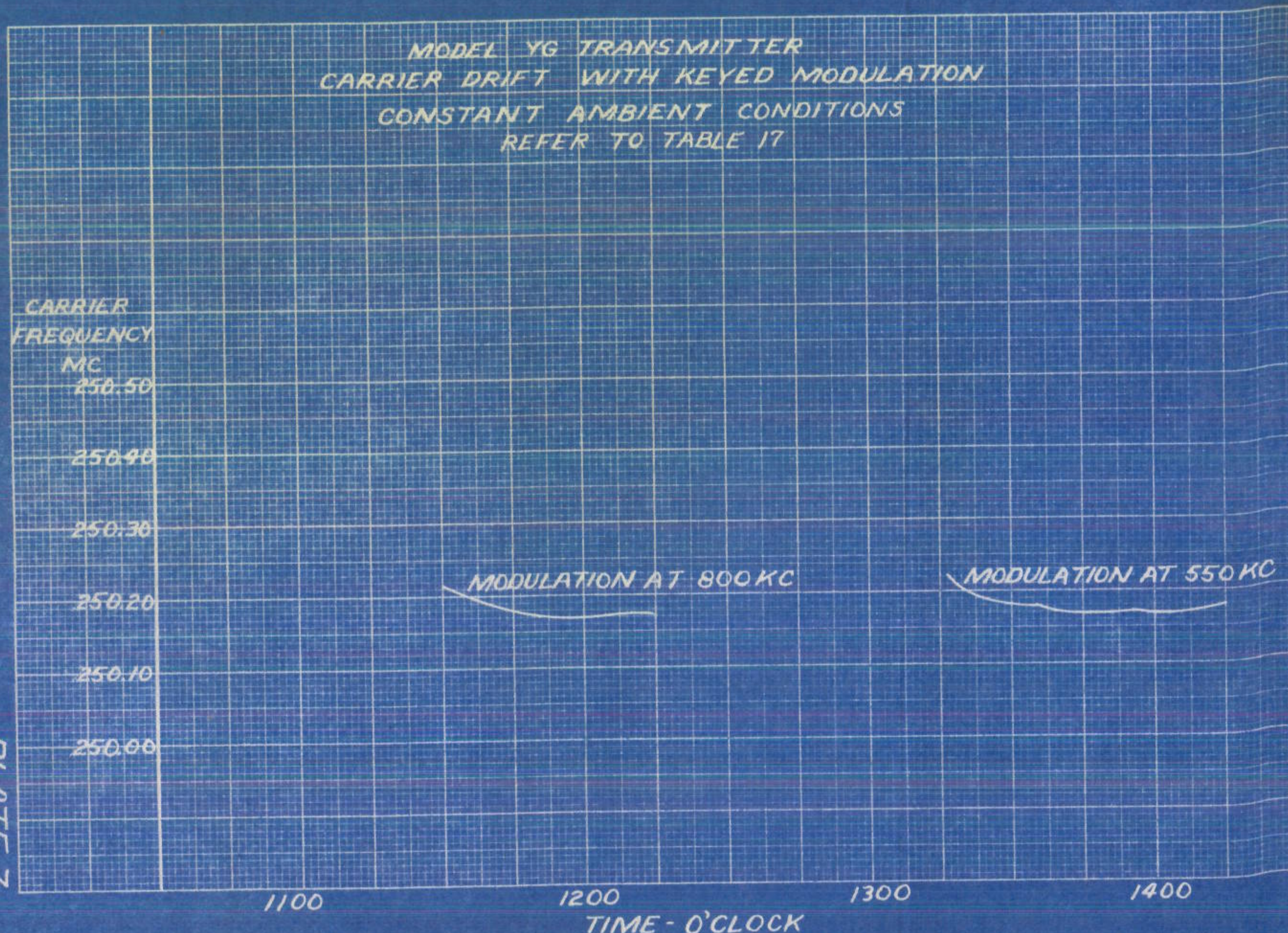

PLATE 3

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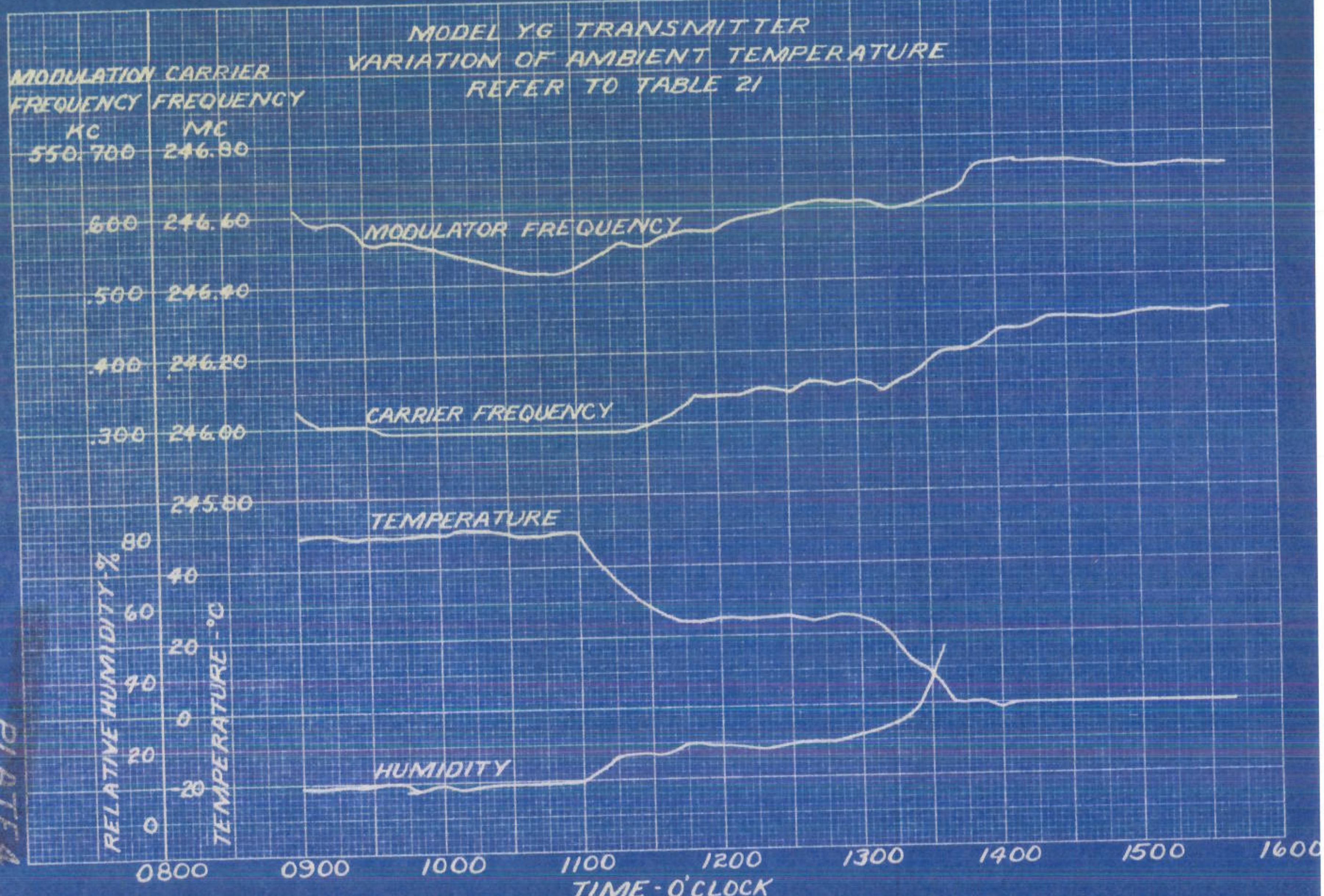

MODEL YG TRANSMITTER
VARIATION OF AMBIENT TEMPERATURE
REFER TO TABLE 21
MODULATION FREQUENCY KC
CARRIER FREQUENCY MC
550.700
246.80
.600
246.60
.500
246.40
.400
246.20
.300
246.00
245.80
MODULATOR FREQUENCY
CARRIER FREQUENCY
TEMPERATURE
HUMIDITY
RELATIVE HUMIDITY-%
80
60
40
20
0
TEMPERATURE-°C
40
20
0
-20
0800
0900
1000
1100
1200
1300
1400
1500
1600
TIME-O'CLOCK

PLATE 4

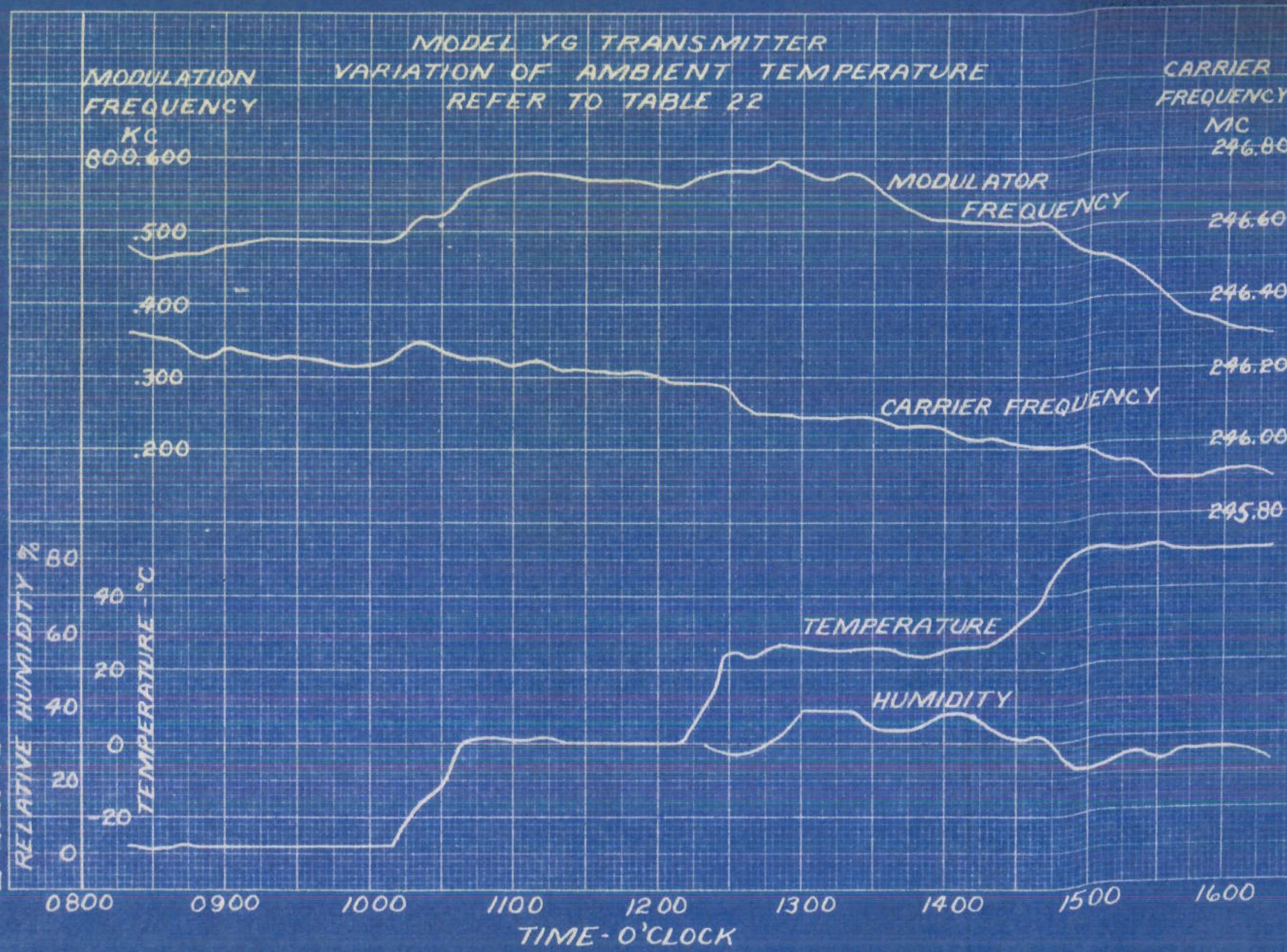

MODEL YG TRANSMITTER
VARIATION OF AMBIENT TEMPERATURE
REFER TO TABLE 22
MODULATION FREQUENCY KC
800.600
.500
.400
.300
.200
CARRIER FREQUENCY MC
246.80
246.60
246.40
246.20
246.00
245.80
MODULATOR FREQUENCY
CARRIER FREQUENCY
TEMPERATURE
HUMIDITY
RELATIVE HUMIDITY %
80
60
40
20
0
TEMPERATURE - °C
40
20
0
-20
0800
0900
1000
1100
1200
1300
1400
1500
1600
TIME - O'CLOCK

PLATE 5

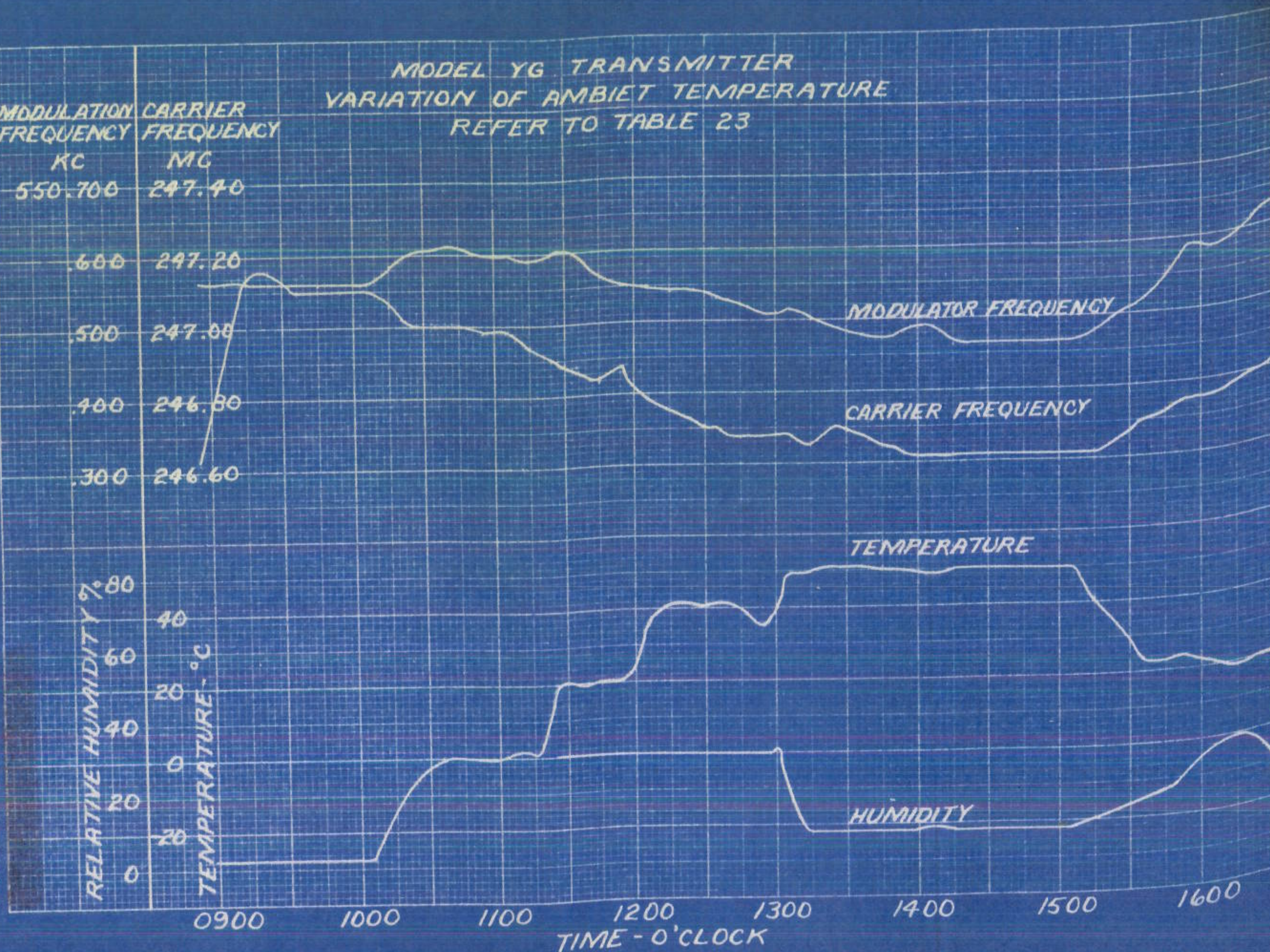
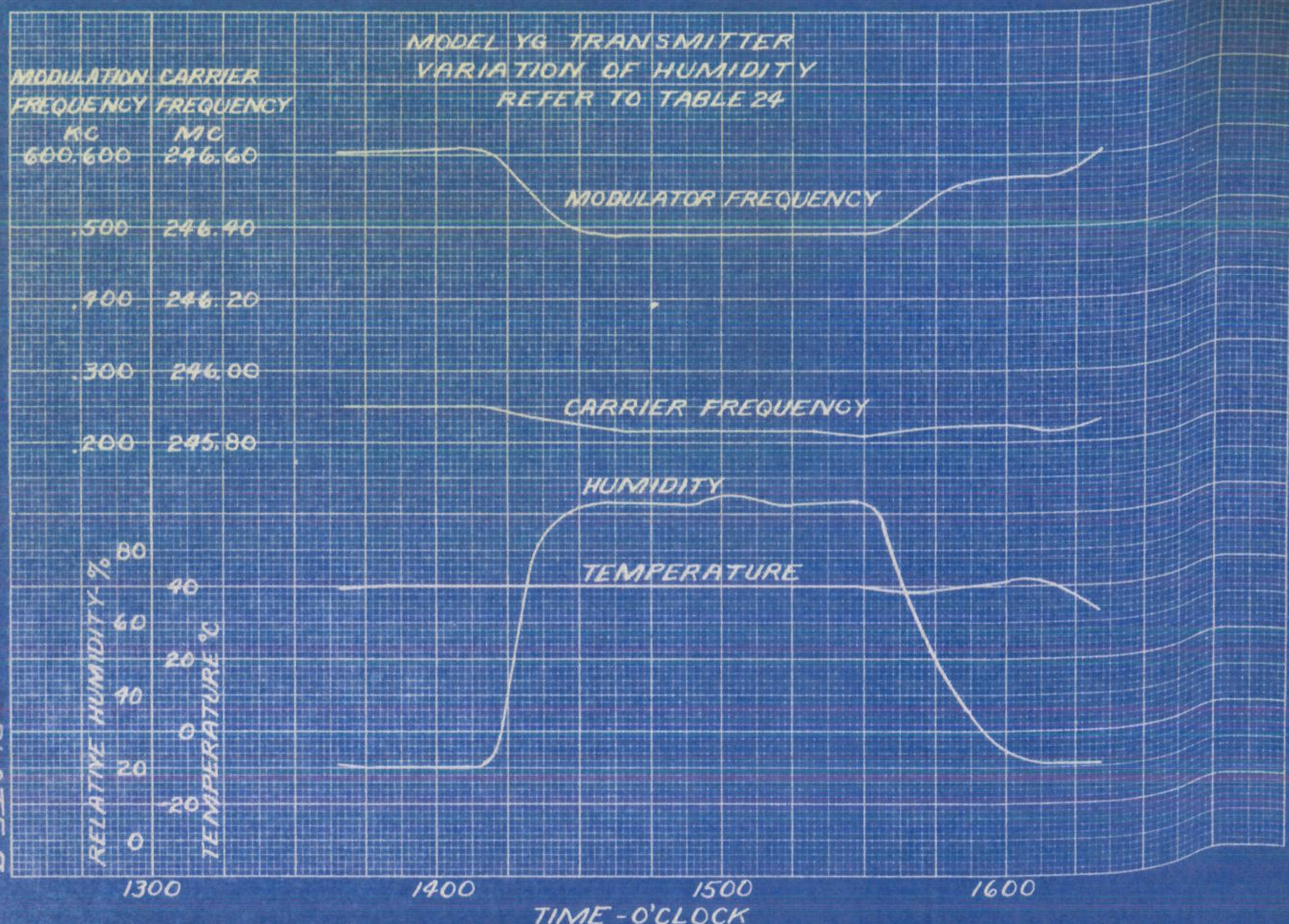

MODEL YG TRANSMITTER
VARIATION OF AMBIET TEMPERATURE
REFER TO TABLE 23
MODULATION FREQUENCY KC
CARRIER FREQUENCY MC
550.700
.600
.500
.400
.300
247.40
247.20
247.00
246.80
246.60
MODULATOR FREQUENCY
CARRIER FREQUENCY
TEMPERATURE
HUMIDITY
RELATIVE HUMIDITY %
80
60
40
20
0
TEMPERATURE - °C
40
20
0
20
0900
1000
1100
1200
1300
1400
1500
1600
TIME - O'CLOCK

PLATE 6



MODEL YG TRANSMITTER
VARIATION OF HUMIDITY
REFER TO TABLE 24
MODULATION FREQUENCY KC
CARRIER FREQUENCY MC
600.600
.500
.400
.300
.200
246.60
246.40
246.20
246.00
245.80
MODULATOR FREQUENCY
CARRIER FREQUENCY
HUMIDITY
TEMPERATURE
RELATIVE HUMIDITY-%
80
60
40
20
0
TEMPERATURE °C
40
20
0
-20
1300
1400
1500
1600
TIME-O'CLOCK

PLATE 7

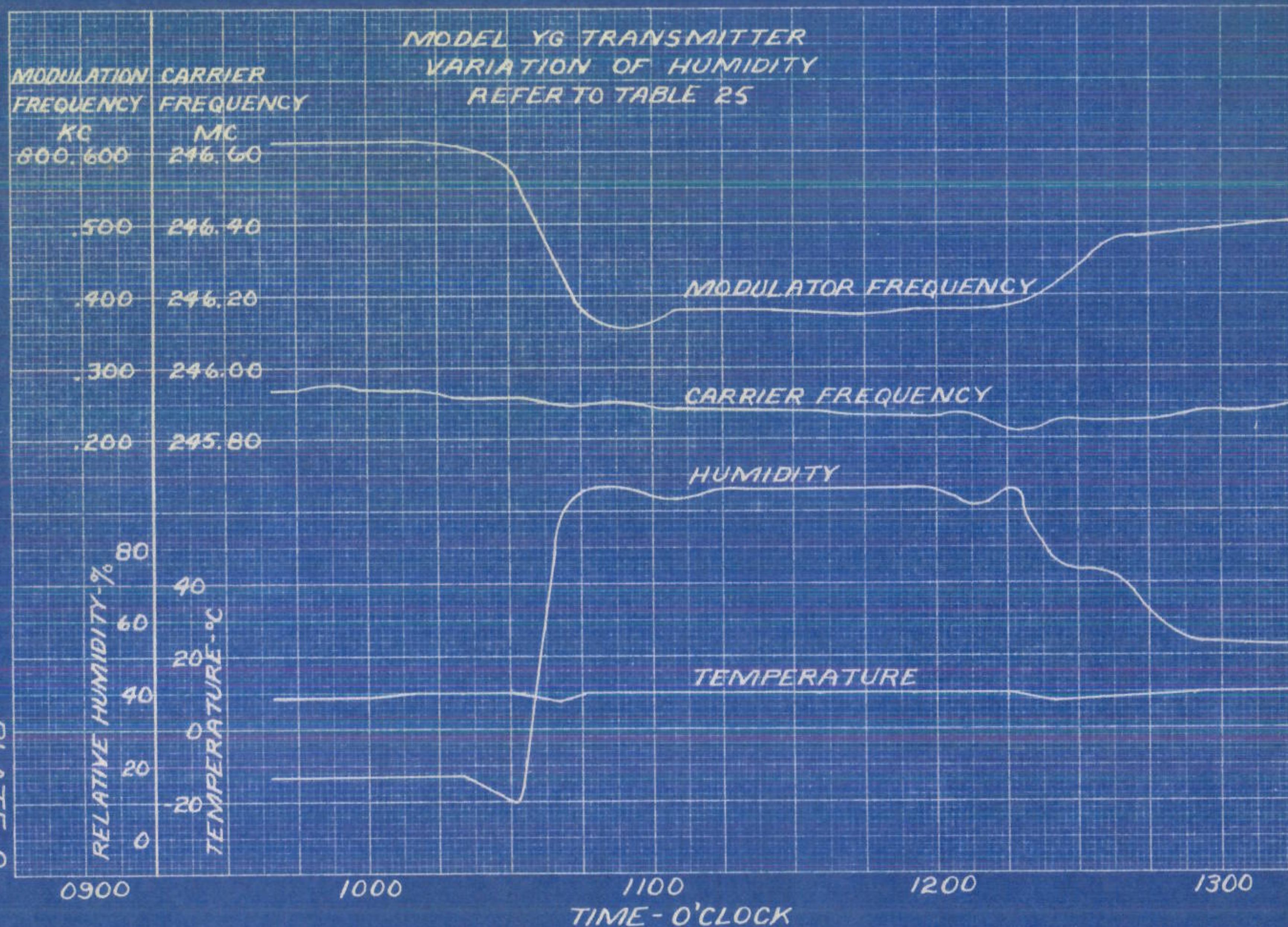


PLATE 8 [redacted]

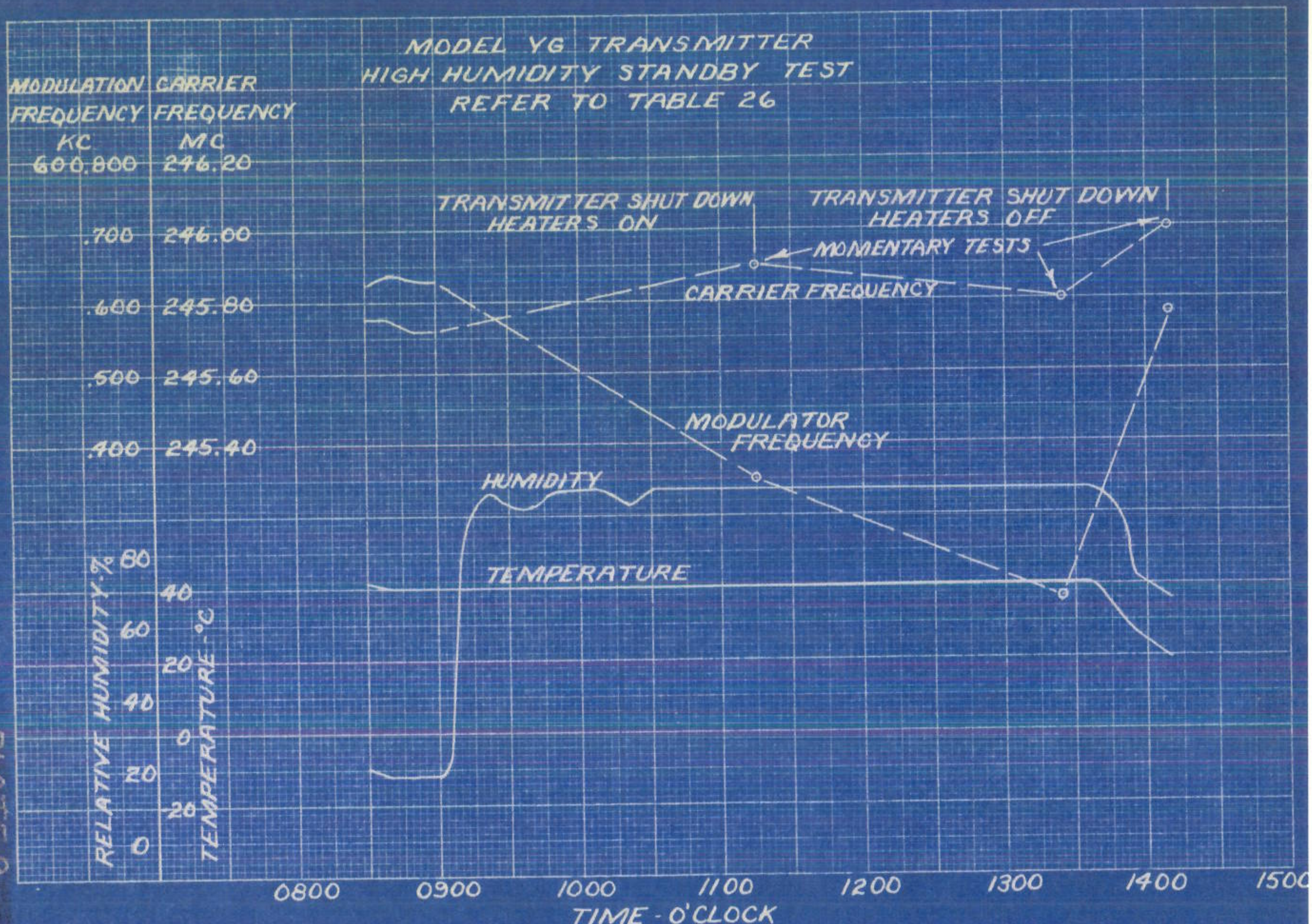

MODEL YG TRANSMITTER
HIGH HUMIDITY STANDBY TEST
REFER TO TABLE 26
MODULATION FREQUENCY KC
CARRIER FREQUENCY MC
600.800
246.20
.700
246.00
.600
245.80
.500
245.60
.400
245.40
RELATIVE HUMIDITY-%
80
60
40
20
0
TEMPERATURE-°C
40
20
0
-20
TRANSMITTER SHUT DOWN HEATERS ON
TRANSMITTER SHUT DOWN HEATERS OFF
MOMENTARY TESTS
CARRIER FREQUENCY
MODULATOR FREQUENCY
HUMIDITY
TEMPERATURE
0800
0900
1000
1100
1200
1300
1400
1500
TIME - O'CLOCK

PLATE 9

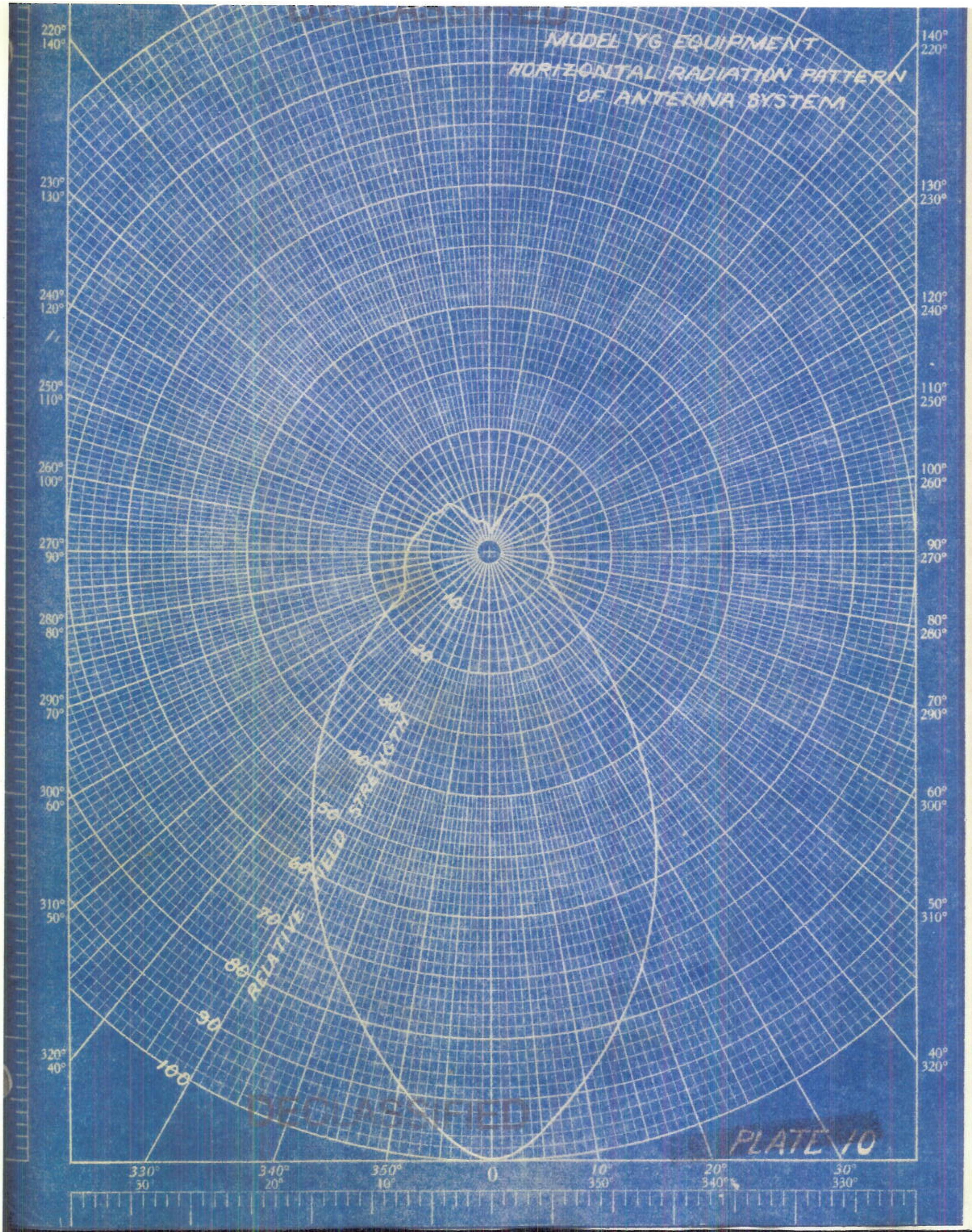

MODEL YG EQUIPMENT
HORIZONTAL RADIATION PATTERN OF ANTENNA SYSTEM
RELATIVE FIELD STRENGTH
10
20
30
40
50
60
70
80
90
100

PLATE 10

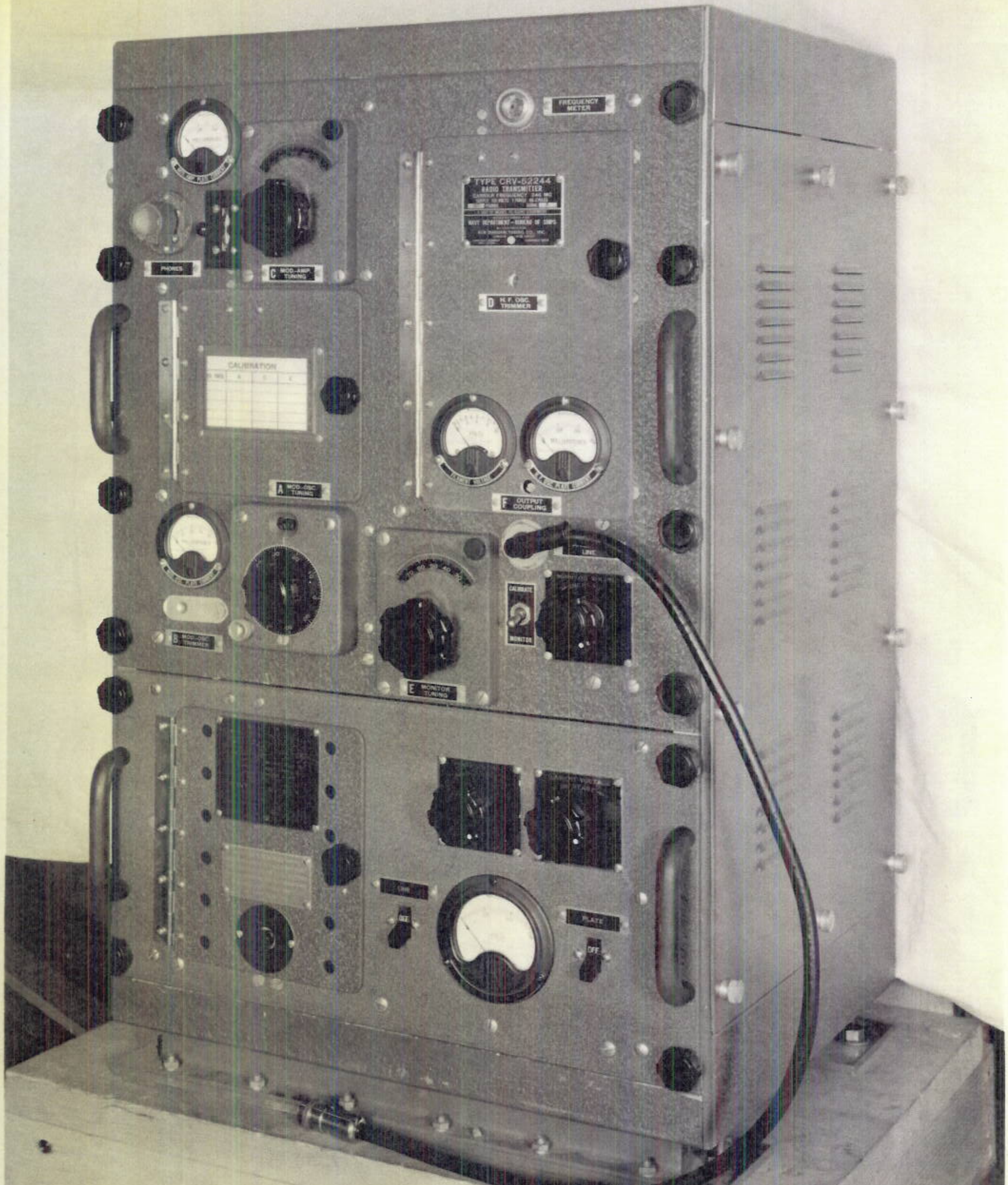


PLATE II

[redacted]

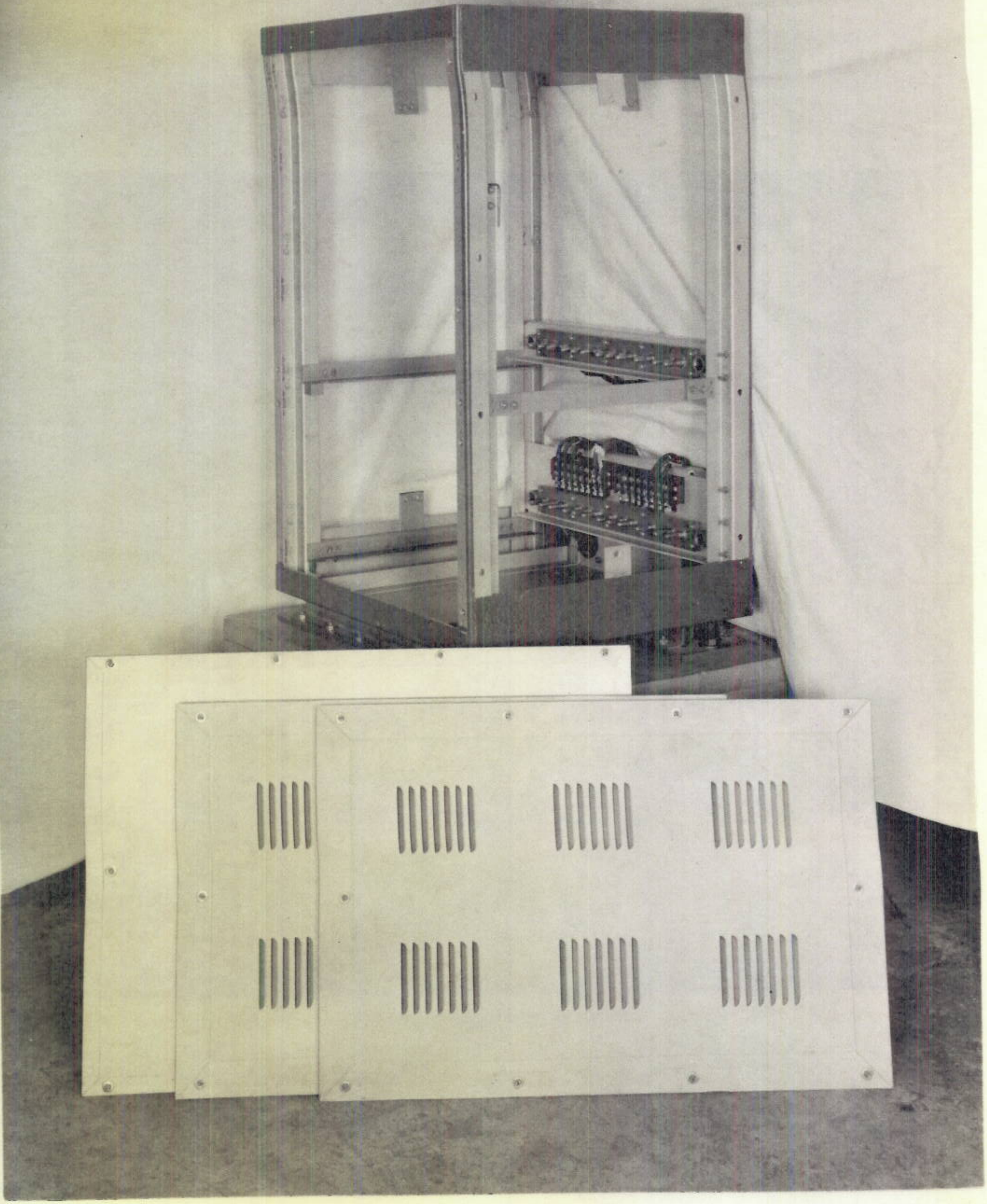
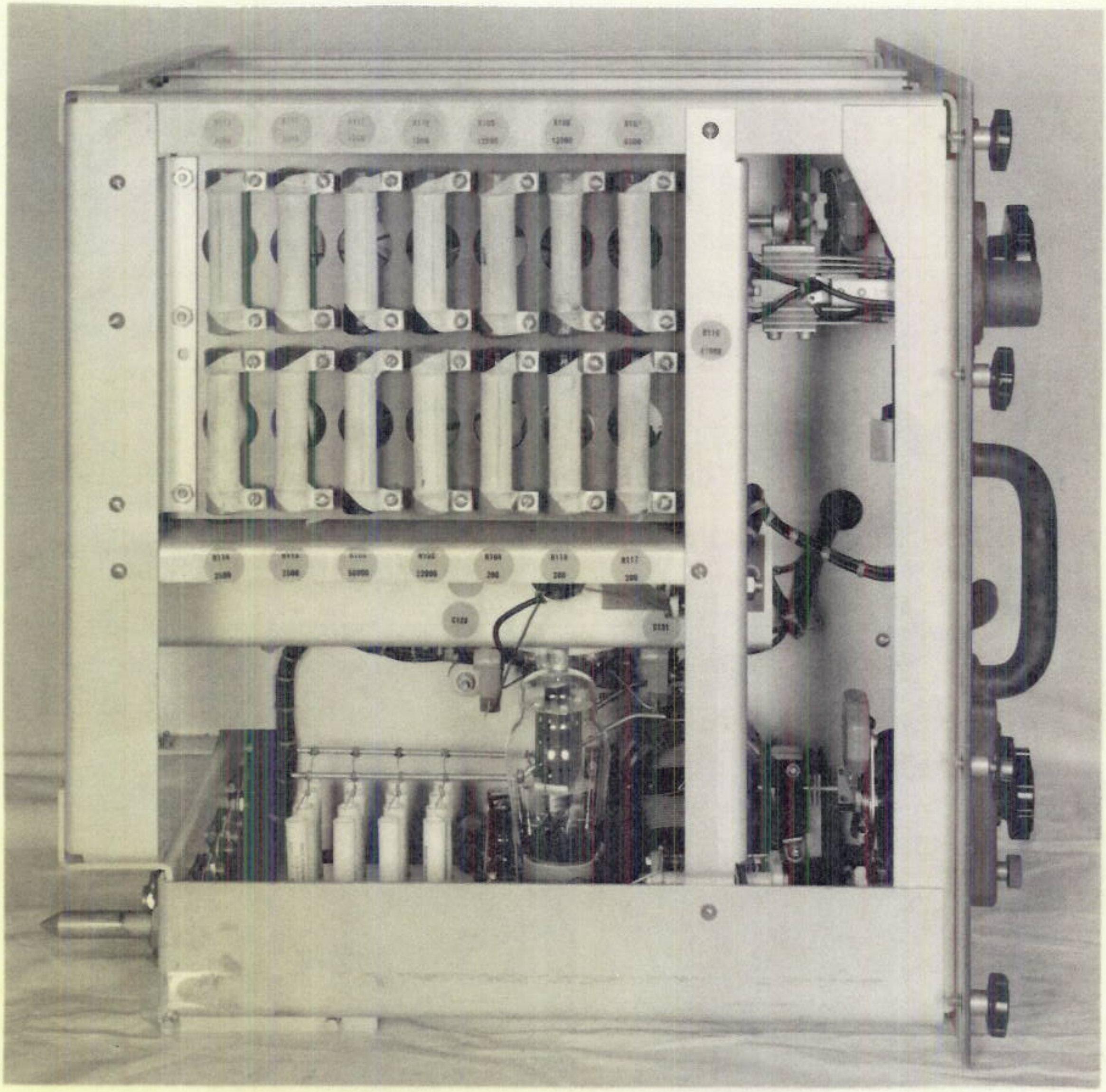


PLATE 13



[redacted] PLATE 14

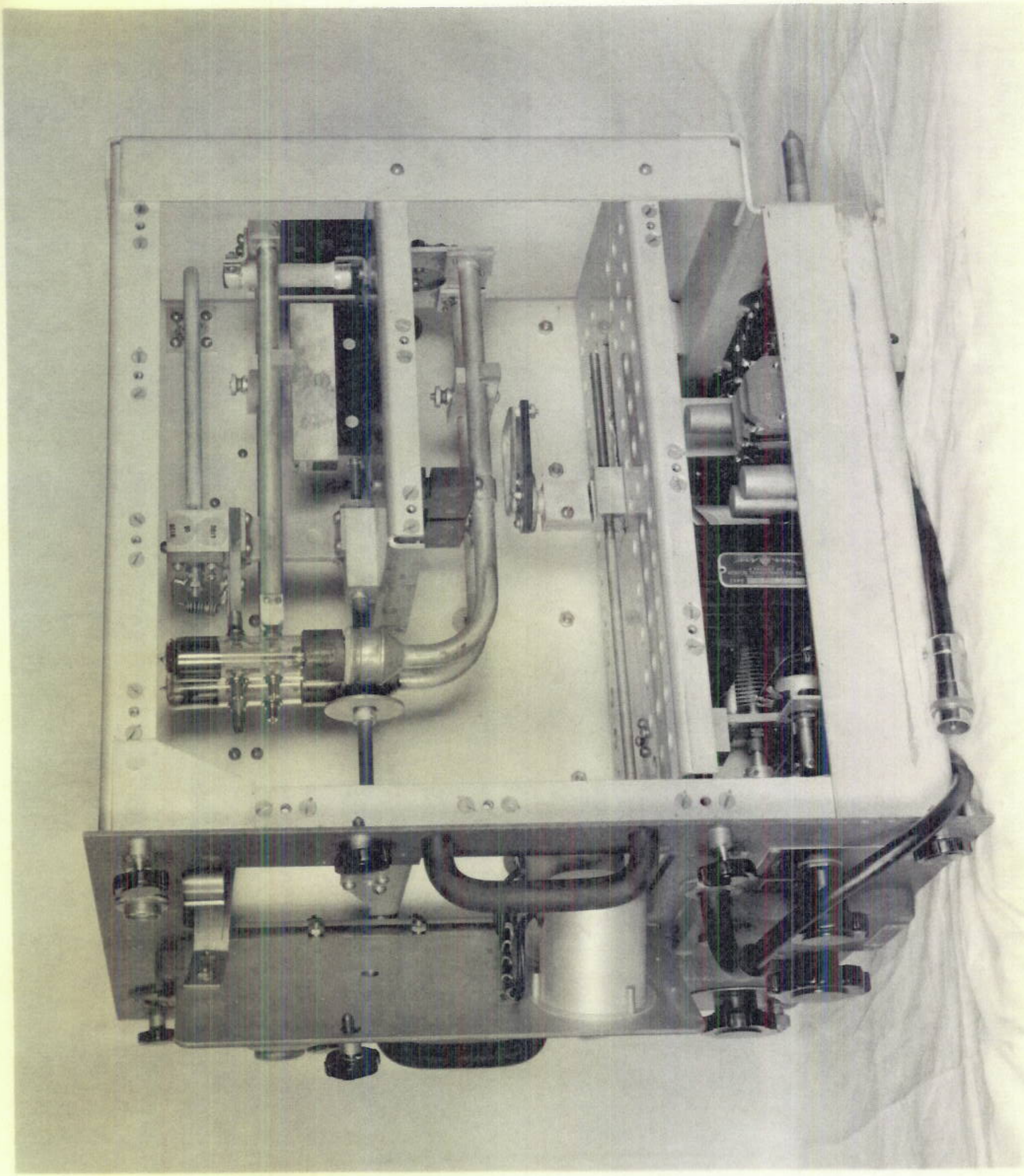


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PLATE 15

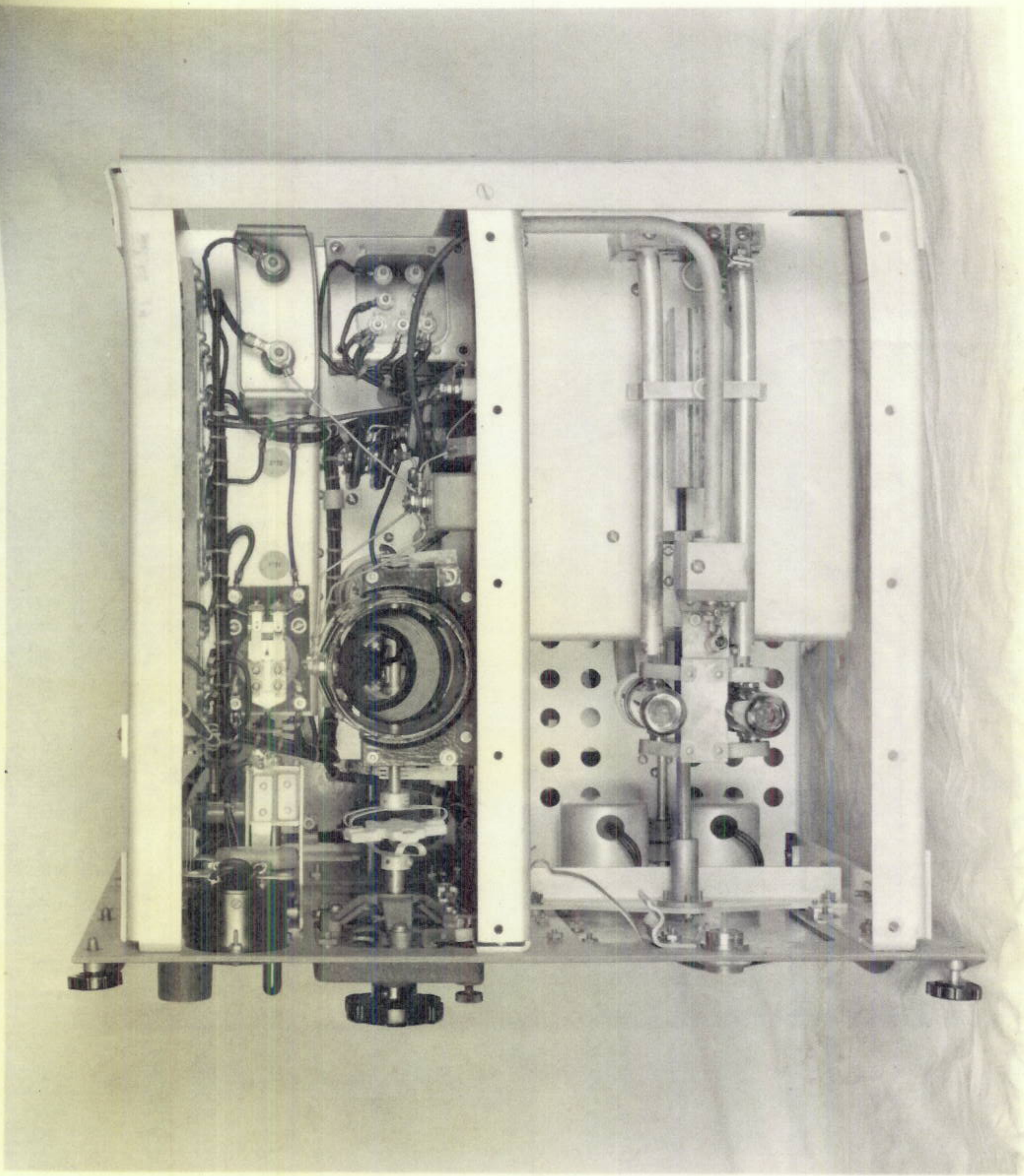


PLATE 16

[redacted]

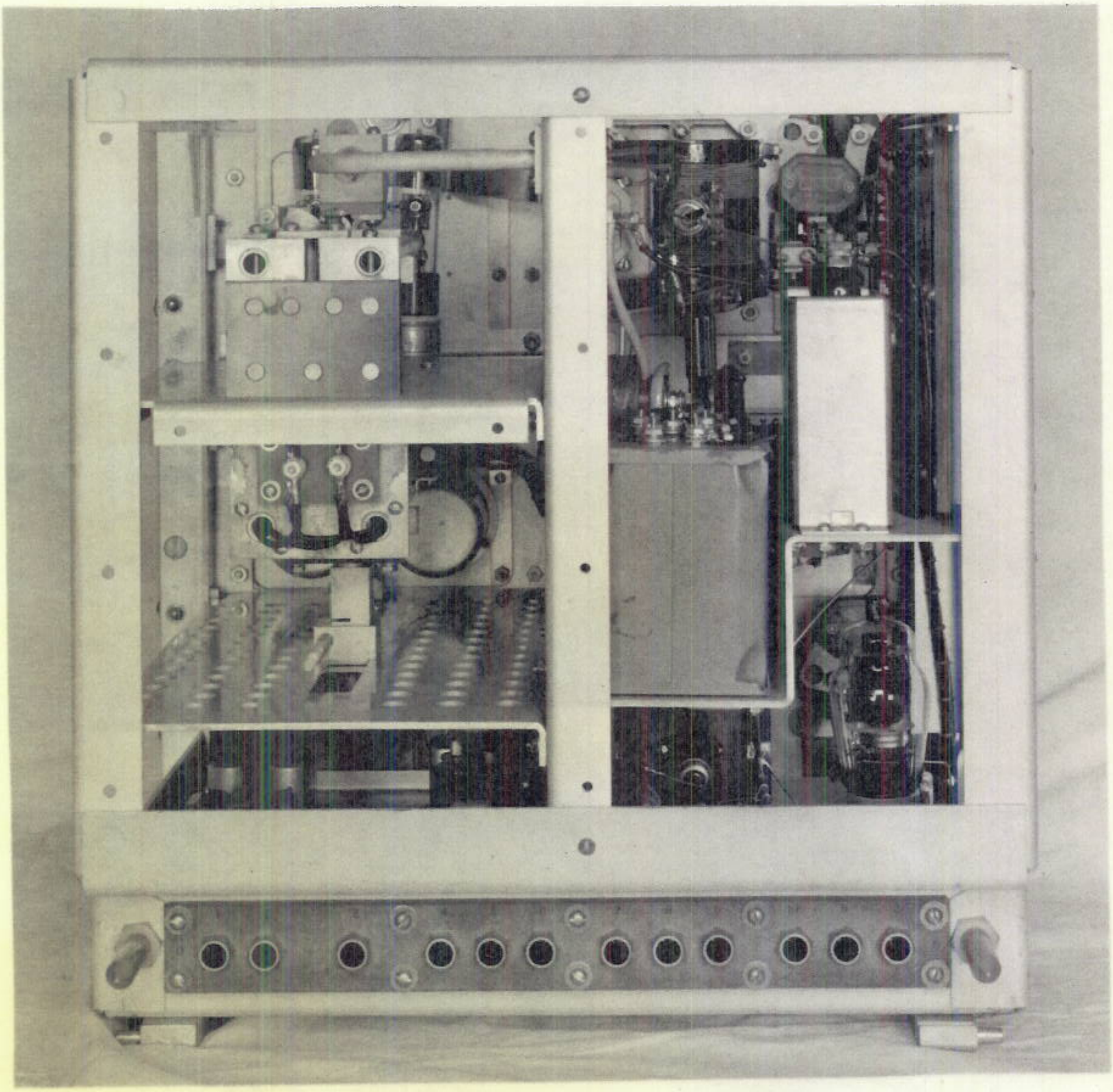


PLATE 17

DECLASSIFIED [redacted]

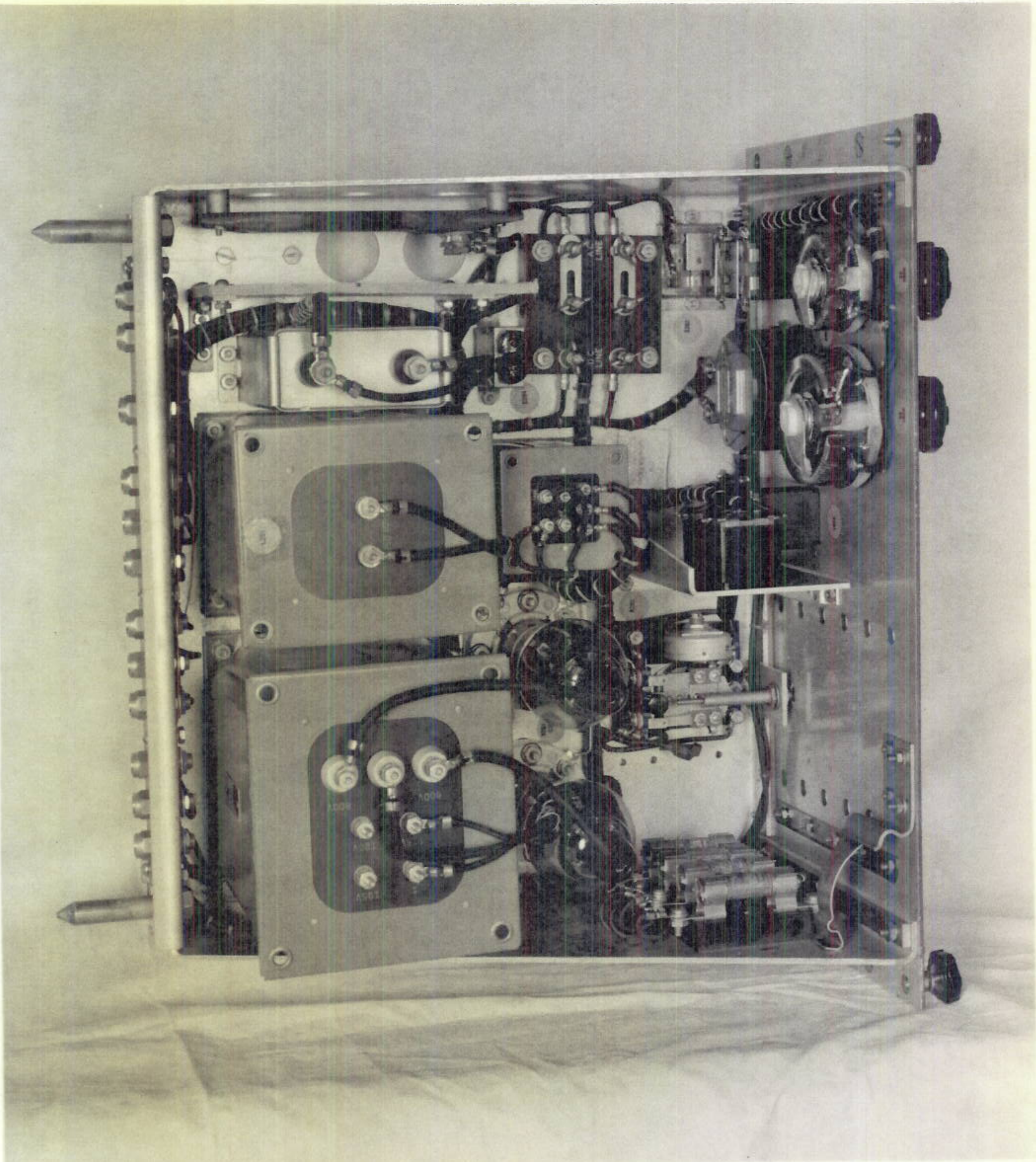


PLATE 18

[redacted]

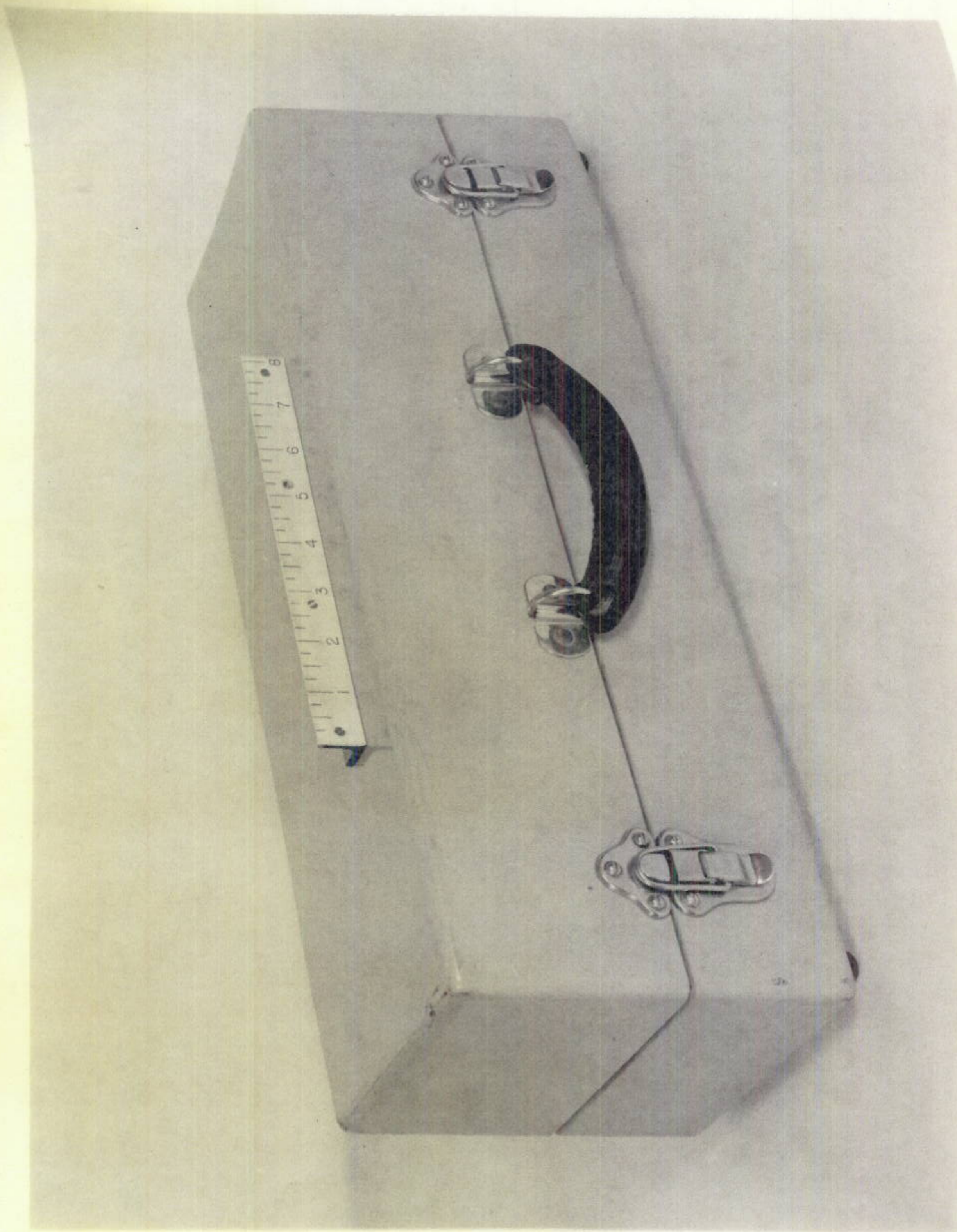
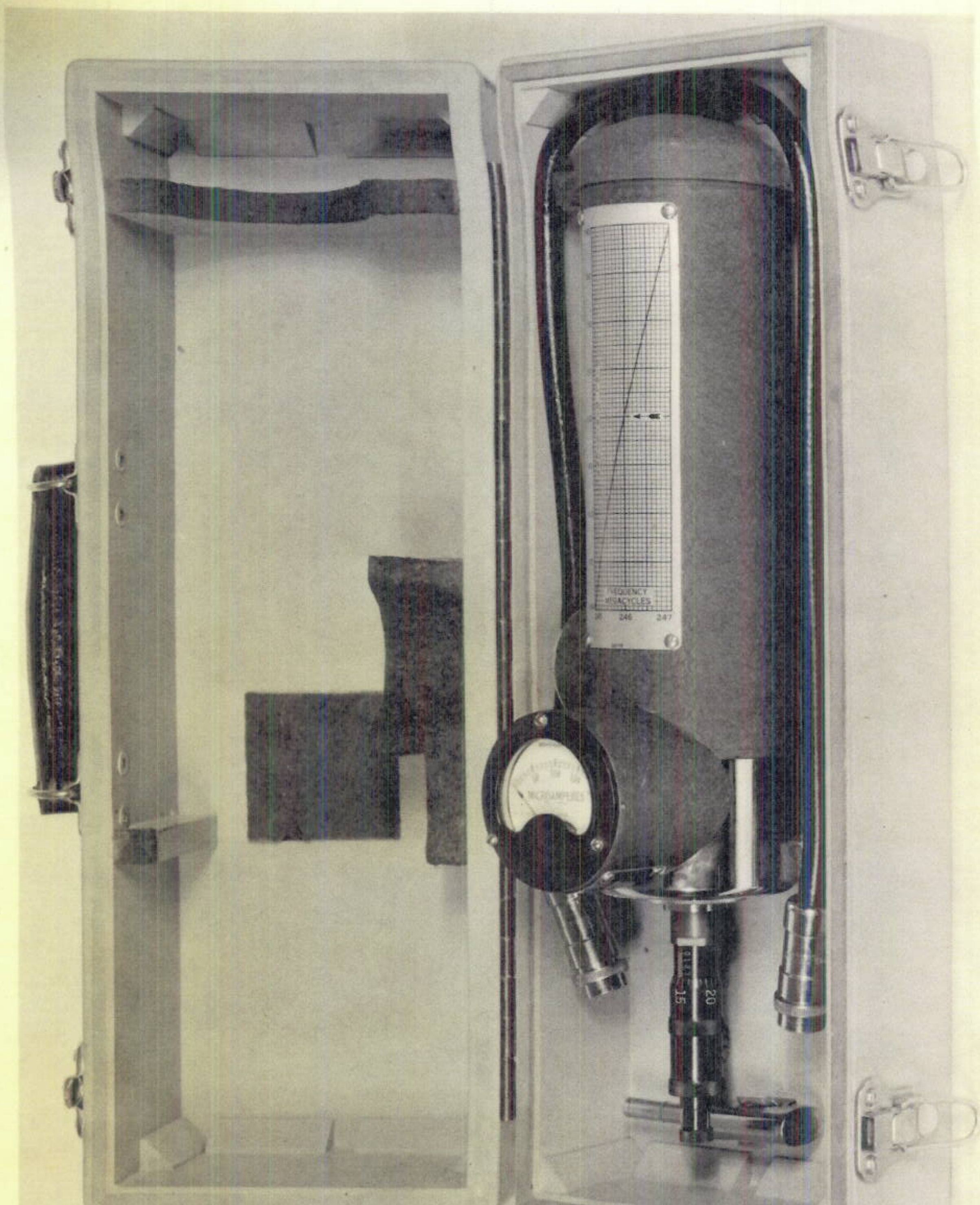


PLATE 19

[redacted]



DECLASSIFIED

PLATE 20

[redacted]

PLATE 21

[redacted]

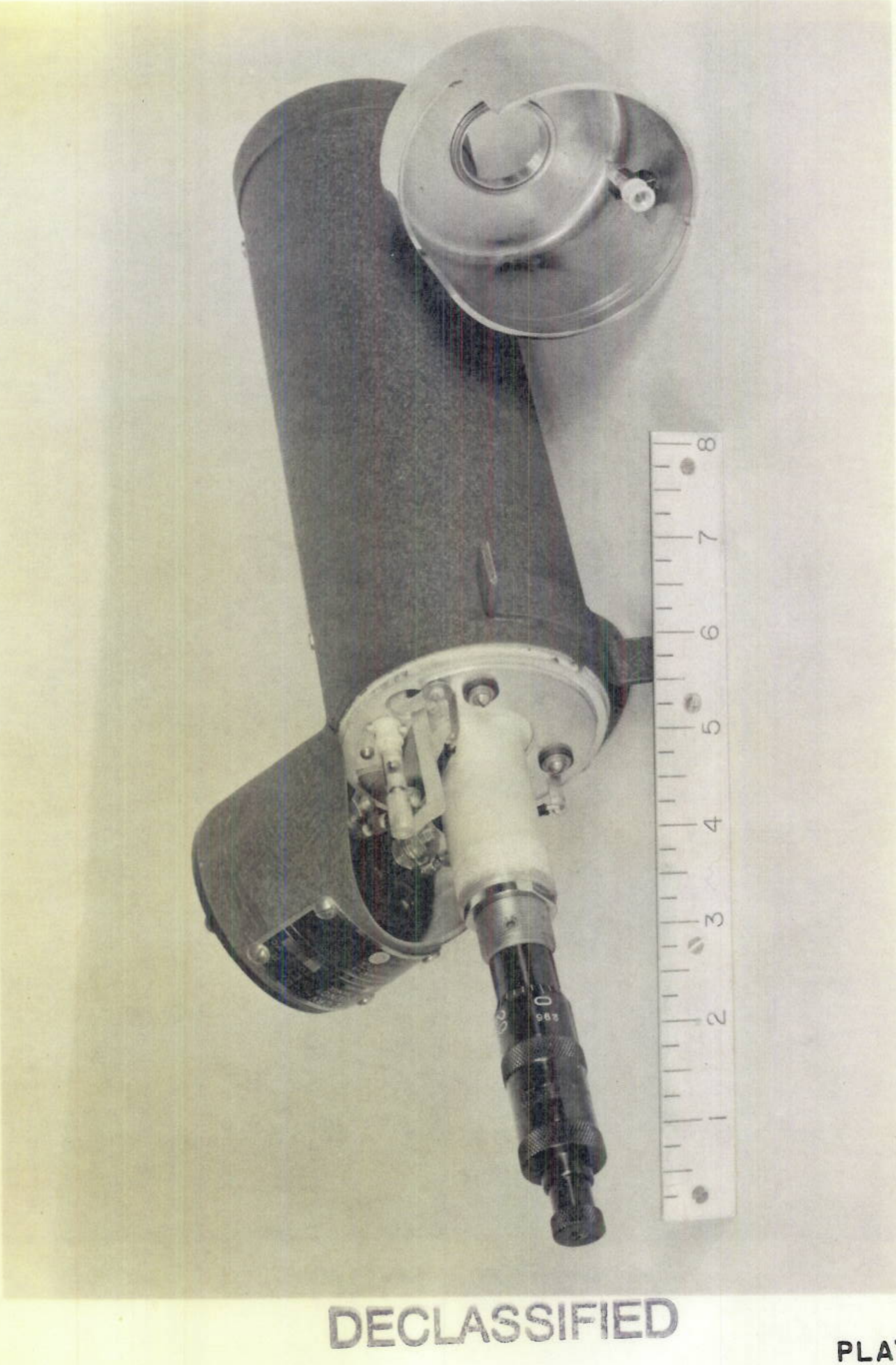


PLATE 22

[redacted]

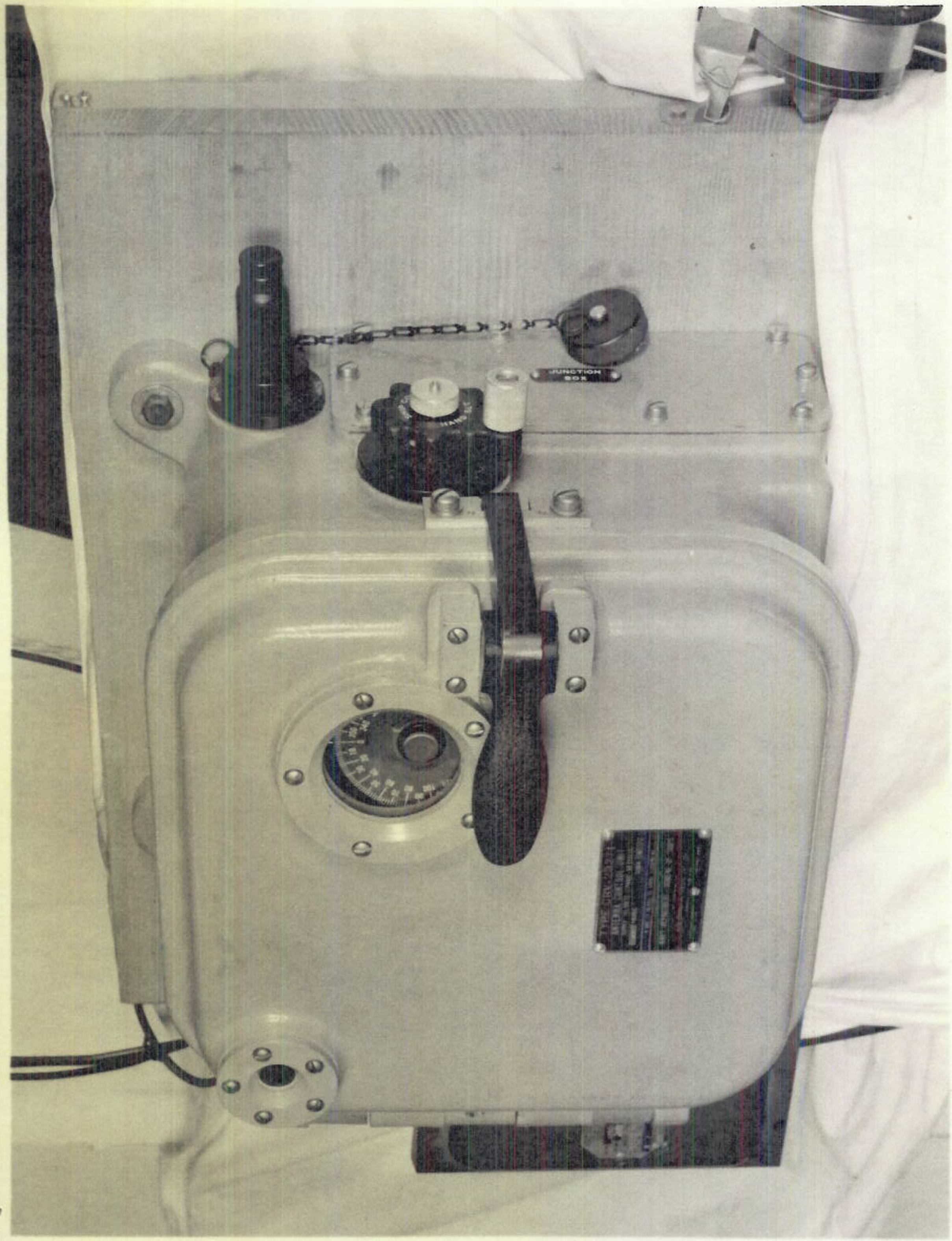


PLATE 23

[redacted]

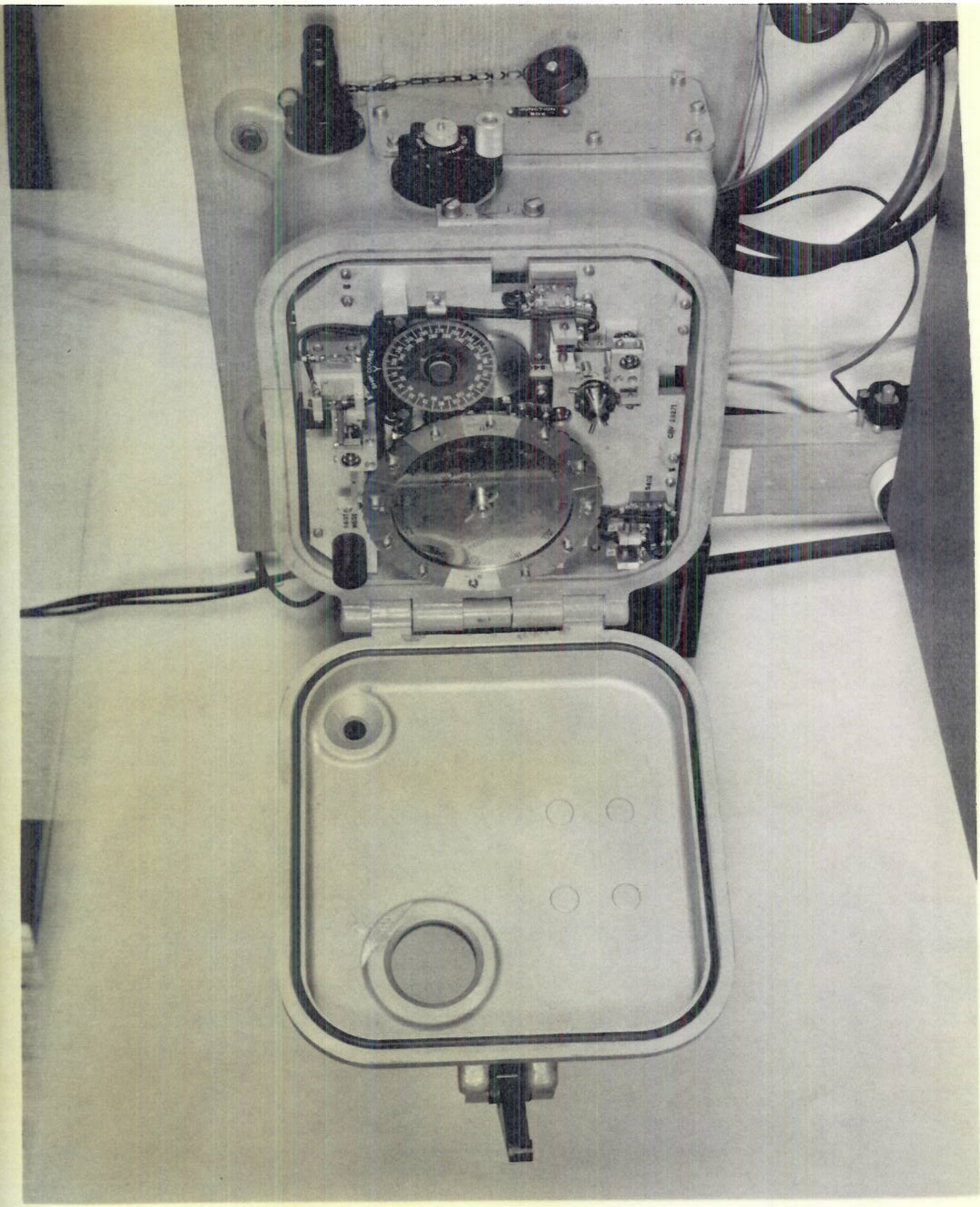
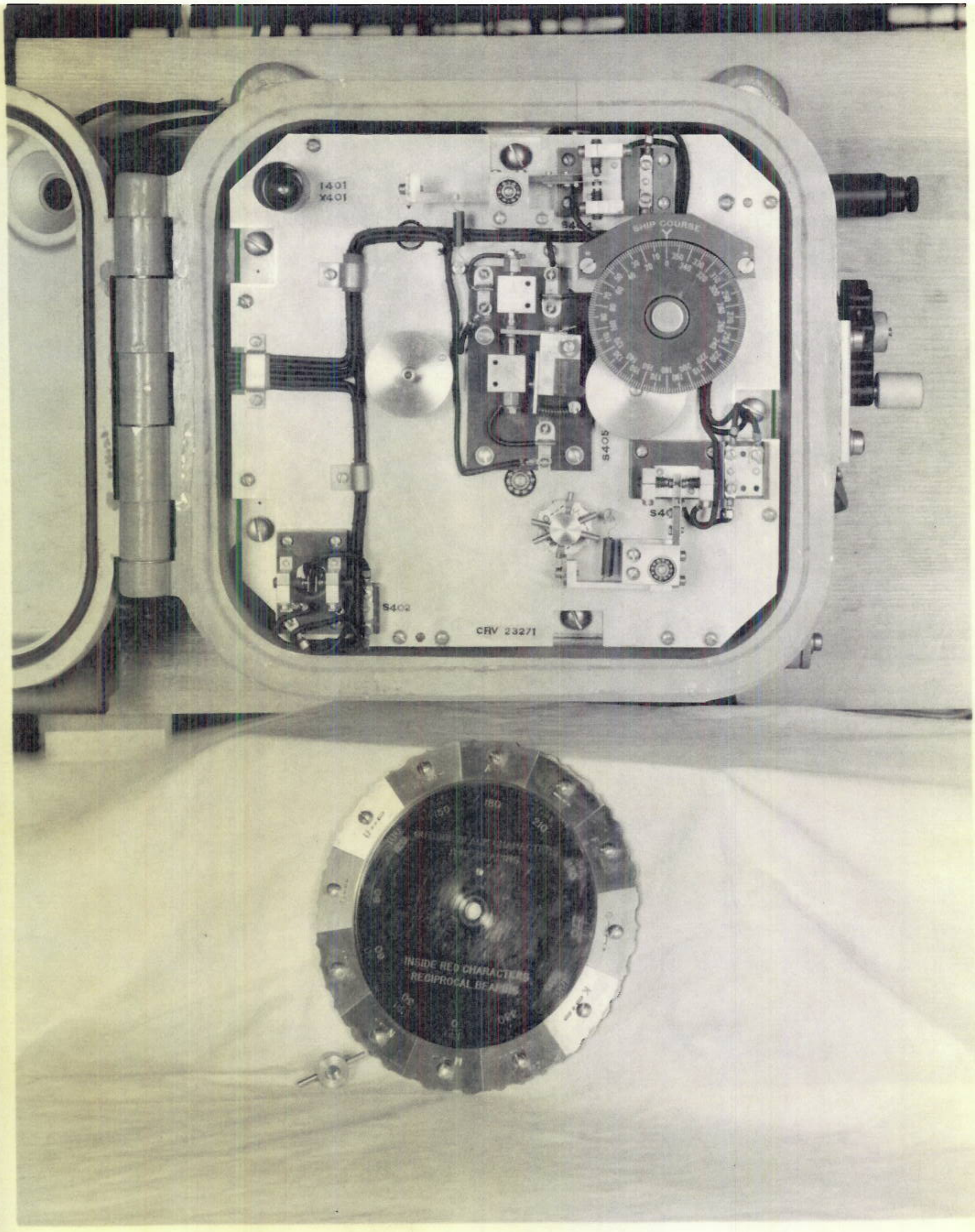


PLATE 24

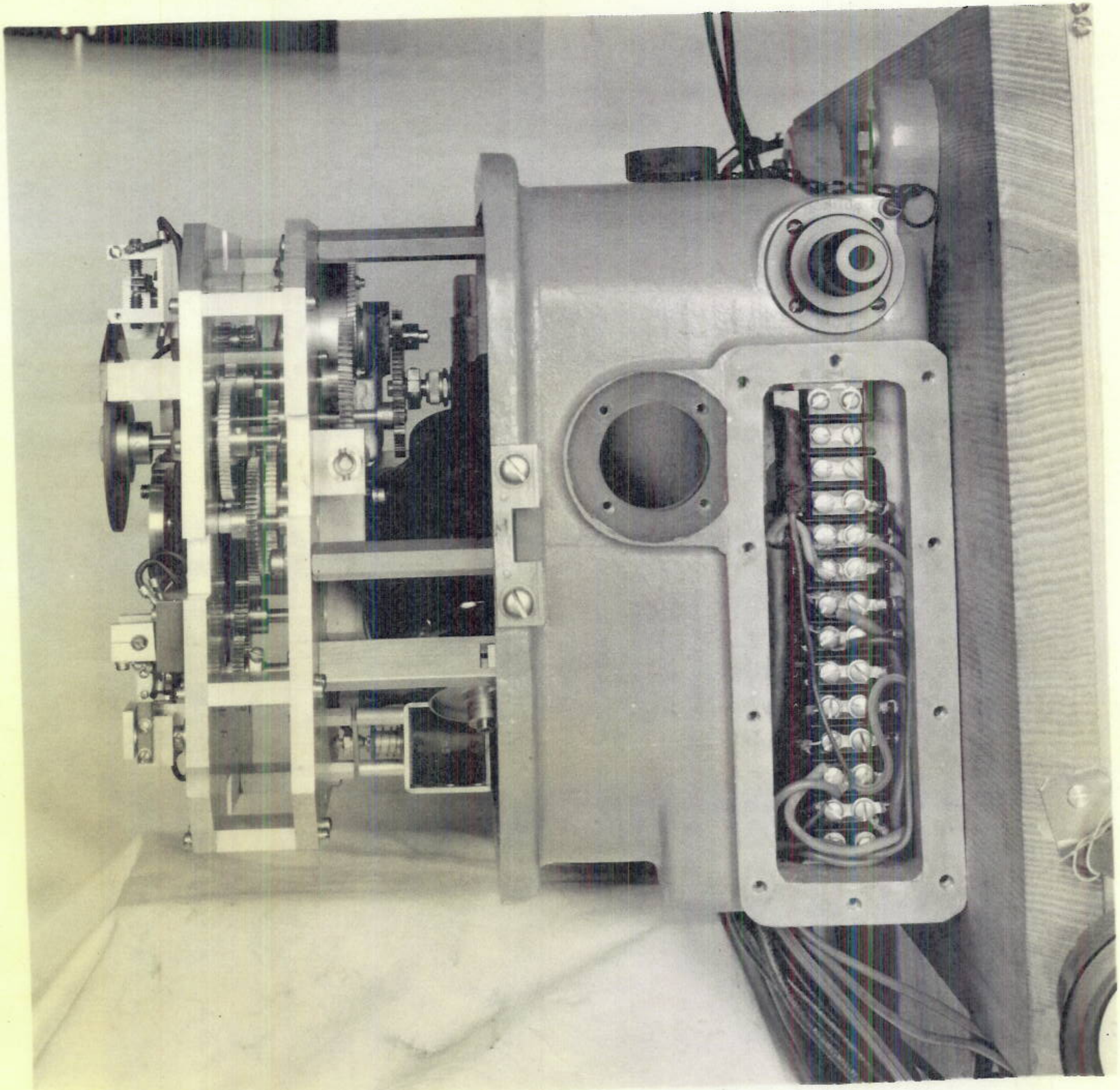
[redacted]



DECLASSIFIED

PLATE 25

[redacted]



DECLASSIFIED

PLATE 26

[redacted]

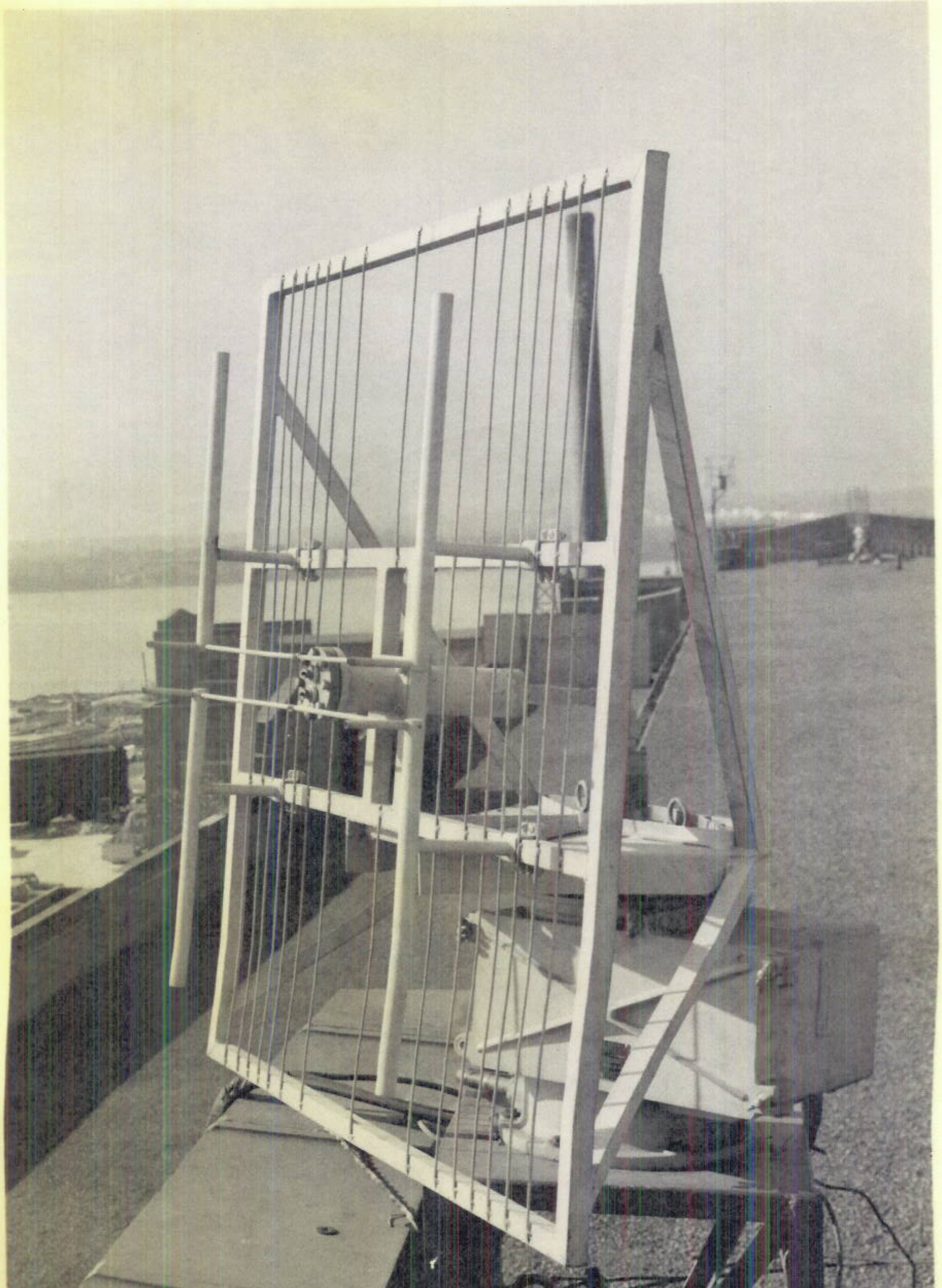


PLATE 27

[redacted]

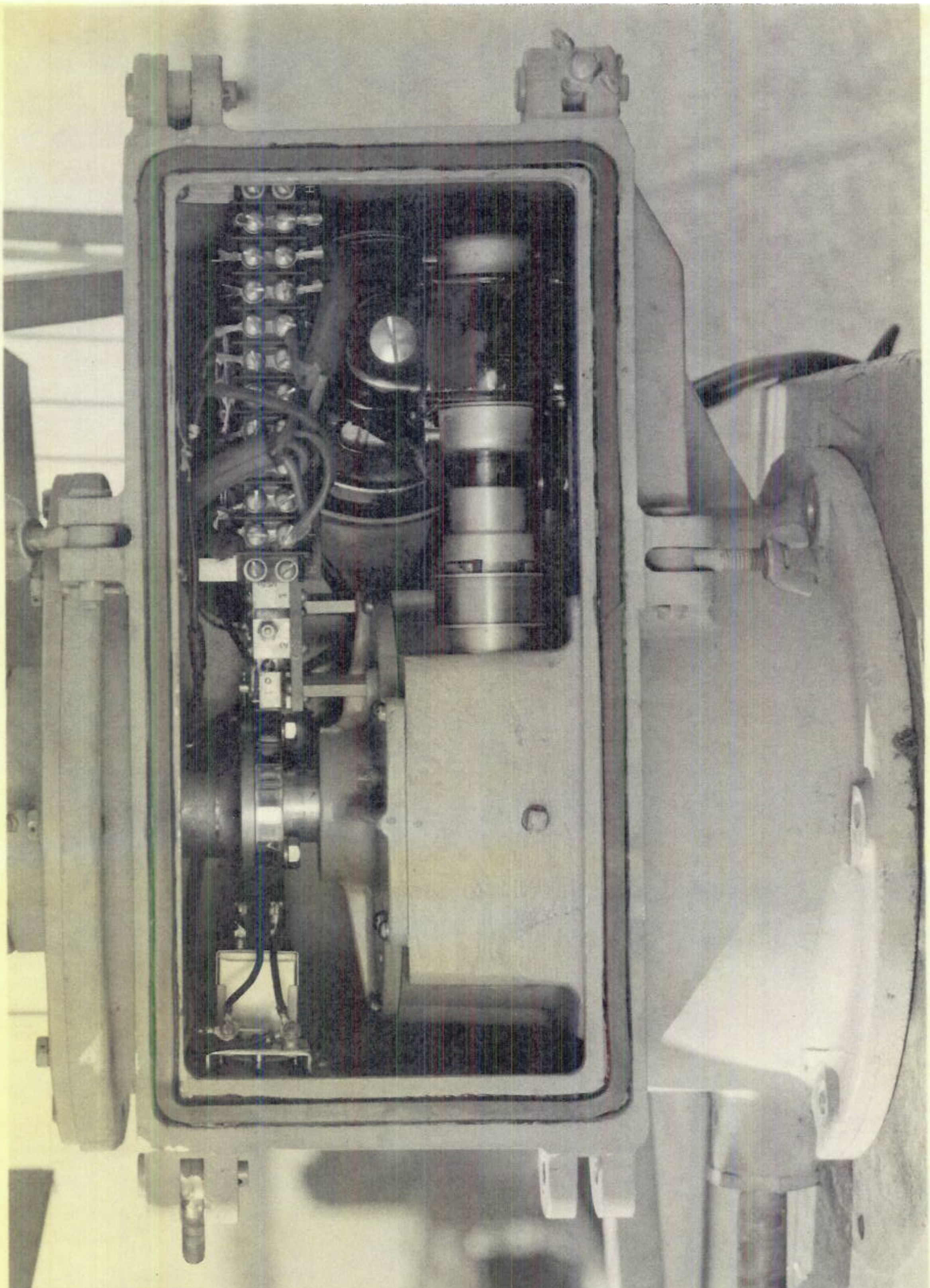


PLATE 28

[redacted]