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NRL Report No. R-1772
Report on Test of
Model YE Homing Transmitting Equipment

REPORT NO. R-1772

DATE 20 August 1941

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SUBJECT

Report on Test

of

Model YE Homing Transmitting Equipment

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C-F42-1/69H
WILL BE APPRECIATED

HRJ:st

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

20 August 1941

FR-1772

From: Naval Research Laboratory
To : Bureau of Ships

Subject: Radio - Contract C-NOs-69090 - Model YE Homing Beacon Transmitting Equipment - RCA Manufacturing Co., Contractor - Report of Test on Transmitting Equipment. - (BuShips Prob. D-1C).

Reference:
(a) Contract C-NOs-69090 of 31 October 1939.
(b) Navy Specifications RE 13A 528B.
(c) Contractor's Descriptive Specifications AS-5515G.
(d) BuShips ltr. C-NOs-69090(11-20-DR6) of 9 December 1940.
(e) BuShips Shipment Order EN-28/10396 of 9 June 1941.
(f) NRL ltr. C-F42-1/69H of 19 June 1941 to RCA via INM, Philadelphia.
(g) NRL Report No. 1755 of 26 June 1941.
(h) NRL ltr. S67/38 of 24 April 1941 to BuShips.
(i) NRL ltr. C-F42-1/69H of 9 July 1941 to BuShips.

Enclosure: (A) Ten (10) copies of NRL Report No. R-1772.
s/c

1. In accordance with reference (d), the Model YE Transmitting Equipment, Serial No. 6 and the Model YE Antenna Array, Serial No. 2, were subjected to the tests required by reference (a) and such additional tests as were required by reference (d). A report, Enclosure (A), is submitted which discusses in detail the results of these tests.

2. At the completion of the tests, the subject equipment was crated for shipment and forwarded to the USS HORNET in accordance with reference (e).

3. During the course of the tests on the Model YE Equipment, several Type 826 Vacuum Tubes, Serial Nos. 501, 503 and 510, were turned over to a Contractor's Representative in exchange for tubes of improved design.

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4. Certain parts, which had been used temporarily during the course of the tests, were returned to the Contractor, as noted in reference (f). The items involved are as follows:

6 - Type 826 Vacuum Tubes, Serial Nos. 526, 527, 528, 529, 531 and 541.

1 - 8000 Ohm Resistor, Type CAO-63152E.

1 - V-Cut Crystal Unit, Serial No. 10952, Frequency 13777.8 KC.

1 - V-Cut Crystal Unit, Serial No. 8407, Frequency 12500.0 KC.

5. This Laboratory has submitted to the Bureau a report, reference (g), covering tests of the directive characteristics of the Model YE Antenna Array.

6. A letter report, reference (h), has been compiled which discusses the socket and base performance of the Types 826 and 829 Vacuum Tubes as employed in the subject equipment.

7. A letter of recommended modifications to the Model YE Homing Beacon Equipment and Specifications RE 13A 528B has already been forwarded to the Bureau as reference (i). Enclosure (A) includes these recommended modifications together with some additional recommendations, which subsequent study indicates are desirable.

8. On the 18th of August, 1941, a conference was held between representatives of this Laboratory and the Contractor regarding the defects found in the existing YE equipment, and the recommendations as to changes necessary or desirable in additional homing equipments, as listed in Enclosure (A). It was indicated to be impractical or impossible to make certain of the recommended changes, and in other cases, the modifications desired would cause a considerable delay in production. Inasmuch as the Bureau will inform the Contractor as to the nature of changes desired in future equipments, the facts disclosed during this conference are related for guidance. Hereafter, reference is made to the recommendations of Enclosure (A), (NRL Report No. R-1772), and wherever a recommendation contains several parts or statements, it will be indicated which portion of the recommendation is under discussion.

Recommendation 2. (Third Statement). The Contractor's representatives stated that lack of space would make it difficult to affix to symbol marking tags for composition resistors, complete information

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as to the symbol number, Navy type number, and resistance value. However, the Contractor intended to give further study to this matter, and if feasible, to do so. It was also stated that, if it was impossible to give all pertinent information, that the resistor mountings will be marked only with the symbol number, and that information as to the Navy type number and the resistance value would appear in the Instruction Book.

Recommendation 2. (Fourth Statement). The Contractor's representatives indicated that designs of "resistor-suppressor" units are now available which have greater mechanical strength than those which were used previously, and it was proposed to use improved units in additional equipments.

Recommendation 4. It was indicated that an effort would be made to obtain plate generators employing isolantite or micalex brush holders, but it was also stated that this change might entail a considerable delay in production of additional equipments. Inasmuch as the operating voltage does not exceed the allowable potential by a very large factor, it is suggested that the Bureau give consideration to the use of plastic insulation for this purpose, if the Contractor finds that too great a delay is caused by complying with the recommended change. If the Bureau permits brush holders of plastic insulation, it is suggested that consideration be given to providing spare brush holders in order that a repair may be speedily accomplished if failure occurs on shipboard.

Recommendation 7. The Contractor's representatives stated that an effort would be made to get a starter provided with an interlocked line disconnect in lieu of a magnetic latch, but indicated that this might cause some delay in production of additional equipments.

Recommendation 9. (First Statement). The Contractor's representatives stated that if wiring changes were made to apply fixed bias to the second amplifier stage, that an extensive modification would be necessary. For this reason, it was believed that no effort should be made to apply fixed bias to this stage. However, it was indicated

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that consideration would be given to this problem and that correction of the difficulty would be accomplished, if possible, by minor wiring changes or alteration of some of the circuit components.

Recommendation 9. (Fifth Statement). In order to preclude the possibility of inserting Types 826 and 829 vacuum tubes in their sockets improperly, it was indicated that a designating arrow would be affixed to assure proper indexing.

Recommendation 9. (Sixth Statement). The Contractor's representatives indicated their willingness to employ a plate connector of the type shown in NRL Sketch No. 62A307.

Recommendation 13. (First Statement). The Contractor's representatives stated that no simple means was known for indicating the currents in the individual transmission lines, and that it would be quite difficult to follow the recommendation made. Also, the Bureau has indicated that there is a possibility that additional equipments will employ a single transmission line rather than a twin line. If a single line is used, there will be no need for corrective action. If a twin line is to be used, it is likely that no improvement over the present arrangement can be provided without undue delay.

Recommendation 15. (Third Statement). The Contractor's representatives stated that dial locks were arranged and constructed in the manner used on the TBL-4 and the TBK-8 equipments, which have been given Navy approval. However, it was stated that the matter of improper dial locking action would be investigated, because there is a possibility that some mechanical tolerance was not maintained and caused the condition noted. It was also stated that additional YE equipments would include dial locks which operate as positively and satisfactorily as those already furnished on the TBL-4 and TBK-8 equipments.

Recommendation 16. (Second Statement). The Contractor's representatives stated if changes were made to allow the filament rheostat to control the filament voltage of the modulation oscillator tube, that this would necessitate redesign of the filament

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transformer and delay production of additional equipments. Inasmuch as there was no evidence of improper functioning due to lack of control of the modulation oscillator filament potential, it is suggested that the arrangement provided in additional models be identical with that used in the existing equipment.

Recommendation 17. The Contractor's representatives indicated that the frequency variation of the modulation oscillator noted during change in supply line voltage was much greater than had been found in similar tests conducted at the factory. The belief was expressed that the relatively large frequency variation found at this Laboratory was due principally to use of a tube low in emission. If tubes in first class condition are employed, the Contractor's representatives believe that no undue frequency variation would occur. If the assumption of the Contractor is correct, no additional corrective action is needed.

Recommendation 20. Although no corrective action on the modulation measuring device was considered necessary, a complete discussion of the modulation measuring circuit should be incorporated in the Instruction Book, setting forth its limitations and describing in detail the means for correctly setting the percentage of modulation.

Recommendation 21. Although the report mainly discussed the fact that the monitor circuits do not function properly when using lines of unequal lengths, under the same set of conditions, difficulty is found in modulating the carrier to the specified level. No means is known for correcting this condition other than has been suggested in Recommendation 21. As previously indicated, there is now under consideration the possibility of employing equipment using a single line, and if this is done, the condition will probably be automatically corrected, and no further remedial action will be necessary.

Recommendation 24. Inasmuch as increasing the clearance between the bottom of the transmitter and the deck, (which in the present design falls short of the minimum specified value by only 3/4 of an inch), would necessitate extensive changes in design and cause a considerable delay in the production of

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additional models, it is suggested that no effort be made to remedy this condition, as the clearance already provided is sufficient to allow convenient electrical connections to the equipment.

Recommendation 25. If an effort is made to relocate the modulation oscillator tube in a more accessible manner, it will mean extensive redesign of the unit, which will cause delay in producing additional equipments. The Contractor's representatives suggested that tubes could be readily changed if the entire unit was removed and set on the deck or a table. Inasmuch as a reasonably long life is expected from these tubes, it is likely that tube changes will be infrequent, so the Contractor's suggestion is considered acceptable. Additionally, the Contractor agreed to provide complete details in the Instruction Book as to means of removing the modulation oscillator chassis.

Recommendation 27 (Third Statement). The Contractor's representatives indicated that efforts to reduce the overall width of the motor generator equipment would cause serious delay in production of additional equipments. Inasmuch as the specification limit is exceeded by a factor of only 1/4-inch, it is recommended that no efforts be made to reduce the overall width of the power unit.

9. The Contractor's representatives stated that appropriate corrective measures would be taken for all recommendations not specifically discussed in the foregoing paragraph.

R. P. Briscoe,
Acting Director.

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20 August 1941

NRL Report No. R-1772
BuShips Prob. D-1C

NAVY DEPARTMENT

[redacted]

Report on Test

of

Model YE Homing Transmitting Equipment

(Contractor: RCA Manufacturing Company, Inc.)

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Authorization: BuShips ltr. C-NOs-69090(11-20-DR6) of 9 December 1940.

Date of Tests: 31 October 1940 - 13 June 1941

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By direction.

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AUTHORIZATION

1. The tests herein reported were authorized in reference (a). Other pertinent information is listed as references (b) to (l).

Reference:
(a) BuShips ltr. C-NOs-69090(11-20-DR6) of 9 December 1940.
(b) BuEng. Specifications RE 13A 528B.
(c) Contract NOs-69090 of 23 August 1939.
(d) Contractor's Descriptive Specifications.
(e) Contractor's test report on Model YE Equipment.
(f) Preliminary Instruction Book on Model YE Equipment.
(g) NRL ltr. S67/38 of 24 April 1941.
(h) NRL ltr. C-S67/62--S67/66 of 16 April 1940.
(i) NRL ltr. C-F42-1/69H of 9 July 1941.
(j) Bu. S and A ltr. NOs-69090(SPM) of 17 January 1940, to RCA via INM, Philadelphia.
(k) Bu. S and A ltr. NOs-69090(SPM) of 20 January 1940, to RCA via INM, Philadelphia.
(l) BuEng. ltr. C-NOs-69090(11-10-DR5) Serial C-DR5-14 of 20 January 1940, to Bu. S and A.

OBJECT OF TESTS

2. The object of the tests was:

(a) To determine the extent to which the equipment complies with the contractural requirements and basic specifications and modifications thereto.

(b) To determine the degree of compliance with reference (d), which governs in regard to points not specifically covered by reference (b).

(c) To obtain data to serve as a basis for making recommendations regarding changes found necessary or desirable to make the equipment more suitable for Naval use.

(d) To obtain such performance data as necessary for making recommendations as to revision of the basic specifications used in the purchase of additional similar equipments.

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CONCLUSIONS

(a) The Model YE Transmitting Equipment, as submitted, is capable of meeting the requirements of the Naval Service. However, a few minor objectionable features were found during the course of the tests, and these have been discussed in detail herein.

(b) The frequency stability and accuracy requirements of the governing specifications have been met in all respects, and the power output obtained conforms with specified requirements.

(c) The appearance, construction and performance of the equipment are such as to comply for the most part with the usual Navy standards.

(d) Inasmuch as the frequency of the carrier is controlled by a crystal, a frequency stability of high order is attained.

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RECOMMENDATIONS

The tests herein reported indicate that certain corrective procedure and remedial measures are necessary in the event that additional models of the YE Equipment are procured. Included herein will be a specific recommendation for each item appearing under the heading of "Summary of Defects" in this report. The numerals appearing at the end of each statement refer to the paragraph of this report wherein each matter is discussed in detail. Accordingly, it is hereby recommended:

(1) That care be exercised in preparing the equipment for shipment to assure that no damage occurs during the process of packing, and that the crating is sufficiently substantial to assure that no damages will occur in transit, 12, 30.

(2) That all wire-wound vitreous enamel resistor units be provided with a Navy type number; that there appear on all symbol marking tags for the various wire-wound vitreous enamel resistor units information as to the type number of the pertinent resistor; that all mountings for composition resistors be marked to indicate the type number and resistance value of the resistor involved, if feasible; that care be exercised in the selection of composition "resistor-suppressor" components to minimize the possibility of breakage; 33(d), 80.

(3) That engraving filler used be of a kind which does not become molten under high ambient temperature conditions, 39.

(4) That brush supports of the plate generator be made of ceramic material, 42, 184(1).

(5) That all fuse mountings be permanently marked in a manner to indicate the voltage and current ratings and circuit symbol number of the fuse involved, 45, 46, 79(b); that the primary circuit of the distribution transformer receive adequate fuse protection, 45; that the components of the starter be provided with symbol markings and that the schematic wiring diagram be amended to include the starter circuits, 79(a); that the correct symbol markings be used to designate all components in a manner which is consistent with the wiring diagram, 79(c).

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(6) That suitable soft copper straps be used to ground all flexible mounted chassis in the transmitter, 49, 57, 106.

(7) That an interlocked 440-volt line disconnect switch be provided in the motor starter, 49, 180.

(8) That the wax coating of all coated condensers have a melting point sufficiently high to prevent the "dripping" of wax from the condensers under high ambient temperature conditions, or if this is not possible, that the condensers be located in a manner to assure that no fouling of other components occurs from the falling wax, 51.

(9) That the necessary changes be effected to the second amplifier stage to assure safe operation of the Type 829 vacuum tube, 52, 54(a); that the value of the bias resistor in the grid circuit of the fourth amplifier have a value of 14,000 ohms instead of 8,000 ohms, 54(b); that all power amplifier tubes furnished with the equipment be of the improved type which successfully withstood the various tests, 54(c); that the necessary steps be taken to minimize the possibility of breakage of any of the Type 826 tubes, 54(d); that the possibility of improving the socket arrangements for the Types 826 and 829 vacuum tubes be taken under advisement, 54(e); that consideration be given to the adoption of a new kind of plate connector for Type 829 vacuum tubes, 144(4).

(10) That stops be provided on the neutralizing condensers to prevent accidental contact between the plates, 55(a), 72.

(11) That the necessary steps be taken to permit a finer degree of plate voltage control in the region of normal operating plate potential, 55(b).

(12) That the transmitter tuning controls be considered capable of performing all required functions, even though some controls are not located on the front panel; that all controls be provided with a nameplate showing the letter designation and a descriptive phrase; 60, 61, 99, 124.

(13) That the transmission line current indicating devices be arranged in a manner to read the individual line currents, if possible, and that the

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nameplates for these meters be marked "Transmission Line Current," 64, 155.

(14) That lock washers be used under the heads of machine screws employed for securing meters to the front panel, and that flat washers be used under the lock washers to protect the meter case flange from damage, if necessary, 65, 94.

(15) That changes be effected to assure that at least two significant figures on the main tuning dials are visible at all times, 71; that all control knobs be pinned to their respective shafts, 72; that the necessary changes be effected to assure that operation of dial locks causes no interference with the setting of the controls, and that all dial locks adequately secure the controls against accidental movement, 129.

(16) That the range of the filament rheostat be sufficient to permit adjusting filament voltages to the proper value under any specified line voltage condition, 78(a), 82, 143; that the advisability of permitting no filament voltage control for the modulation oscillator tube be considered, 141.

(17) That the necessary steps be taken to reduce variation in the modulation frequency when the supply line voltage is 10% below normal, 78(b), 118.

(18) That the screen grid by-pass condensers be of a higher voltage rating; that is, of the kind which the manufacturer deemed advisable to use as a replacement for others originally used in the equipment, 92.

(19) That care be exercised to maintain alignments in a manner to preclude the possibility of thermometer breakage, 110; that the range of variation of the oven compartment temperature, with ambient temperature change, be reduced, if feasible, 113.

(20) That the modulation meter be considered satisfactory in its present form, 121, 133.

(21) That should difficulty arise in the operation of the monitor circuit as a result of inequality in the length of the two transmission lines forming the twin line, that this condition be corrected by equalizing the length of the lines, 122, 188(b).

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(22) That the modulator calibration charts be retained in their present location, even though the arrangement provided is not entirely satisfactory, 125(a).

(23) That the mode for connecting the primary circuit of the distribution transformer at both specified primary voltages be designated on a suitable nameplate applied in a manner to be readily visible, 141, 142.

(24) That the clearance underneath the transmitter be increased in a manner to comply with specified requirements, 144(3).

(25) That the modulation oscillator tube be relocated in a manner to allow more convenient tube change, if practicable, but, in the event this is not possible, that the proper procedure to follow in making tube changes be given in the instruction book, 144(4).

(26) That the gas admission valves to the 7/8-inch lines be relocated in a manner to increase their accessibility, 154(b); that all connectors for connecting the various 20-foot lengths of 7/8-inch transmission line be of the "solder" type, equipped with shoulders, and that the necessary number of "solderless" couplings be provided for use at the locations where they are essential, 154(e); that six anchor joints, in accordance with Sheet 10-A of Naval Research Laboratory Specifications RA 62A 231 be provided for use with the twin 7/8-inch line, 154(f).

(27) That the necessary changes be incorporated in the starter box to permit convenient mounting to a bulkhead, 157; that dowels with 1/4-inch square heads be provided to align the units of the motor generator equipment, 170; that the overall width of the motor generator equipment be reduced by 1/4-inch to allow it to come within the specification limit, 173; that a lubrication nameplate be provided on the motor frame, 175; that the ripple content of the plate generator be considered satisfactory for the purpose, even though it does exceed the specification limit, 179.

(28) That photographs of the equipment be included in the final instruction books and that several minor errors and discrepancies found in the preliminary instruction book be corrected, 185.

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(29) That the production of additional models of the YE equipment be permitted after all defects herein reported have been treated in a manner acceptable to the Bureau.

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In compliance with the request in the letter of authorization, reference (a), a list of suggested modifications to Specifications RE 13A 528B have been compiled and are presented for use in connection with revision of the specification requirements applicable to additional equipments purchased. The numeral appearing at the beginning of each item refers to the paragraph of the specifications under discussion, while the numeral appearing at the end of each item refers to the paragraph in the body of the report from which the suggested modifications are compiled. Accordingly, it is recommended:

(30) That the specifications be amplified to provide specific limits with respect to individual frequency tolerances instead of relying on "overall" tolerances, as stated in Paragraph 3-8 of the specifications. These tolerances are based on the results of the detailed tests conducted under Paragraphs 3-6 and 3-7 of the specifications. The percentages listed are somewhat more liberal than the actual figures obtained during the tests, but are sufficiently stringent to insure equipment of satisfactory operating characteristics. The amplification of Paragraphs 3-6 and 3-7 are set forth in items (a) to (r) inclusive:

(a) Par. 3-6-1. Stability of the carrier frequency for two-hour key locked, full power operation at 80% modulation shall be within 0.0015% of the assigned frequency, 101.

(b) Par. 3-6-2. The carrier frequency variation resulting from change of tubes in the circuit associated with the production of the carrier frequency shall not cause an average variation from the mean frequency of more than 0.0005%, 102.

(c) Par. 3-6-3. The carrier frequency during changes in ambient temperature between the limits of 0°C and 50°C shall not vary more than 0.0001% of the assigned frequency per degree change of ambient temperature, 103.

(d) Par. 3-6-4. Stability of the carrier frecuency during variations in the relative humidity under constant ambient temperature conditions shall be within 0.0005% of the assigned frequency, when the relative humidity is varied between the limits of 30% and 95%, at an ambient temperature in the 40°C to 45°C range, 104.

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(e) Par. 3-6-5. Stability of the carrier frequency when the equipment is inclined at any angle up to 45 degrees from the vertical in any direction shall be within 0.0005% of the assigned frequency, 105.

(f) Par. 3-6-6. The set of the carrier frequency during vibration of the equipment shall be within 0.0003% of the assigned frequency, 106.

(g) Par. 3-6-7. The set of the carrier frequency during shock tests shall be within 0.0001% of the assigned frequency, 107.

(h) Par. 3-6-8. Stability of the carrier frequency during variation of the supply line voltage between the limits of ±10% of normal shall be within 0.0005% of the assigned frequency, 108.

(i) Par. 3-6-9. Stability of the carrier frequency during a 45-minute keying period shall be within 0.0005% of the assigned frequency, 109.

(j) Par. 3-7-1. Stability of the modulation frequency during two-hour key locked operation shall be within 0.005% of the assigned frequency, 111.

(k) Par. 3-7-2. The modulation frequency deviation resulting from change of tubes in circuit associated with the production of the modulation frequency shall not cause an average variation from the mean frequency of more than 0.01%, 112.

(l) Par. 3-7-3. The stability of the modulation frequency during variation of the ambient temperature between the limits of 0°C and 50°C shall be within 0.0005% for any 1°C change in temperature, 113.

(m) Par. 3-7-4. The stability of the modulation frequency during variations in the relative humidity at a constant ambient temperature of 40°C to 45°C shall be within 0.006% of the specified frequency when the relative humidity is varied between the limits of 30% and 95%, 114.

(n) Par. 3-7-5. Stability of the modulation frequency during inclination of the equipment at any angle

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up to 45 degrees from the vertical in any direction shall be within 0.002% of the assigned frequency, 115.

(o) Par. 3-7-6. The set in the modulation frequency due to vibration shall not exceed 0.001% of the assigned frequency, 116.

(p) Par. 3-7-7. The set in the modulation frequency due to shock shall not exceed 0.001% of the assigned frequency, 117.

(q) Par. 3-7-8. The stability of the modulation frequency shall remain constant within 0.003% of the assigned frequency for line voltage variations of ±10% of normal, 78(b), 118.

(r) Par. 3-7-9. Change from continuously keyed to intermittently keyed condition shall not change the modulation frequency by more than 0.001% of the assigned frequency, 119.

(31) That specifications be expanded to include the following requirements:

(a) Suitable provision shall be made to maintain the modulation frequency determining elements at a constant definite temperature between 69°C and 71°C, the maximum variation from this temperature not to exceed one-half of one degree. The design of the temperature controlled compartment shall be such that a definite normal operating temperature within the two-degree limit will be automatically attained in a time not to exceed three hours after the heater circuits are energized and will be subsequently maintained within the limits of one-half degree Centigrade, 113.

(b) A suitable thermostatic protective device shall be incorporated in the constant temperature compartment to protect the equipment against damage due to excessive temperatures. This device shall automatically open the heater circuit in the event that the compartment temperature reaches 80°C and shall automatically restore the circuit for operation in the event that the temperature returns to normal, 113.

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(32) That Paragraph 3-14 of Specifications RE 13A 528B be amplified to include Paragraph 3-14-2 of Specifications RE 13A 465E and that a modulation oscillator frequency range overlap of not less than 3 per cent between all steps throughout the range be specified in this paragraph, 126.

(33) That Paragraph 3-25 of Specifications RE 13A 528B include the following frequency tolerances:

(a) Operation of the power output control shall not vary the carrier frequency by more than 0.001% of the assigned frequency when the power output is reduced from 100% to 25%, 132.

(b) Operation of the power output control shall not vary the modulation frequency by more than 0.01% of the assigned frequency when the power output is reduced from 100% to 25%, 132.

(34) That the Bureau review the "Summary of Defects" of this report with the object of extracting other pertinent data to incorporate in the specifications.

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MATERIAL UNDER TEST

9. The material under test consisted of one production Model YE Radio Transmitting Equipment and included the following major parts:

1 - Radio Transmitter Unit, Model YE.
1 - Two-Unit Motor Generator Set.
1 - Motor Starter.
1 - 230-foot length of balanced coaxial 7/8" Transmission Line.

(Note: For type or model numbers and serial numbers of the first three of the above items, refer to the nameplate data in Table 8.)

In addition, a portion of the tests were conducted with the following items, which, with the above major parts, constitute a complete Model YE Homing Beacon Transmitting Equipment:

1 - Directive Antenna with Drive Tube and Drive Unit, Type CFI-66018, Serial 2.
1 - Control Unit; Type CFI-23145, Serial 2.

No interconnecting cables were supplied.

10. The YE Radio Transmitting Equipment, made by the RCA Manufacturing Co. under Contract NOs-69090, was received by this Laboratory on 31 October 1940. Transportation was accomplished by means of the Contractor's truck. The equipment was shipped in wooden packing cases or crates, suitable for regular rail transportation. This equipment was destined for the U.S.S. HORNET, but was diverted to the Naval Research Laboratory for the purpose of making the tests covered in this report.

11. The following vacuum tubes accompanied the shipment:

4 - Type CRC-826 Vacuum Tubes (Serial 501, 503, 507 and 510)

2 - Type CRC-829 Vacuum Tubes (Serial 925 and 933)

7 - Type CRC-807 Vacuum Tubes

2 - Type CRC-955 Vacuum Tubes

1 - Type CRC-6A6 Vacuum Tube.

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(a) The following tubes were subsequently received from the RCA Manufacturing Company on 12 November 1940:

4 - Type CRC-826 Vacuum Tubes
(Serial 526, 527, 528 and 531)

(b) The following tubes were received from RCA Manufacturing Company on 5 December 1940. Prior to shipment these tubes had been subjected to an 82-hour life test.

4 - Type CRC-826 Vacuum Tubes
(Serial 522, 537, 543 and 546.)

METHOD OF TEST

12. The equipment, when received, was carefully examined to determine whether any damage had been incurred during shipment. The only irregularity found was a bent inner-conductor coupling in the antenna terminal, which may have occurred during packing.

13. The Equipment was then interconnected and placed into operation with the aid of the preliminary instructions which had been furnished.

14. Power output measurements were made by a calibrated lamp load, which was matched to the source impedance, through a half-wave transmission line impedance matching arrangement. Power output measurements were made both at the transmitter and at the end of a 230-foot twin coaxial transmission line.

15. Frequency changes and drifts were checked by means of a Model LK frequency indicator, the transmitter functioning at full power output, 80 per cent modulated, whenever the specifications required this method of operation. As no equipment was available which would measure frequency drifts at 246 megacycles, measurement of the unmultiplied crystal frequency was resorted to, and the carrier frequency for each individual case was determined through multiplying the crystal frequency by the factor employed in the transmitter between the crystal and P.A. stages, namely, 18 to 1.

16. Frequency range, overlap and calibration of the modulator oscillator dial were determined by means of a Model LM frequency measuring equipment.

17. The entire Model YE Transmitting Equipment was placed in a test chamber and subjected to variations in

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ambient temperature between the limits of 50°C and 0°C, and to variations in relative humidity between the limits of approximately 30% and 95% at an ambient temperature in the region of 40°C.

18. Measurements of the ripple voltages present in the output of the generators were made by means of suitable voltmeters.

19. Quality of signals and character of keying were determined by means of a Model ZB-RU receiver and by oscillographic observations.

20. The ability of equipment to withstand vibration and the simulated roll and pitch of a vessel was determined by mounting the transmitter, motor generator and starter on a test table which is capable of producing the necessary conditions.

21. Shock tests were conducted by subjecting the equipment to blows from a 20-pound weight suspended in the manner prescribed by the governing specifications.

22. The amplitude of undesired audio modulation on the unmodulated carrier was determined by rectifying a portion of the carrier and measuring the ripple present with a suitable voltmeter.

23. The r-f voltage output of the frequency meter coupling circuit was measured by use of a General Radio Type 726-A Vacuum Tube Voltmeter.

24. The percentage of carrier modulation was measured with a General Radio Type 687-A Oscillograph.

DATA RECORDED

25. Complete data were recorded during all tests conducted and this information is included in the plates and tables appended to this report.

PROBABLE ERRORS IN RESULTS

26. 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.

27. The visual frequency indicating equipment employed is capable of measuring beat note frequencies to within one

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or two cycles.

28. It is believed that radio-frequency power measurements are accurate to within 10%.

29. All meters employed in the tests were of the precision type and were used under conditions to insure maximum accuracy.

RESULTS OF TESTS

30. Inspection of the equipment when unpacked revealed that a bent antenna terminal was the only damage. With the aid of the preliminary instructions supplied, the equipment was wired up and placed into commission.

31. In the following paragraphs of this report, reference is made to the various sections and paragraphs of the governing Specification RE 13A 528B, under which the equipment was constructed.

SECTION I (INTRODUCTORY)

32. Par. 1-1 to 1-3, inclusive. The general construction and design of the Model YE Transmitting Equipment conforms with the Introductory Section of the Specifications. The transmitter circuits are adjustable over a frequency range of from 200 to 250 Mc. The modulator is capable of 80 per cent modulation of the carrier over the range of 540 to 830 kc. The succeeding paragraphs of this report discuss in detail the construction and operational characteristics of the equipment.

SECTION II (GENERAL)

33. Par. 2-2. The component parts which go to make up the complete assembly were examined to the extent possible without resorting to complete disassembly or destruction of the various parts.

(a) The vacuum tubes employed in the equipment have received Navy Type Approval.

(b) Numerous units of standard design are used in the equipment. Special designs of parts are used where necessary to meet the requirements of the governing contract.

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(c) Table 1 appended hereto lists the result of several meter checks. The meters, the accuracy of which would have affected the power output tests, etc., were checked against precision instruments. It will be noted that satisfactory agreement exists between the readings of meters and standard instruments.

(d) Table 2 lists the resistors used in the equipment. Most ferrule type resistors are stamped with a Navy type number and the resistance value. However, resistors R-102, R-107, R-127, R-159, R-162, R-163, R-170, R-182, and R-183 bear the resistance value and only a letter prefix, but no type number. Numerous composition resistors of the carbon and ceramic type have been used in the equipment. The pigtail connections of the carbon type are molded into the body of the resistor, but in the ceramic type they are molded into the cap on either end of the resistor. In each case the resistor is supported by its pigtails. Composition resistors are color coded, and in addition, the resistance value is stamped on the body of some. Parasitic chokes consisting of a composition resistor, with a coil wound over it, are used in the plate circuits of all the low-frequency tubes, and in the grid circuit of the modulator tubes. During the course of the tests the body of parasitic suppressor resistor R-176--L145 became detached from the end cap, due apparently to poor bonding. Difficulty of this kind was not experienced with the other parasitic suppressor resistors employed in the equipment. Many of the composition resistors have been mounted directly on the tube sockets as is common in receiver wiring. Table 2 lists the measured values of power, voltage and resistance and such other pertinent data obtained. All resistors are operated within their specification limits.

(e) Various other component parts used in the equipment, and which are covered by the reference specifications of paragraph 2-2-(4) of the governing specifications, are discussed in detail under appropriate paragraphs of this report.

34. Par. 2-3. Light weight aluminum alloys have been used in the construction of the transmitting equipment in the interest of weight reduction. In general, the structure is such that a strong and rugged assembly has been provided. Frame members are spot-welded to gusset plates and reinforced with 1/4" rivets at corners, and 1/4" bolts at braces. The

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frame is constructed of 1-1/2" x 1-1/2" x 3/16" aluminum alloy angle. The front panel and doors are of 3/16" aluminum alloy, while the side and top shields are of 3/32" aluminum alloy.

35. Par. 2-3-1. During the course of the tests no contact difficulties were experienced.

36. Par. 2-3-2. Only one multiposition switch is employed in the equipment. It is of the self-positioning, self-cleaning type and is used to vary the inductance of the modulating oscillator tuning inductor.

37. Par. 2-3-3. All variable resistors employed in the equipment are of the wire-wound type. The characteristics of these units are listed in Table 2.

38. Par. 2-4. Examination of this equipment showed that the workmanship is of high grade. No defects were discovered which would indicate faulty workmanship. On the whole the equipment is well arranged and presents a pleasing appearance.

39. Par. 2-5. The entire transmitting equipment was subjected to a number of cycles of temperature change, ranging between 0°C and 50°C, and humidity variations from 30% to 95% at 40°C. No operational failures were noted during these tests and no signs of over heating were observed. No evidence of corrosion could be noted at the completion of these tests. The effects of humidity and temperature upon frequency stability of the equipment is discussed under Paragraphs 103, 104, 113 and 114. After the temperature and humidity tests, it was noted that the white engraving filler in the indicator of Control "A," and also that in the engraving of the 440-volt terminal block cover, had partially "flowed" from the engraved indentations under high temperature condition. This condition was remedied by the Contractor by using the proper type of filler.

40. Par. 2-6. All items of construction are fully protected against corrosion, as evidenced by the fact that after having been subjected to a relative humidity of 95% and operating under normal atmospheric conditions, no visible sign of corrosion was discovered.

41. Par. 2-7. Several items used in the construction of the equipment are of steel or magnetic materials where not necessary for electro-magnetic purposes. These items, however, have been protected against corrosion.

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42. Par. 2-8. Good quality ceramic insulation has been used throughout the equipment where required by good engineering practice. Phenolic insulation has been used in numerous locations in d-c or low frequency a-c circuits at potentials of less than 500 volts. Plastic insulation has been used for the brush supports of the high voltage generator, where the voltage limitation of 500 volts is exceeded; that is, the normal operating voltage of this circuit is 750 volts. Suitable ceramic insulation should be used as brush supports in future models of the equipment.

43. Par. 2-9. Wood has not been employed in the construction of the Model YE equipment.

44. Par. 2-10 (General). The design of the electrical circuits is such that during the course of these tests no failure of any part occurred and the overloads to which the equipment was subjected resulted in no damage. Protection of the oscillator oven is provided with a thermal cut-out to guard the equipment against damage due to excessive temperature. The effectiveness of this cut-out is shown in Table 4.

45. Par. 2-10-1. Fuses for the 440-volt main line are 250-volt refillable cartridge type required by the specifications. These fuses are located in the motor starter box, but have not been shown on schematic diagram W-303226. No fuse protection has been provided in the primary of the distribution transformer T-101. On the secondary side of T-101, the two branch circuits are protected by 250-volt refillable cartridge type fuses. Adequate fuse protection in the primary circuit of this transformer is considered necessary to afford safe operation. Protection for both output leads of the bias generator is provided by fuses in the generator connection box. These fuses are of the same type as those used in the two branch circuits. All low voltage fuses, with the exception of the bias fuses, have suitable nameplates marked with current and voltage ratings mounted adjacent to fuse mountings. Only the fuses in the transmitter are labelled with symbol numbers corresponding to symbols appearing on schematic diagram W-303226. For the convenience of Naval personnel in servicing the equipment and making fuse replacements, there should be placed adjacent to all fuses permanent markings showing the current and voltage ratings and the circuit symbol number of the fuse. A list of fuses supplied with Model YE equipment is furnished in Table 3.

46. Par. 2-10-2. Fuse protection has been provided in the high voltage lead of the plate generator, the fuse being located in the generator connection box. This fuse, which is manufactured by the Littlefuse Company, is capable of being

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renewed upon return to the manufacturer. The construction is also such that it can be easily renewed by the Naval Personnel if a refilling kit is available, which provides means for soldering a new fuse wire in place. No renewal kit was furnished with the YE equipment. Thus, as actually furnished, insofar as the Naval Service is concerned, this fuse is non-renewable; however the specifications do not prohibit such types of fuses for the application in question. The inside surfaces of the generator connection box are covered with a substantial thickness of sheet mica to guard against the likelihood of arc-over from fuse to ground. The generator fuse has not been provided with nameplates to indicate fuse rating and symbol number as required by the specifications. For the convenience of Naval personnel in servicing the equipment and making fuse replacements, there should be placed adjacent to all fuses permanent markings showing the current and voltage ratings and the circuit symbol number of the fuse. Table 3 lists the fuses used in the Model YE equipment.

47. Par. 2-10-3. The design and construction of the overload relays in the transmitter are such that the relays may be readily adjusted to function at any value between full load and 25% overload. A complete description of these relays is contained in Paragraph 48 below.

(a) The motor starter is provided with a thermal overload which protects two phases of the three-phase line. This overload is calibrated to operate between 4.4 and 5.3 amperes. It is normally set at 4.5 amperes and requires no oil.

(b) The adequacy of motor protection was tested by opening the unprotected phase of the motor under load. Although the motor current increased from 2.6 to 4.6 amperes, the transmitter operation was normal and the test was continued for one-half hour with no undue heating of the motor. The thermal overload device did not trip during the 30-minute test period.

(c) The thermal overload protection was also tested by starting the motor with one phase open. The motor came up to speed normally and continued to run under normal load for 15 minutes with no undue signs of heating. The thermal overload device did not shut down the motor during the course of this test. The reason why this motor starts with one line open was not determined, but such action is not usually found in the case of 3-phase induction motors.

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(d) From the above tests it is apparent that while the motor thermal overload protection device does not protect against an open phase, such protection is not required from the standpoint of safeguard to the equipment.

48. Par. 2-11. Two plate overload relays K-101 and K-102 are provided in the transmitter. K-101 protects the crystal oscillator, first, second, third, and fourth amplifiers and modulator power amplifier, while K-102 protects the power amplifier tube. Basic specifications, as modified by Reference (j) do not require overload protection for the modulation oscillator and monitor circuits. The relays bear the following data:

Relay K-101

Square D Company
Time Delay Relay
Class 9055 Type F
600 Volts Max.
.62--1.25 Ampere Range
574008--D1

Relay K-102

Square D Company
Time Delay Relay
Class 9055 Type F
600 Volts Max.
.22--.44 Amperes Rating
574008--E1

Calibrated tripping points, marked 0.62, 0.91 and 1.25 amperes on K-101, and 0.22, 0.32, and 0.44 amperes on K-102, are indicated on the plungers. Adjustment is made by means of a knurled screw at the bottom of the plunger. Range of adjustment is sufficient to allow setting at any value between normal full load relay current and 25% overload current. Oil is required for proper relay operation, and an engraved nameplate states that fact. Directions for properly filling the dashpot with oil are etched on the relay nameplate. The currents through the relay coils under full power 80% modulated condition are as follows:

K-101 - Normal Operation: 0.875 Amperes.
25% Overload Setting: 1.1 Amperes.

K-102 - Normal Operation: 0.265 Amperes.
25% Overload Setting: 0.329 Amperes.

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During the course of these tests the overload relays performed satisfactorily. The relays are mounted on one of the lower access doors, so as to be readily accessible with the door open. A reset button for each relay forms a red target when the relay trips. In the closed position the reset button is flush with the door panel. Relays are provided with individual resets and targets to indicate the overloaded circuit. The function of each overload is indicated on a nameplate located directly above the reset. A further indication of a tripped overload relay is given by an amber indicator light, identified by a suitable nameplate.

49. Par. 2-12. The design of the equipment is such that all frame members and external shields are at ground potential. Where units are mounted on Lord mountings, suitable flexible ground straps have been provided. The original straps proved too stiff under vibration and were replaced by the Contractor with ones of softer copper. This matter is discussed more fully in connection with vibration tests. All access doors in the transmitter are provided with electrical interlocks which open the master start relay and shut down the motor generator and remove generator field excitation. Interlock voltage of 110 volts is provided by the distribution transformer T101. The starter box is equipped with a magnetic latch which locks the door when line voltage of 440 volts is present. This magnetic latch, however, does not prevent 440 volts being applied to the starter when the door is open. The Bureau has indicated in connection with other types of radio transmitting equipments that 440-volt line disconnects in the starter box are necessary for compliance with safety requirements. No line disconnect was provided in the Model YE Equipment. For this service, attention is brought in particular to a disconnect employed in conjunction with the equipment covered by NRL Report No. R-1634, wherein an interlock was provided making it necessary to open the disconnect before opening the starter box door, and which would not permit closing the line disconnect unless the starter box door was closed. An arrangement of this kind is considered necessary to make the Model YE Equipment comply with this portion of the specifications insofar as the protection of personnel from high voltage hazards is concerned.

(a) Door interlocks are of the single push button, door switch type, encased in metal boxes with no connections exposed. These interlocks have proved to be rugged and positive in operation. They have been mounted so as not to reduce the door openings.

(b) The interlocks on the two large doors are mounted close to one door latch. Although the other door

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latch is 19 inches from the interlock, positive operation of the interlock resulted when only the farther latch was locked. The present location of the interlocks is governed by the lack of space between the latches, and is such that the wiring is less exposed. The Model YE transmitter is fitted with substantial doors of 3/16" aluminum alloy and the door latches are rugged and grip securely. Hence there is no danger of the doors bending or opening under shock or vibration.

(c) In regard to the 440-volt supply, which is not removed from the input terminals by the door interlocks, protection to the operating personnel is provided by a suitable bakelite cover for the terminals which is clearly engraved to designate the voltage involved.

(d) In order to insure that no dangerous potentials persist for an appreciable time after the access doors are opened, the time for the generator to come to a complete stop was determined. This was found to be 31 seconds. The residual voltages present immediately after the interlock circuit was opened were as follows:

Main Plate Supply -- 100 Volts
Bias Supply -- 20 Volts

It may be seen that no high voltage hazard is present.

50. Par. 2-13. Ventilation of the transmitter is accomplished by means of perforated side and back shields. The top shield is solid. In addition, tube access doors are perforated. Ample space has been provided around tubes for natural ventilation. Positive ventilation of the 829 tube in the third amplifier stage and the 826 tubes in the fourth amplifier and power amplifier stages is provided by a motor driven fan and ducts which carry an air stream to the individual tubes. To guard against small particles of dirt striking the glass envelopes, the air is screened with a spun glass filter. To insure against operation of tubes without forced ventilation, an air-pressure interlock in the main air duct removes the plate voltage with loss of air pressure. Resistors are so mounted as to facilitate natural ventilation. No ventilation of the modulating oscillator 807 tube is provided. This tube is mounted in the temperature controlled oven and hence operates at a temperature of 70°C. During the course of the tests during various key-locked runs at ambient temperatures as high as 50°C, no signs of undue heating were noted.

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51. Par. 2-14. Inspection of the equipment after being subjected to temperature and humidity tests revealed no leakage of compound except for three small mica condensers, C-122, C-123 and C-124, which have an external glazing coat of wax. This coating was observed to have dripped-off after the completion of the temperature and humidity tests. These condensers should be replaced with others which will not exhibit undesirable effects of this nature.

52. Par. 2-15. The equipment was subjected to numerous locked key tests for periods of from two to eight hours duration without any visible signs of failure or serious overheating, except for the 826 vacuum tubes, as explained in detail in Paragraph 54, and which was subsequently remedied. The equipment was keyed, under full power condition, for numerous periods of from one to four hours at 15 words per minute without evidence of brush discharge, corona or sparking. Other keying tests at various keying speeds, up to 20 words per minute, were conducted and the transmitter functioned satisfactorily.

53. Par. 2-16. The tests for this portion of the specifications, which requires that the equipment be undamaged by abnormal antenna conditions, were conducted at the transmitter output terminals so as to include any faulty condition which may arise in the transmission line, as well as at the antenna. The transmitter was tuned to 246 megacycles, full power output, modulated 80 per cent at 800 kilocycles. Under this condition the output terminals were short circuited, open circuited and grounded. A short circuit between the inner conductors of the line increased the power amplifier plate current sufficiently to operate the overload relay. An open circuit in either line resulted in excessive power amplifier plate current, but not sufficiently great to operate the overload relay. Similarly grounding the left terminal caused an excess of power amplifier plate current without operating the overload relay. On the other hand, grounding the right terminal resulted in no change of power amplifier plate current. Table 5 lists the data recorded during the tests. While the protection against disrupted antenna conditions is not perfect, the degree of protection is as good as found in most Naval transmitting equipment; therefore, it is considered that the equipment is satisfactory in its present form.

54. Par. 2-17. The design of the equipment is such that the vacuum tubes operate within the current and voltage limitations of the tube specifications, except as discussed below. Operational values of current and voltage are listed in various tables appended to this report and particularly in Table 6, wherein the measured potentials and currents of each

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circuit are listed. Bias potentials for all tubes of 246 megacycle exciter and power amplifier are obtained by the voltage drop across individual cathode resistors or across grid leak resistors or by a combination of both. The modulation oscillator depends upon a grid leak-condenser combination for bias. None of these tubes receive fixed bias voltage from the bias generator. The modulation amplifier tubes, using a combination of fixed and grid leak bias, are the only tubes receiving bias voltage from the generator. All the monitor tubes employ grid leak or cathode resistor bias.

(a) Failure of excitation, resulting from stoppage of the crystal or other causes, results in the plate current of type 829 vacuum tube of the second amplifier stage rising to a value of 150 milliamperes, which represents a plate dissipation of 71 watts. Since the maximum allowable dissipation is 40 watts, the tube under the above condition is considerably overloaded and may be damaged if the overload is prolonged for any length of time. This tube receives no fixed bias from the bias generator, but does have a 100-ohm cathode resistor. Suitable remedial measures should be effected to eliminate this overload.

(b) One 826 vacuum tube, Serial No. 510, of the fourth amplifier, after operating for a total of approximately ten hours, became defective, as indicated by an excessive plate temperature. Tubes Serial Nos. 510 and 503, of the fourth amplifier, were replaced by tubes Serial Nos. 243 and 404. These tubes failed after operating for two hours, and an emission test showed that, while they were normal when placed in service, the emission of tube Serial No. 243 had materially decreased after two hours' use. This condition was brought to the attention of the Contractor, who increased the efficiency and reduced the plate current of the fourth amplifier by increasing the grid bias resistor R-127 from 8000 ohms to 14000 ohms. Tests were continued using tubes Serial Nos. 528 and 531. No further difficulty was experienced with the fourth amplifier tubes, and it may be considered that the method of correction is such as to insure satisfactory operation. A grid resistor of the correct value should be used in any subsequent models of the YE equipment.

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(c) A somewhat similar condition to that discussed above developed with the power amplifier tubes. The 826 tube Serial No. 501, after operating 39 hours, developed a condition whereby the plate current, after application of plate voltage, gradually increased to an excessive value. This tendency disappeared when the transmitter plate voltage was reduced to 680 volts. After approval of the Bureau by telephone, tests were continued at the reduced voltage using type 826 vacuum tubes Serial Nos. 526 and 527. Concurrently, the Contractor subjected four vacuum tubes (of approved design) to an 82-hour life test in the Model YE transmitter for the U.S.S. LEXINGTON. Afterward, they were placed in service in the YE transmitter at this Laboratory, and operated at full plate voltage (750 volts). Three of these tubes, Serial Nos. 522, 543 and 546, successfully operated for more than 415 hours. The results indicate that the Contractor has made certain improvements in the electrical characteristics in the 826 vacuum tubes which should insure full life expectancy of the tubes at normal working plate voltage.

(d) The fourth tube (of the group tested 82 hours by the Contractor), Serial No. 537, after operating for 13 hours, failed as a result of a broken grid seal. This tube was located in the upper socket of the power amplifier. The failure was noted after the equipment had been removed from the temperature chamber and installed on the vibration table, but before the equipment was subjected to vibration. This tube was replaced by type 826 tube, Serial No. 507, which has successfully operated for more than 400 hours. The discussion in the next sub-paragraph provides more information on the subject of strains on tube seals.

(e) The failure of the glass seal as noted in (d) above, led to a study of the prongs and sockets of the type 826 and 829 vacuum tubes. In the interest of reducing tube capacities, these tubes have been constructed without the customary tube base and with the prongs molded into the glass envelope. The strain on the prongs ordinarily taken up by the base are therefore applied to the glass seals. Elimination of the socket base has been resorted to in the case of the type 826 vacuum tubes to obtain a further reduction of circuit capacities. The tube prongs are inserted into semi-flexible spring

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contacts mounted directly on the circuit elements. Positioning of the tube is governed by an oversized cathode prong, which, with the filament prongs, pass through guide holes in metal ears. Considerable care must be exercised in inserting the tube into the guide holes to eliminate undue strain on the prongs and glass seals. The rigidity of the guide holes permits little sidewise movement of the tube. After the failure noted in (d) above, the manufacturer increased the diameter of the filament and cathode guide holes by 0.002 inches. RCA Type UT-107 Sockets are provided for the type 829 vacuum tubes of the second and third amplifier stages. The socket in the second amplifier is shielded, while that in the third amplifier is not. No operational difficulties were experienced with these sockets. However, it is possible by piercing the mica insulation of the socket to insert the cathode prong in the small prong holes. Thus the tube can be inserted in three different positions. Little likelihood of improper alignment of the tube is anticipated, however, since only in the correct position can the plate connections be made. While the prongs and sockets of the type 826 and 829 vacuum tubes can not be considered entirely satisfactory, little improvement can be suggested. Reference (g) recommends that the small holes of RCA Type UT-107 Sockets be reduced to 0.1 inches maximum to prevent incorrect insertion of the type 829 vacuum tubes.

55. Par. 2-18. This paragraph of the specifications requires that the design of the equipment be such that safe operation and satisfactory performance are assured. The tests conducted on the equipment indicated that in several minor respects the operation is not entirely safe or satisfactory.

(a) A short circuit resulting in an overload of the plate generator occurs when the neutralizing condensers are adjusted toward the maximum capacity position. However, the overload relay functions to remove the plate supply before any damage results to the tubes or circuits. Since there is no indicating dial or stop on the neutralizing condenser, the position of the condenser plates is not known. Consequently, the plates can come in contact with one another and produce a short circuit while the operator is exploring over the capacity

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range for the purpose of finding the proper neutralizing point. Since a fairly small change of capacity is necessary to reneutralize after tube replacements, short circuiting of the plate supply should occur only on rare occasions. Nevertheless, the possibility of short circuiting the plate supply exists in the present design, and suitable means should be provided to eliminate this occurrence.

(b) Considerable difficulty was experienced in setting the plate voltage to the normal operating value of 750 volts by adjustment of the plate voltage control. A fairly coarse adjustment was provided by the plate voltage control; in fact, the plate voltage was variable only in steps of approximately 40 volts when operating in the region of normal plate voltage; i.e., 750 volts. It was usually impossible to obtain normal plate voltage, except in the following manner. It was necessary to advance the control to a point somewhat above 750 volts and then back off on the setting of the plate voltage adjusting device. By the selection of the proper over-voltage and by virtue of the generator field magnetic hysteresis characteristic, the voltage could be reduced to the desired value. The necessary modifications should be effected in any additional models of the YE equipment to permit convenient adjustment of the voltage delivered by the plate generator to any value in the normal operating range.

(c) Other instances where the Model YE Equipment did not afford safe operation or satisfactory performance are discussed elsewhere in this report under heading of the appropriate paragraph of the specifications.

56. Par. 2-19. The transmitter is provided with a rigid foundation pedestal, substantially constructed, of angle iron. Angle iron members are used both at the front and rear of the base. Four holes, one in each corner, are provided for bolting to the deck. These holes are of the proper size to accommodate a 1/2" machine bolt. The equipment operated successfully and without damage when inclined at an angle of 45° from the vertical. Tests were conducted both when inclined from front to back and from side to side. For a detailed discussion of the effects of inclination on the frequency stability, see Paragraphs 105 and 115 of this report.

57. Par. 2-20. The equipment was subjected to vibration and shock without suffering major damage or failing to operate. The only damage resulting from vibration and shock was the

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breakage of a grounding strap of the 246-megacycle chassis. All the flexible grounding straps of the YE transmitter were replaced by the Contractor with straps of softer copper, which should prove more satisfactory in that they are more flexible. As the equipment had been removed from the vibration test table prior to the replacement of the copper straps, no tests were conducted as to their suitability for the purpose. Machine screws and nuts are secured by lockwashers of the shakeproof and split type. Some elastic stop-nuts have also been used. All nuts and screws are provided with a non-corrosive plating. Fiber washers have been used to absorb stresses between ceramic insulators and metallic supports. Soldering lugs are crimped to the wire and insulation and do not depend upon solder for mechanical strength.

(a) Special consideration was given to the matter of damage and faulty operation that might result from the shock of gunfire transmitted to the "antenna terminal" and the transmitter by the twin 7/8" coaxial lines. It was believed that a more flexible mounting of the antenna terminal was desirable. This led to the design and construction of a spring-mounted antenna terminal, which was tested by an improvised installation representing that portion of the twin 7/8" coaxial line between the transmitter and the bulkhead. A 2" x 12" plank was mounted vertically to simulate the bulkhead. The twin 7/8" coaxial line passed through the plank and was rigidly secured thereto. The twin line ran horizontally for a distance of approximately 8 feet from the plank to a pendant support from which the line bent downward along a 12" radius to the antenna terminal of the transmitter. The transmitter faced the bulkhead. The mounting springs of the transmitter antenna terminal were arranged to give the twin coaxial line and antenna terminals a freedom of motion of two inches in any direction, while transmitter had a freedom of roll of approximately 1-1/2 degrees parallel to the direction of the coaxial line. The connections between the spring-mounted antenna terminal and transmitter proper were affected by the connecting straps supplied in the transmitter. These straps had freedom of motion in the direction of the applied shock. Power from the transmitter was supplied through the twin line to a flexibly connected lamp load during the tests.

(b) Shocks comparable to that occasioned by gunfire were applied to the simulated bulkhead. Observations were made to determine if any change in transmitter

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operation resulted from the shocks. No permanent change of power output, frequency or meter readings occurred. The transmitter was then vibrated for a period of three hours at various vibration frequencies within the limits of the vibration test table. Transmitter output and operation remained normal and no damage to the equipment resulted. At critical frequencies, vibrations of some magnitude were imparted from the transmitter to the coaxial line. To damp these oscillations, the mounting springs were changed from 0.030-inch phosphor-bronze wire to 0.040-inch steel wire. This changed the frequency and reduced the amplitude of oscillation. No change in transmitter performance, due to shock or vibration, was observed after the replacement of mounting springs.

(c) At the completion of the tests discussed in (b), above, the spring mounting was replaced by the original rigid mounting. Shock and vibration were again applied to the coaxial line and transmitter in a similar fashion to the above tests. During these tests, the rigid mounting proved as satisfactory as the spring mounting. Study of the action under shock and vibration indicated that sufficient flexibility existed in the coaxial line couplings immediately above the antenna terminals to isolate the antenna terminal and transmitter from the effects of gunfire.

(d) Further tests were made to determine the ability of the above mentioned couplings to hold gas under pressure, when subjected to shock and vibration. With pressure in the line, the bulkhead was repeatedly shocked and then the transmitter was vibrated for one-half hour. During this period, no discernable decrease in the gas pressure of the line was observed.

(e) From the results of the above tests, it was concluded that no advantage could be realized by spring mounting the antenna terminal, and it is believed that the mounting furnished by the Contractor insures freedom from damage and faulty operation resulting from shock or gunfire, and from severe vibration.

58. Par. 2-21. All tubes and the crystal of the super-frequency exciter and power amplifier, together with the monitor tubes, are assembled on a chassis mounted on six Lord Mounts. The modulator amplifier and rectifier tubes are

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shock mounted as a group by four Lord Mounts. The modulation oscillator tube is shock mounted through the six Lord Mounts supporting the temperature controlled oven in which it is housed. The method of tube mounting is adequate to protect them from damage and from improper functioning resulting from shock or vibration.

59. Par. 2-22. In view of the complexity of the super-frequency circuits, and since the YE equipment is essentially a combination of two radio transmitters, circuit design and control is of the simplest possible form compatible with the requirements of the governing specifications. Controls have been held to a practical minimum and are clearly designated by suitable nameplates.

60. Par. 2-23-1. All indicating instruments and controls for the operation and monitoring of the equipment are located on the front panel, with the exceptions mentioned hereafter. Included among the exceptions is the 246-megacycle power amplifier neutralization control. This control is located inside the power amplifier tube compartment. Adjustment of the control is made by a long insulated screwdriver which is inserted through the perforations of the power amplifier tube access door. The 246-megacycle exciter and power amplifier controls have been recessed and covered by a non-perforated access door. The front panel arrangement is such that the carrier instruments and controls are grouped above a dividing line and those of the modulator below the line. Although not required by the governing specifications, the transmitter is adjustable over a range from 200 to 250 megacycles. Three additional controls, which are accessible only by removing the transmitter side shields and taking off cover plates of the circuits controlled, are provided to maintain circuit efficiency throughout this range. These controls, however, have been preset for 246-megacycle operation and require no further adjustment for operation at this frequency. Table 7 lists the controls and indicating instruments. In general, the arrangement of the controls and meters is symmetrical, presents a pleasing appearance, and permits easy and rapid operation. As related previously in this paragraph, all controls are not located on the front panel; thus the design does not strictly comply with the specifications. No constructive suggestions can be offered as to providing a design which would allow full control from the front panel, considering all the various kinds of controls required to allow a transmitter to function satisfactorily at an output frequency of 246 megacycles. Also there will be reasonably few occasions wherein it will be necessary to shift the YE transmitter output frequency. In this respect the apparatus in question differs considerably from the more

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conventional radio transmitters, for in the latter kind of equipment there is frequent need for shifting output frequencies. Since no suggestions can be offered as to means of improving the accessibility of controls without impairing some characteristic of the transmitter, and since it is believed that the present arrangement will fulfill Navy requirements, no modification of the arrangement of controls will be recommended.

61. Par. 2-23-2. The controls are identified by a letter from "A" to "Q" (excluding "I" and "O"), and a descriptive word or phrase is included to indicate the purpose of the particular control. This information appears on small nameplates adjacent to the controls. Refer to Table 7 for details. There is no control designated by either "I" or "O." These nameplates are engraved with white lettering on a black background and are easily readable at a distance of 24 inches under normal lighting conditions. Nameplates are secured by means of round-head 4/40 screws tapped into the panel or control body, as the case may be. There are four controls, "R," "S," "T," and "U," which are not located on the front panel, and do not require adjustment if the carrier frequency is not changed, with the exception of Control "R," which also requires readjustment after tube changes. These controls, upon delivery, were not completely marked with designation nameplates like the other controls. The neutralization control nameplate, bearing the inscription "Neut Adjust," is located within the power amplifier tube compartment and on the power amplifier circuit shield adjacent to the control. As originally received, this control did not bear an identifying letter. Subsequently, the Contractor applied a paper label bearing the symbol "R" on the power amplifier circuit shield near the control. There is also located within the tube compartment a disconnecting link designated as "Neut Link," the purpose of which is to remove the plate voltage from the power amplifier while making preliminary neutralization adjustments. The other three controls, which consist of adjustable shorting bars and which are located within the super-frequency circuit shields, were not designated in any way as received from the Contractor. The nature of these controls is such that their adjustment remains fixed for 246-megacycle operation. However, since it is contemplated that the Model YE equipment may be required to work at some other frequency than 246 megacycles, and since readjustment of these controls is necessary in that event, the Contractor supplied paper labels to identify these controls, which are designated as "S," "T," and "U." The labels were placed on the shield covers of the circuits involved. In order to comply with the specifications, Controls "R," "S," "T," and "U" should be provided with letter

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designations and appropriate descriptive phrases indicative of their functions on a suitable nameplate placed in the proximity of the control.

62. Par. 2-24. All control shafts are grounded for protection of personnel. All control knobs and switch handles are bakelite. The 246-megacycle controls, which are recessed behind the tuning access door, are controlled by a tuning tool, formed of 3/4-inch hexagonal bakelite rod, 4 inches long. Each end is reinforced by a metal band which carries a diametrically positioned pin to engage a slot in the tuning control shaft. The neutralizing screwdriver is made of 3/8-inch bakelite rod 8 inches long. One end is ground to a screwdriver point, and the other has a metal point attached with a rivet. The metal point is for unlocking the control and the bakelite point is for operating the control. Both these tools are secured to the tuning access door by suitable clips. While no provision has been made to anchor these tools to the transmitter to prevent loss, the Laboratory has no satisfactory securing method to recommend. Hand rails are protected by a coating of rubber.

63. Par. 2-25. (General). All electrical indicating instruments are 3.5-inch diameter, flush type with bakelite cases. All meters are provided with antiglare glass.

64. Par. 2-25-1. No thermocouple instruments have been used in this equipment, but as permitted by the reference (j), vacuum tube rectifiers and associated d-c meters are provided. A coupling loop, inductively coupled to each side of the coaxial line input, drives two rectifiers in push-pull. The rectified current of each rectifier actuates a d-c meter, which is calibrated in r-f amperes. It was impossible to make a direct comparison between the current flow in each side of the line and the current indicated by the meters; however, when one side of the line was disrupted, both meters continued to read. The meter readings, although different from that before the disruption of the line, were identical. It seems safe to say, therefore, that the r-f meters give only a relative indication of the total current flowing in the coaxial line. Suitable means should be included in all additional models to indicate the individual line currents. The r-f meter nameplates read "Antenna Current" rather than "Transmission Line Current," as required by the reference (j), and this defect should be corrected. The two meters are mounted directly on the front panel in the same fashion as the other d-c meters, which was permitted by reference (j).

65. Par. 2-25-2. Panel and mounting holes are drilled so that meters may be replaced with others of the same nominal

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size, having the maximum dimensions permitted by the meter specifications. All instruments have been so mounted as to permit removal from the front without access to the inside of the set. Panels are drilled and tapped for 6-32 screws. No lock washers have been provided under screw heads, as required by Paragraph 2-51 of the specifications. This defect should be corrected in additional models of the equipment. Play in meter leads is not excessive.

(a) The two d-c voltmeters used in the equipment are 1,000 ohms per volt. The bias voltmeter, with a range of 0-300 volts, is self-contained. The plate voltmeter, with a range of 0-800 volts, is provided with an external multiplier of the tubular type.

(b) All meters and multiplier are by-passed by 0.02 µf, 1,000-volt capacitors.

66. Par. 2-26. Appropriate nameplates have been affixed to all major units of the equipment. Table 8 lists the number, size and character of the nameplates provided.

67. Par. 2-27. Assembled separate items have been provided with nameplates bearing the data listed in Table 8.

68. Par. 2-28. Spare parts were not available to determine interchangeability. All essential items are clearly marked for identification and rating.

69. Par. 2-29. To determine whether all screws and bolts used in the Model YE equipment complied with the requirements of this paragraph would necessitate a complete disassembly of the equipment. This was not done. It is assumed that such inspection has been made at the point of manufacture.

70. Par. 2-30-1. All scales, dials and switches are arranged so that a clockwise rotation of the control knob results in an increase in the final controlled effect.

71. Par. 2-30-2. Verniers are employed on the Modulation Oscillator Frequency Control, "B;" Fourth Amplifier Plate Tuning Control, "M;" P.A. Grid Tuning Control, "N;" P.A. Plate Tuning Control, "P;" and the antenna coupling control, "Q." The Modulation Oscillator dial has 2500 divisions; 25, evenly spaced, on the main dial; and 100, evenly spaced, on the vernier dial. The main divisions are spaced 0.187" apart, and each vernier division is spaced 0.078" from those adjacent. Each turn of the control knob corresponds to one division on the main dial and to 100

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divisions on the vernier. On the main dial 12 significant figures are visible, and four or more are visible on the vernier. Controls "M," "N," "P," and "Q" are provided with 20 evenly spaced divisions on the main dial and 100 on the vernier. The main dial marking spacings are 0.187-inch apart, and the vernier, 0.06-inch apart. Each turn of the main control corresponds to 100 divisions on the vernier. In some positions of the main dial, only one significant figure is visible, and in others, two. Inasmuch as the arrangement conflicts with the specifications, and causes some confusion in reading the main dial, the necessary remedial measures should be taken to eliminate this defect. All figures on the vernier are visible in any position.

72. Par. 2-30-3. All rotatable devices, including control knobs, insulating couplings and gears, with exceptions hereafter mentioned, are pinned to their respective shafts. The P.A. grid and plate tuning gears are secured by Allen set screws. No slippage occurred in the gear arrangement, and the means of securing appears adequate for the purpose. A setscrew wrench has been provided and is securely mounted on the inner surface of the tuning access door. All controls are provided with suitable stops, with the exception of the neutralization control "R." As pointed out in Paragraph 55 (a) above, accidental short-circuit occurred when the condenser plates were brought together. This is a condition which should be remedied on future equipment. Stops, where provided, have proved adequate for the protection of the equipment. When the Model YE transmitter was delivered, it was found that the knob of the modulation oscillator, Control "B," was secured to its shaft by setscrews only. This knob was pinned to the shaft at this Laboratory prior to the disposition of the equipment. In future designs of the equipment, this knob should be pinned to the shaft.

73. Par. 2-31-1. Tolerances in all cases are sufficient to allow components of specified limiting dimensions to be accommodated.

74. Par. 2-31-2. This paragraph of the specifications states that the design shall be such that component parts may be readily replaced, and in general, the requirement of this paragraph has been met. However, to maintain the short connecting leads required by the frequency involved, certain of the assembled components have been compactly arranged and cannot be replaced easily. Some components can be replaced only by removing the super-frequency chassis and front panel. Some components cannot be removed without access to the rear. The modulation oscillator construction is such that it may be removed as a unit from the temperature compartment by

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loosening four screws. These screws are provided with knobs similar to the door lock knobs for convenient removal without tools. It is considered that the accessibility of parts is as good as is compatible with the various requirements of the specifications.

75. Par. 2-31-3. All toggle and push button switches have been located near the edge of the front panel so as to permit convenient replacement without removal of other units. Switches cannot be removed from the front of the panel, and access to the sides of the transmitter is necessary to accomplish removal and replacement.

76. Par. 2-32. The weights of the various units of the Model YE equipment are listed in Table 9. It will be noted that the total weight is 1,334.5 pounds, whereas the specifications permit 1,500 pounds.

77. Par. 2-33. The dimensions of each single unit are listed in Table 9. It will be noted that the dimensions are such that when the equipment is uncrated it will pass through the doors and hatches listed in this paragraph of the specifications, without further disassembly.

78. Par. 2-34. The equipment was subjected to sudden and gradual variations of supply line voltages between the limits of ±5% of normal, and additionally between the limits of ±10% of normal. These variations covered time periods of 1 minute, 5 minutes and 10 minutes. The results of these tests are given in Tables 27, 28 and 29. No damage occurred to the equipment and the equipment functioned normally and satisfactorily, with the exceptions indicated below:

(a) With a line voltage 10% below normal, it was impossible to adjust the filament voltage to the normal value (6.5 volts), as the maximum value of filament voltage obtainable under this condition is 6.3 volts. The necessary changes should be effected to allow normal filament voltage to be obtained by adjusting the filament rheostat at any line voltage within the specified limit.

(b) The effect of line voltage variation upon the output frequency of the modulating oscillator was greater than had been anticipated. However, all pertinent details are discussed in Paragraph 118 of this report.

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79. Par. 2-35-1. Most of the component parts are designated by a symbol number on labels cemented to the chassis near the component. These numbers are legible in all cases, and most numbers are readily viewed when access doors are opened or shields are removed. The compactness of the circuit arrangement has resulted in conditions so that some of the symbol numbers can be viewed only with the aid of a flashlight and mirror. A number of symbol markings are visible only from the rear of the transmitter. It is considered that the arrangement of symbol marking tags is as suitable as possible in view of the compactness of component parts.

(a) Motor Starter. No symbol markings have been provided for the starter components, and the circuits of the starter have not been shown on the schematic diagram W-303226. The schematic diagram should be modified to show the starter circuits, including symbol numbers of parts; also the starter components should be provided with symbol marking tags.

(b) Motor Generator. Fuse mount symbol numbers have been omitted from the connection box, although the fuses are given symbol numbers on the schematic diagram. In additional models of the equipment, the fuse mounts should bear the circuit symbol number of the fuse involved.

(c) Transmitter. Resistor R-185 was incorrectly labelled R-184. The symbol R-184 has not been assigned to any actual resistor in the Model YE equipment. The symbol R-176 occurred twice, once as the modulation oscillator parasitic suppressor resistor and again as the modulator parasitic suppressor resistor. On the schematic diagram the oscillator parasitic resistor is designated as R-184, while the modulator parasitic resistor is R-176. No label had been provided for R-208. The terminal board "M" was incorrectly labelled as "G," while terminal board "J" was labelled "H." Resistor groups R-104, R-105 and R-109, R-110 were interchanged as a group in respect to their designation on the schematic diagram. The order of R-111, R-112 and R-113 was reversed to that shown on the diagram. The defects indicated above should be eliminated in all additional models. Since the Model YE equipment was not a preliminary model, but was destined for Naval Service, such corrections as could be made without undue difficulty were made before the equipment was released from this Laboratory.

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80. Par. 2-35-2. All wire-wound ferrule type resistor mounts have included on the symbol marking label the resistance value and the Navy Type number, excepting resistors R-102, R-107, R-162, R-127, R-163, R-182 and R-183, which lack the Type number. None of the composition resistor mountings are marked to indicate the Navy Type number or resistance value. These defects should be corrected in additional models of the equipment. All tube sockets have been marked to indicate the type tube to be used in each socket.

81. Par. 2-36. All shock-proof mountings are of the "Lord" type, which may be replaced without undue difficulty.

82. Par. 2-37. As discussed under Paragraph 78 above, the equipment functioned satisfactorily, except as noted, when line voltage changes of ±10% occurred.

83. Par. 2-38. "U" bolts have been provided at each of the top corners of the transmitter frame. When not in use, they drop into the frame and are prevented from rattling by clips and wing head screws. The opening of the lifting eye is 1-3/8" diameter. Suitable nameplates are provided on the sides of the transmitter unit near the top to indicate the location of the lifting eyes.

84. Par. 2-39-1. The front panel and doors of the transmitter are finished in a black wrinkle finish as required by the specification. The three remaining sides and top are similarly finished.

85. Par. 2-39-2. All exterior aluminum surfaces have been finished as described in Paragraph 84 above.

86. Par. 2-39-3. Exterior screws of the knurled head type are finished in black nickel. No evidence of corrosion of these members occurred during the tests.

87. Par. 2-39-4. Interior surfaces of aluminum or aluminum alloy are provided with a dull natural finish and have shown no signs of corrosion. The protective coating did not cause contact trouble during the tests.

88. Par. 2-40-1. All indicating lamps are of a single type. They are rated at 18 volts 0.11 amperes and are of the candelabra screw base, Navy Type TS-51.

89. Par. 2-40-2. The indicator lamps are mounted as part of a combined receptacle resistor lamp assembly. The housing of the lamp and socket are aluminum, finished in dull black. A threaded metal shell with a rolled outer front edge

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forms a bezel around the lamp cap. The outside diameter of the front panel bezel is 1-3/8-inch. The projection of the glass globe beyond the bezel is one inch maximum. The overall length from front of housing to rear terminal is 5-7/8 inches. A review of the above dimensions reveals that all specified dimensional requirements have been met.

90. Par. 2-40-3. The globes have been inside etched with the colors as specified and as listed in Table 7, appended hereto.

91. Par. 2-41. Capacitors of the electrolytic type have not been used in the construction of the Model YE transmitter.

92. Par. 2-42 to 2-49. These paragraphs of the specifications cover type tests of component parts. No separate component parts were provided for test, and it is assumed that such tests have been made at the point of manufacture. During the course of the tests on the Model YE equipment, the Contractor replaced capacitors C-105, C-106, C-113, C-114, C-124, and C-132. The purpose of the replacement was to increase the voltage rating of these condensers. The substitute condensers had nearly twice the mica thickness of the original ones, but had the same capacity rating, 0.003 µf. However, no difficulty from voltage breakdown of these condensers had been experienced prior to their replacement. Inasmuch as the Contractor deemed it advisable to replace the previously mentioned condensers with others having a higher voltage breakdown value, it is suggested that the latter type of condenser be used in all additional models.

93. Par. 2-50. Damage to the tubes or equipment due to absence of suitable filament or bias voltage is prevented by proper relay protection. Time delay relay K-105, energized with the filaments, prevents relay K-108 from energizing the fields of the bias and plate generators until the filaments have been heated for 45 seconds. Since field excitation for the plate generator is obtained from the bias machine, plate voltage is dependent upon bias voltage.

94. Par. 2-51. The requirements of this paragraph have already been discussed in Paragraph 65 of this report.

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SECTION III (TRANSMITTER)

95. Par. 3-1 (General). The design of the Model YE transmitter is based upon the crystal-oscillator, multiplier, power-amplifier principle, while that of the modulator is based on the self-oscillator, power-amplifier principle.

(a) The crystal oscillator circuit consists of a 13,666.7 kc crystal, in conjunction with one Type 807 vacuum tube, as the frequency generating source. This circuit operates at room temperature. The output frequency of this circuit is at the fundamental of the crystal.

(b) In the first amplifier stage, which employs a Type 807 vacuum tube, the crystal frequency is doubled to 27,333.34 kilocycles. The coupling between this and the following stage is through a short link circuit.

(c) In the second amplifier stage, transition is made to the push-pull circuit. The tube employed is the twin beam power Type 829 vacuum tube, which also acts as a tripler to raise the frequency to 81 megacycles.

(d) The third amplifier stage also uses a Type 829 vacuum tube in a tuned grid, tuned plate circuit. However, no frequency multiplication occurs in this stage.

(e) The fourth amplifier, which triples the frequency to 246 megacycles, employs two Type 826 vacuum tubes in push-pull. The grid circuit of this stage is tuned by lumped inductance and capacitance, but the plate circuit employs capacity loaded, parallel line tuning.

(f) The 246-megacycle power amplifier also employs two Type 826 vacuum tubes with a neutralized circuit. Both the grid and plate circuits are tuned by capacity loaded parallel lines.

(g) The transmission line input circuit is inductively coupled to the power amplifier. An adjustable capacitor matches the transmitter output impedance to the transmission line input impedance.

(h) The first demodulator, which is inductively coupled to the transmission line input circuit, removes the modulation from the carrier. Two Type 955 vacuum tubes are used in this circuit, as permitted by

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reference (k).

(i) The second demodulator, employing one Type 6A6 vacuum tube, rectifies the modulation to d-c to operate relay, K-104, which controls the monitor light in the control unit.

(j) The modulation oscillator consists of an electron-coupled circuit, using a Type 807 vacuum tube. This oscillator, which operates over the frequency band of 540 to 830 kilocycles, is not keyed. The frequency controlling circuit and oscillator tube are maintained at a constant temperature of 70°C. in a temperature controlled compartment.

(k) The modulator amplifier, consisting of three Type 807 vacuum tubes operating in parallel is keyed by varying the control grid bias. The output voltage of this stage is applied to the 246-megacycle power amplifier through a coupling capacitor and a short transmission line.

(l) A modulation rectifier, employing a Type 807 vacuum tube, indicates the percentage modulation of the carrier by measuring the r-f modulating voltage applied to the 246-megacycle power amplifier. The rectified d-c output of the modulation rectifier operates a milliammeter calibrated in per cent modulation, as permitted by reference (j).

(m) Power output tests were made of the transmitter working into a lamp load through a matching section at 225 and 246 megacycles. These tests are shown in Table 10. Power output tests at 246 megacycles were also conducted working through a 230-foot length of hard drawn twin 7/8" coaxial line into a matched lamp load. The results of these tests are listed in Table 11. It is probable that the unmodulated power output at the end of the line was in excess of 54 watts, since there was some power loss in the matching circuit between the line and the lamp load. Although the tests were conducted with a 230-foot line, the equipment should be capable of delivering the specified 50 watts of carrier power, 80% modulated at any frequency between the limits of 540 and 830 kilocycles through the required 250-foot length of twin line, considering the quantity of power available with the former length of line. A noteworthy point brought out during the power output test was that a bond was required at the exact end of the twin line,

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in order to obtain maximum line efficiency. This bond was made of a copper strap connected between the extreme ends of the 7/8" line end seals. Bonding of the twin line four inches below the exact end was not effective in maintaining the line efficiency. This bonding was also found to be essential when the twin line was working into the antenna array. Power Outputs, 80% modulated, of values from 110 to 113 watts were obtained at the transmitter output terminals. Under the same conditions, the unmodulated power was between the limits of 88 and 91 watts. At the end of the 230-foot twin 7/8" coaxial line unmodulated power of 54 watts was obtained at an operating frequency of 246 megacycles, and modulated power outputs of 60.5 and 61.5 watts were obtained at modulation frequencies of 550 and 800 kilocycles, respectively. At the end of Table 11, the loss of power through the 230-foot twin line has been tabulated. This is based on the ratio of power as observed at the transmitter and at the end of the twin line. The greater loss under the modulated condition appears to indicate that some side-band "clipping" loss occurs. In all cases, the percentage of modulation, during power output measurement, was determined by oscillographic observation of the modulated carrier.

96. Par. 3-2. No provision has been made to key the carrier, since the specifications did not require such operation. Only the modulation on the carrier is keyed. The modulator amplifier is keyed by varying the bias between the limits of 30 volts and 240 volts, but the modulation oscillator is not keyed. Satisfactory key action was observed at keying speeds up to 20 words per minute. The equipment was subjected to numerous test runs of from two to six hours duration, during which time no keying difficulties developed. The keying was clear and free from "bounce." Oscillographic observations as to the character of keying were made using a ZB-RU receiver combination. These tests gave additional confirmation of the fact that suitable key action was obtained. Refer to Plate 14 of NRL Report No. R-1755 for oscillographic records of key action.

97. Par. 3-3. Determination of the harmonic content of the transmitter output was not undertaken. The character of the emitted signal was observed locally and no traces of lilt were discovered. In addition, the combined Models YE and ZB-RU Homing Equipment were given numerous flight tests, during which no lilt or other objectionable features were noted.

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98. Par. 3-4. The undesired audio frequency modulation present including hum, ripple and other disturbances was measured, and was found to correspond to a modulation level of less than one per cent of the 50-watt carrier.

99. Par. 3-5. The subject of controls has already been discussed in Paragraphs 60 and 61 of this report, and reference to those paragraphs gives all particulars. A list of controls is furnished in Table 7, while Tables 10, 11 and 48 list the settings of these controls.

100. Par. 3-6 (General). The carrier frequency stability tests were conducted while the transmitter was operating at full power, 80% modulated, into a matched lamp load. Stability measurements were made at the crystal frequency, rather than at the carrier frequency, since available equipment was not capable of measuring frequency drift at 246 megacycles. In order to obtain an audio beat note on the existing frequency drift equipment, it was necessary to use a 12,500.00-kilocycle crystal instead of the one which the equipment normally uses (13,666.67-kilocycles). This reduced the carrier frequency to 225 megacycles. All carrier frequency drift measurements were made under this condition. The frequency relation between the drift indicator and the transmitter was such that an increase in transmitter frequency resulted in a decrease in beat frequency. The frequency readings were corrected, so that an increase of transmitter frequency is tabulated as an increased reading. The frequency trace on the graphic recorder chart, however, traced the beat frequency and, therefore, is inverted; i.e., a decreased reading represents an increase of transmitter frequency. To avoid confusion, the carrier frequency, rather than the crystal frequency, is indicated in the tables. The carrier frequency is 18 times that of the crystal frequency. The arithmetrical summation of the carrier frequency variations from all causes totaled 0.0051%, which is within the specification requirement of 0.012% (See Table 32 for details.). Details as to frequency variations from the individual causes will be presented in the next few paragraphs.

101. Par. 3-6-1. Locked Key Operation for Two Hours. Tables 13 and 14 cover the locked key tests for 225 megacycles, 80% modulated at 550 and 800 kilocycles. Carrier frequency changes of approximately 0.0009% were noted. The data presented in these tables indicate the degree to which the plate voltage and modulated output watts fell off during the course of these tests. These tests, as discussed under (c) of Paragraph 54 above, were conducted at a plate voltage of 670 volts. No preheating of circuits or tubes was employed in connection with this test.

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102. Par. 3-6-2. Change of High-Frequency Oscillator Tube. The effect of tube change on the carrier frequency is tabulated in Table 15. This test was conducted by making six tube changes. In the table the per cent deviation from the original frequency and the per cent deviation from the mean frequency are listed. The maximum deviation from the original frequency was 0.00044%, while the deviation from the mean was 0.00023%. This test was made at reduced plate voltage as noted under (c) of Paragraph 54 above.

103. Par. 3-6-3. Variations in Ambient Temperature. Tables 17 and 18 present the data obtained from tests conducted in the temperature-humidity test chamber to determine the effect of ambient temperature on the Model YE equipment when operating at full power locked key, 80% modulation at 550 and 800 kilocycles, respectively. The per cent change per degree and the total per cent change are indicated on Plate 1. The tests were made at a plate voltage of 670 volts.

104. Par. 3-6-4. Variation in Humidity (Ambient Temperature Constant). Tables 19 and 20 list the data of humidity tests performed in the temperature-humidity test chamber on the Model YE equipment. The variation of the humidity caused a frequency variation of 0.00022% and 0.00038%. The modulating frequencies during these tests were 550 and 800 kilocycles. Plate 2 illustrates the test graphically when the carrier was modulated at 550 kilocycles.

105. Par. 3-6-5. Inclination from Roll and Pitch of Ship. The complete Model YE equipment, including transmitter, starter, motor generator and matched lamp load, was secured to the inclination table by means of the regular base fittings. It was then subjected to inclination up to 45° from the vertical in a fore and aft, and side to side direction. Tables 21, 22, 23 and 24 cover the results of these tests, which are also shown graphically in Plates 7 to 10, inclusive. A study of the plates will reveal that a slow drift in frequency occurred during the inclination of the transmitter. This frequency variation did not restore itself immediately, but drifted slowly back toward the original condition after the inclination had been stopped. It is believed that the frequency variation was due for the most part to a change in the average ambient temperature around the crystal, resulting from a temperature gradient between the air in the inclination table pit and that directly above it, through which the transmitter was moving. The maximum variation of the carrier frequency during inclination was 0.00037%.

106. Par. 3-6-6. Vibration. With the complete equipment secured to the vibration test stand, it was subjected

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to varying degrees of vibration, both in amplitude and frequency. The tests, listed in Table 25 and illustrated in Plates 15 and 16, were conducted at 225 megacycles, modulated at 550 and 800 kilocycles. The maximum carrier frequency change was approximately 0.00017%. The vibration tests resulted in the breaking of the copper grounding strap located at the upper right-hand rear corner of the super-frequency chassis. The straps originally supplied with the Model YE equipment were of hard copper and somewhat "springy." Later the Contractor supplied new grounding straps of soft copper, which should prove more flexible under vibration and be more satisfactory for the purpose. However, no vibration tests were made to determine their suitability, due to pressure of other tests. Inasmuch as the use of the replacement straps appears to be a step in the right direction, it is suggested that similar members be used in all additional models.

107. Par. 3-6-7. Shock. With the transmitter secured to the deck in the manner provided, shocks were applied to the equipment in the fashion designated by the governing specifications. The results are illustrated in Table 26. These tests were performed while the carrier was modulated at 550 and 800 kilocycles. The greatest change in carrier frequency was 0.000016%.

108. Par. 3-6-8. Variation of Supply Line Voltage. Table 27 records the effect of line voltage change on the carrier frequency for slow and rapid variations. The greatest frequency variations occur with increased line voltage, the greatest being 0.000032%.

109. Par. 3-6-9. Change from Unmodulated to Keyed Modulation Condition. The test was made in conformance to this paragraph of the specifications, the results of which are illustrated in Table 30. The maximum carrier frequency variation, which occurred at the end of the 45-minute test period, was 0.000136%. Modulation of 800 kilocycles was applied to the carrier at a rate of 15 w.p.m. during the keyed modulation condition.

110. Par. 3-7 (General). Frequency stability tests of the modulator were made while it was modulating the carrier at a level of 80%, with full carrier power output. The frequency of the modulation oscillator was adjusted so that an increase in modulation frecuency resulted in an increase in the frequency indicated by the measuring apparatus. The modulating oscillator circuit is housed in a temperature controlled compartment, which operates at 70°C. When the temperature compartment was energized for the first time, it was discovered that the thermometer had been broken. This resulted from mis-

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alignment between the thermometer mounting holes and compartment entrance hole, which was such that pressure was applied to the glass stem when the screws were tightened. Since the strain was applied through a rubber sleeve, the condition was not immediately evident while installing the thermometer. To carry on the tests, another thermometer was placed in the temperature compartment. However, it was not of the same form as the one originally supplied. This thermometer had a somewhat greater exposed surface due to longer scale than the original thermometer. This caused a very slight increase of radiation surface. Later the Contractor supplied a new thermometer and a Contractor's representative corrected the misalignment so that breakage would not occur upon installing the thermometer. Care should be exercised to assure that conditions which cause thermometer breakage are eliminated in all additional models. All modulation frequency stability tests were conducted after a three-hour warm-up period to stabilize the temperature of the heated compartment, as permitted by Paragraph 3 of reference (a). Table 12 illustrates the time required to bring the oven temperature to a stabilized condition after energization of the heater circuits. The oven reached a stable temperature of 69°C in two hours and ten minutes, which is within the specified time limit of three hours. The total percentage change of modulation frequency during the warm-up period was approximately 0.103%. Frequency stability tests were conducted at 550 and 800 kilocycles, except for the variation of supply line voltage tests, in which the tests were made at intervals of 50 kilocycles over the modulation frequency range. The total modulation frequency variation resulting from all causes is 0.0667%, which is within the specification requirement of 0.1%. See Table 33 for details.

111. Par. 3-7-1. Two Hour Locked Key Test. The tests, which are illustrated in Tables 13 and 14, were conducted at two modulating frequencies, 550 and 800 kilocycles, respectively. A steady decrease in frequency was noted, which had a maximum value of 0.0013%, in the 550 kilocycle modulating frequency during the two hour period. The two hour locked key run at 800 kilocycles resulted in 0.0035% decrease in frequency, but the greatest change occurred twenty minutes before the end of the run. This test was conducted at a reduced plate voltage as explained previously. (See Paragraph 54 (c) of this report for details.)

112. Par. 3-7-2. Change of Modulating Oscillator Tube. This test was conducted using the original tube and five additional tubes. For pertinent data, refer to Table 16. The tube numbers appearing in the table are reference numbers only; not tube serial numbers. In order to change tubes, it was necessary to open the oscillator oven, since the tube is located

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in the oven. The frequency measurements were not taken until twenty minutes after the oven had been closed. This was necessary to allow the oven temperature to recover to normal value. The data presented in Table 16 show both the deviation from the original frequency and the deviation from the mean frequency. Data were recorded for both of the two modulating frequencies, 550 and 800 kilocycles. The greatest deviation from the original frequency, which had a value of 0.013%, occurred at 550 kilocycles. The greatest deviation from the mean frequency also occurred at 550 kilocycles, and had a value of 0.009%. These tests were conducted at a plate voltage of 670 volts as explained in Paragraph 54 (c) above.

113. Par. 3-7-3. Variations in Ambient Temperature. Ambient temperature tests on the modulator frequency, which were conducted simultaneously with the carrier frequency stability tests, Paragraph 103, are illustrated in Tables 17 and 18. The two modulating frequencies used were 550 and 800 kilocycles. The frequency change with variation of ambient temperature is illustrated in Plates 3 and 4. During the ambient temperature test the oven temperature varied between the limits of 71.5°C at an ambient of 50°C to 66.0°C at an ambient of 0°C. Although no limits are given in the governing specifications, the variation of temperature is considered to be excessive. The necessary modifications should be effected in additional models of the equipment to hold the heated compartment within the limits of ±1°C under any specified ambient temperature condition. The heater cycle at an ambient of 0°C was 25 seconds "on" and 5 seconds "off."

114. Par. 3-7-4. Variation in Humidity (Ambient Temperature Constant). Tables 19 and 20 show the results obtained at modulating frequencies of 550 and 800 kilocycles, respectively. The maximum modulation frequency variation during these tests was 0.005%, which occurred at 550 kilocycles. Plates 5 and 6 appended hereto show the results of the humidity variation tests in graphical form.

115. Par. 3-7-5. Inclination from Roll and Pitch of Ship. The greatest frequency variation occurred at 550 kilocycles during "side to side" inclination, and had a value of 0.0025%. The data obtained during these tests are listed in Tables 22 and 24, and shown graphically in Plates 11 to 14 inclusive.

116. Par. 3-7-6. Vibration. At 550 kilocycles the modulation frequency variation was only one cycle or 0.00018%. At 800 kilocycles, vibration resulted in a variation of 5 cycles or 0.00062%. The test data are illustrated in Table 25 and Plates 17 and 18.

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117. Par. 3-7-7. Shock. The modulation frequency was little affected by shock. In some cases no change was noted. The maximum change of 4 cycles or 0.00050% occurred at 800 kilocycles. The observed data are shown in Table 26.

118. Par. 3-7-8. Variation of Supply Line Voltage. By the terms of this paragraph the equipment should be subjected to line voltage variations of ±10% of normal. No time limit for the voltage variation is given. Table 27 records the data taken when the line voltage was varied by a factor of ±10% over periods of both 5 minutes and 1 minute; and also for variations of ±5% over periods of both 5 minutes and 1 minute. The greatest frequency change occurred at 800 kilocycles when the line voltage was changed from ±10% in 5 minutes. The per cent change was 0.0246%. Under the same condition, the frequency change at 550 kilocycles was only 0.0067%. A test was then made as illustrated in Table 28, at six frequencies over the modulation frequency range, and the voltage was varied by a factor of ±10% in one minute. This test showed that greater changes in frequency resulted when the line voltage was reduced by 10% than when raised by 10%. Also, the higher frequencies showed greater frequency changes than the lower ones. To determine the maximum variation in modulation frequency, the line voltage tests were conducted at every 50 kilocycles over the range and time was given to permit the frequency to reach a stabilized condition. In all cases the stabilized condition was reached at reduced line voltage in 10 minutes and at increased line voltage in 5 minutes. These data are presented in Table 29, wherein it will be noted that the modulation frequency, at reduced line voltage, varied as much as 0.0309% at 650 kilocycles. While this large frequency variation is not sufficient to bring the total frequency variation from all causes outside the limit of 0.1% required by Paragraph 3-8 of the specifications, nevertheless, it is considered excessive. It should be noted that the modulation oscillator filament voltage is not provided with a control, but rather operates directly from the supply line. Consequently, when the line voltage is reduced by 10%, the oscillator filament voltage is reduced by a like amount and remains there until the line voltage is restored. The large frequency variation noted above, therefore, may be a result of insufficient emission in the oscillator tube under the low filament voltage condition. In future equipment means should be taken to remedy the reasonably large change in modulating frequency which occurs from line voltage variations.

119. Par. 3-7-9. Change from Continuously Keyed to Intermittently Keyed Condition. The modulation was keyed at the rate of 15 words per minute, with the transmitter adjusted to deliver full carrier power, 80% modulated, for a period of

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30 minutes. At the end of this period, the modulation frequency was noted. While the transmitter continued to emit full carrier power, the modulator remained inactive for 20 minutes. At the end of this period the modulation frequency was noted at the end of a 10 second dash. Table 31 records the data for the two modulating frequencies, 550 and 800 kilocycles. It will be noted that only small frequency changes occurred.

120. Par. 3-8. A summary of the carrier frequency stability tests, as outlined in Paragraph 3-6(1-9) of the governing specifications, is presented in Table 32. The value listed for each individual test is the maximum percentage frequency variation observed. The total percentage frequency change is determined by arithmetically adding the maximum percentage frequency variations found in the tests mentioned above. Column 2 under the heading "Maximum Frequency Variation %" gives the percentage values of the several tests conducted under each subparagraph of Paragraph 3-6. The total at the foot of Column 3 is the arithmetical sum of maximum percentage frequency variations resulting from the several tests. The total percentage frequency change of 0.0051% is well within the limiting tolerance of 0.012% required by Paragraph 3-8 of the specifications. Similarly, Table 33 summarizes the modulation frequency stability tests, as outlined in Paragraph 3-7(1-9) of the governing specifications. Columns 2 and 3 give the maximum percentage values as observed for 550 and 800 kilocycle modulation, respectively. The total of Column 4, under the heading "% Frequency Variation to Determine Total," is 0.0667%, and is also well within the limiting tolerance of 0.10% recuired by this paragraph of the specifications.

121. Par. 3-9. The "percentage modulation" meter, provided with the equipment, employs a vacuum tube rectifier and associated d-c meter, as permitted by reference (j). The rectifier tube is a Type 807 vacuum tube coupled to the modulator tank circuit through a 0.01 µf condenser. The scale of the d-c plate meter is directly calibrated in percentage modulation. Essentially the modulation meter is a vacuum tube voltmeter that measures the r-f voltage across the modulator tank circuit. Its calibration depends upon the transmitter plate voltage being maintained at 750 volts, as may be observed from a study of the data in the lower portion of Table 41. In this table, it will be observed that the modulation meter reading decreased as the plate voltage was reduced, while the percentage modulation of the carrier remained essentially constant at 80%. Thus, while the actual percentage modulation remained constant as the voltage was lowered, the meter indication was no longer 80%, but some lower value. To operate at a reduced plate voltage at the desired modulation level, it is, therefore, necessary to first

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adjust the percentage modulation at normal plate voltage before reducing the plate voltage. While this may seem an inherent defect in the modulation meter, it should be pointed out that any known type of modulation meter does not hold its calibration regardless of the carrier level. This circuit is simple and serves the purpose intended. To determine the accuracy of the meter at 80% modulation, a test was conducted at a number of modulation frequencies, observing the modulated carrier on an oscilloscope. As is illustrated in Table 34, there is a good agreement between the "percentage modulation" meter and the actual percentage of modulation over the modulation frequency range. A control has been provided for adjusting the modulation to the 80% level at any frequency within this range.

122. Par. 3-10. The transmitter is provided with a monitor circuit employing two Type 955 vacuum tubes in a push-pull, first demodulator circuit. The input circuit of the first demodulator is coupled to the transmitter output circuit by a coupling loop. Modulated carrier is applied to the grids of the demodulator tubes, the rectified grid currents of which serve as an indication of transmission line currents, as discussed in Paragraph 64. The demodulated output of the first demodulator, consisting chiefly of the modulation component of the carrier is capacity coupled to the input of the second demodulator using a Type 6A6 vacuum tube. The operation of this tube is such that the rectified modulation operates d-c relay K-104 to close a pair of contacts, brought out to terminals 20A and 21A of the transmitter. The monitor circuit and relay K-104A successfully followed the keying at all rates up to 20 w.p.m., when the plate voltage was varied between normal and 25% of normal voltage. The transmitter was then working directly into a matched lamp load. However, the monitor circuit did not respond to the keying when working into the antenna array through the twin line with one line shorter than the other. As discussed in Paragraph 188(b), the relay failed to function under this condition. In the particular installation, satisfactory operation could be obtained by adjusting the twin lines to very nearly the same length.

123. Par. 3-11. The transmitter has been supplied with three pairs of terminals for remote control operation. The potential across these terminals in no case exceeds 200 volts. The maximum measured voltage was 117 volts. Closing one pair of these terminals starts the motor generator, heats the filaments and starts the tube cooling blower. When the transmitter "Plate" switch is closed, unmodulated carrier power is emitted continuously after a period of 45 seconds, which is the time for closing of a time limit relay. Closing the second pair of terminals causes keyed modulation to be applied

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to the carrier at any rate up to 20 w.p.m. The open circuit voltage across the keying terminals is 100 volts d-c. When the circuit is closed, the current flow is 75 milliamperes d-c. Two toggle switches, one the local "start" switbh and the other the "plate voltage" switch, and a test key have been provided on the transmitter for local operation of the control circuits. A third pair of terminals is provided to supply a.c. at 115 volts, single phase, 60 cycle. These terminals are connected through the plate voltage relay in such a manner as to be energized only when the plate voltage is applied. The remote control circuits were connected to the Model YE Control Unit CFI-23145 and found to function in accordance with the requirements of the governing specifications. Full particulars are discussed in Paragraph 186 of this report.

124. Par. 3-12. The number of transmitter controls has been kept to a minimum, which is compatible with all provisions of the specifications. The transmitter controls have already been discussed in Paragraphs 60, 61 and 99 above. A list of the controls may be found in Table 7.

125. Par. 3-13.

(a) A holder for the modulator calibration charts is mounted on the front panel, directly over the modulator oscillator unit, at approximately waist height. The cards contain spaces to record the settings of the modulation controls for fifteen frequencies. Four inactive cards are mounted behind the active one. These cards are protected by a celluloid cover sheet. Cards are removed by lifting them upward, but they must be bent outward at the same to pass the carrier tuning access door knob. Although the location of the card holder can not be considered entirely satisfactory, it is the only location possible, because there is insufficient room to place it elsewhere. Therefore, no corrective action is suggested.

(b) Carrier frequency calibration cards and holder, with sufficient columns to record dial settings for six carrier frequencies, are mounted on the inner surface of the super-frequency tuning access doors. One active card and four inactive ones are provided. Cards are protected by a celluloid window. These calibration cards, which are required by Reference (j), proved a convenient reference for a quick check of dial settings. Rapid adjustment of the super-frequency controls is not required, since the carrier operates on a fixed frequency.

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126. Par. 3-14. The accuracy of reset of the modulation frequency to previously calibrated frequency is illustrated in Table 36. The average error in reset at 800 kilocycles was 0.0009% and the maximum error for any one trial was 0.0017%. At 550 kilocycles the average error in reset was 0.00069%, while the maximum error was 0.0009%. The accuracy of reset falls within the tolerance of the governing specifications. As required by Reference (j), the overlap of the modulation oscillator bands were determined in accordance with specifications RE 13A 465E and is presented in Table 35. The minimum of the several values of percentage overlap indicated is seen to be 3.57%. No requirement as to overlap is stated in the governing specifications. A value of not less than 3 per cent is required in Specifications RE 13A 465E, and it can be seen that the Model YE equipment fulfills this requirement.

127. Par. 3-15. Test for Lost Motion, Backlash and Torque Lash. Table 37 covers the tests conducted to determine the lost motion, backlash and torque lash in the controls of modulation oscillator. The results of these tests are within the requirements of this paragraph of the specifications.

128. Par. 3-16. Verniers have been provided on all but step-by-step controls, by means of positive gearing. In the case of the frequency determining circuit of the modulation oscillator, the vernier ratio is such that the variation of the resonant frequency per division of marking is as shown in Table 38. The change per division over the range is not more than 0.01% nor less than 0.001%. In the other circuits the vernier ratio is such as to provide non-critical adjustment of the circuits controlled.

129. Par. 3-17. Friction type locking devices have been provided on the tuning controls of the carrier and modulation circuits. All carrier control locking devices are positive and prevent the accidental movement of the controls. The locking device of the modulation oscillator Control "B" is positive and prevents movement of the control when locked. However, the location of the locking device is such that the control is moved by the hand during the locking process. To avoid this condition, it would be necessary to increase the spacing between the knob and the lock. In the present design, extreme care must be exercised to avoid disturbing the dial setting. It proved to be a considerable disadvantage when changing frequency rapidly. This condition should be remedied in future equipments. The design of the locking device used on Oscillator Plate Tuning Control "C" and Modulator Plate Tuning Control "D," is such that, while the

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control can not creep under vibration, positive locking against accidental movement is not obtained. These controls, when locked, can be turned by hand without undue effort, as the drag of the locking brake is insufficient for the purpose. The lock design for future equipment should be such as to afford positive locking under all conditions. Locking of the neutralizing condensers is accomplished by means of a screw adjacent to the control. The neutralizing screwdriver is fitted with a metal point on one end for turning the locking screw, as explained in Paragraph 62 above. No sharp edges or corners are present on the locking devices and they do not interfere with the rotation of the control when unlocked. Table 39 illustrates the effect of dial locks on the carrier and modulation frequencies.

130. Par. 3-18. A trimmer capacitor C-166 is provided in the modulation oscillator ("Dow Oscillator") for readjustment of the calibration, when the oscillator tube is changed. The capacity of this condenser is 7 μμf minimum and 20 μμf maximum. Tubes possessing the limiting characteristics of the tube specifications were not available for test purposes. Therefore, it was impossible to determine if the capacity range of C-166 was sufficient to maintain the oscillator calibration, when the oscillator tube is changed.

131. Par. 3-19. No readjustment of the filament, plate or bias voltage was necessary when shifting from one modulation frequency to another. The values of filament, plate and bias voltages obtained without readjustment of voltage controls, when the frequency was varied over the range, are shown in Table 40.

132. Par. 3-20. The urgency of other tests of the Model YE equipment prevented conducting the tests required by this paragraph of the specifications. This portion of the specifications referred to radio receiver interference caused by components such as blower motors, etc.

133. Par. 3-25. Table 41 illustrates the effect of varying the power output control. This control consists of a plate voltage rheostat. The power output was reduced in steps over the range from 100% to 20%. Throughout this range the percentage modulation of the carrier at 800 kc was observed and found to be maintained essentially at the 80 per cent level. At the same time the indications on the modulation meter decreased in value, since it reads percentage modulation correctly only when the plate voltage is 750 volts, as explained in Paragraph 121. The readings of the meter over the range tested are recorded under the heading, "Per Cent Mod. Meter." The change of carrier and modulation frequency with variation of power are also given in the Table 41.

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134. Par. 3-26. Indicator lamps have been provided on the front panel in a row immediately above the lower access doors. The significance of each indicator lamp is indicated by a name plate directly over the lamp. The lamps signify the following functions:

(1) When bias voltage is supplied to transmitter -- green.
(2) When plate voltage is supplied to transmitter -- red.
(3) When starting contactor is energized -- blue.
(4) When temperature compartment heater circuit is energized -- amber.
(5) When master oscillator tube filament is energized -- clear.
(6) When an overload relay is tripped -- amber.

135. Par. 3-27. A list of the indicating instruments is given in Table 7. Provision has been made to indicate the combined plate current, as well as the individual plate currents, of the P.A. tubes. The meters showing the individual plate currents also include the grid current of the tube involved. A grid current meter is provided in the modulator power amplifier stage as required by Reference (j). As explained in Paragraphs 64 and 122 above, the antenna ammeters make use of rectifiers and associated d-c meters. These meters are mounted on the front panel in the same manner as other d-c meters. In addition to the indicating instruments required by the governing specifications, meters are provided to indicate the grid currents of third and fourth amplifier stages.

136. Par. 3-29. The Model YE Transmitter consists of a single component unit whose dimensions are listed in Table 9. The total space requirement comes within the space limitations of the specification. The transmission line connections project 1-1/2" above the top of the transmitter but are considered a part of the transmission line rather than the transmitter.

137. Par. 3-30. The dimensions and assembly of the equipment are such that it complies with the specification requirements and will pass through hatches of the size indicated in Paragraph 2-33 of the specifications.

138. Par. 3-31. The transmitter unit includes, integral with its assembly, all vacuum tubes, radio frequency circuits, meters, filament and distribution transformers, relays and filters for the motor generator equipment. These filters are in the form of by-pass capacitors located in the transmitter unit.

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139. Par. 3-32. The transmitter is shielded on all six sides and the various circuits within the transmitter are shielded from each other. The carrier producing stages and circuits are individually shielded. Lead sheathed wires are used for circuits other than for radio frequency purposes and the sheaths are grounded. Lead sheaths are protected by buffers at all points where damage might result.

140. Par. 3-33. Indicating instruments have been equipped with by-pass units as discussed in Paragraph 65 above.

141. Par. 3-34. Filament voltages for all tubes, except the modulator oscillator tube, are supplied by filament transformers T-103, T-104, and T-105, which are located near the rear of the transmitter at about mid-height. The modulation oscillator filament transformer, T-102, is mounted within the temperature controlled compartment. This transformer is in no way connected to the filament rheostat, but rather is connected directly across the line with no means of voltage adjustment. These transformers are designed for operation on 115 volts, as required by Reference (j). Transformers T-103, T-104, and T-105 are provided with a 110-volt tap, but this is not used. All secondaries are centertapped as required. Distribution transformer T-101 is provided for primary operation on 220/440 volts; and secondary operation at 115 volts. Filament transformer voltage is obtained from this transformer. It has two terminal boards, one with four primary terminals and one with four secondary terminals. Each board has straps for series-parallel operation, although secondaries are always operated in parallel. The primary terminals are numbered 1 to 4 inclusive, while the secondary terminals 5 to 8 inclusive, corresponding to terminal numbers on schematic diagram W-303226. Primary windings are series connected for 440-volt operation and parallel connected for 220-volt operation. No voltage designations are given on the terminal boards of the distribution transformer to indicate the connections for either primary voltage. This information may be given on the transformer name plate, but this can be read only by removing the transformer, and the transformer was not removed solely to check this feature. In future equipment, information should be given on a transformer nameplate in a visible location, or in the instruction book to clearly designate the proper connections to be used for operation at various voltages.

142. Par. 3-35. The transformers functioned satisfactorily during the complete tests without signs of overheating. The transformers are of the air-cooled type, without covers. The filament transformer terminals are clearly marked with the primary voltage rating and with the secondary voltage

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and current ratings. As pointed out in Paragraph 141, the voltage ratings of the distribution transformer terminals are not indicated on the terminal boards. All transformer terminals are mounted on bakelite boards.

143. Par. 3-36. Undue variation in the filament voltage did not occur, as shown in Table 42, when the equipment was keyed. It will be noted that normal filament voltage was not maintained when the line voltage was reduced by minus 10% of normal. The maximum filament voltage obtained under this condition was 6.3, whereas 6.5 is the rated filament voltage. The design of future equipment should provide sufficient control to maintain normal filament voltage at reduced supply line voltage.

144. Par. 3-37. The transmitter is so constructed that:

(1) It can be installed with its back flush against a bulkhead, although servicing is made more difficult.

(2) Its foundation pedestal can be bolted to the deck for security and provides ample strength for installation afloat. This pedestal is formed of two "U" channels laid on their sides with four 9/16" diameter holes drilled vertically through the two sides to form a mounting hole in each corner of the transmitter base.

(3) All cable connections are brought to three terminal boards located at the bottom front of the transmitter, just inside the lower right hand access door, with the exception of the high voltage supply from the motor generator, which is brought to an insulated stud located on the metal panel holding the terminal boards. Clearance under the transmitter is 3-1/4", which is the distance between the deck and the rolled edge along the front of the lower transmitter shelf. The specifications require a clearance of at least 4 inches under the transmitter, and future equipment should comply with this provision. All terminal boards are six inches or more above the deck level. Cables may enter at the deck level from either side of the unit. Lugs on all terminal strips are protected from short-circuiting by insulating baffles between terminals. Terminal board connections are such that the external wiring is connected to the lower terminals of the boards.

(4) All tubes may be replaced through the front access doors, with the exception of the modulation oscillator

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tube, which is mounted within the temperature controlled compartment and at the rear of the oscillator chassis. In order to replace this tube, the chassis must be withdrawn from the compartment. However, even with the chassis withdrawn to the limit of its slide, it is necessary to reach into the compartment to remove the tube, and, further, it is necessary to balance the chassis with one hand while removing the tube with the other. Relocation of the oscillator tube near the front of the chassis would materially simplify the task of tube change. This improvement should be incorporated in future models of the equipment. Some difficulty was encountered in making connections to the plates of the Type 829 vacuum tubes. The plate connectors are in the form of short straps, on the free end of which has been attached a Fahnestock clip. To make the connection, the tube pin must be aligned perfectly with the "eye" of the clip, which is difficult in a crowded compartment. Making this connection should prove even more difficult under conditions of roll and pitch experienced aboard ship. Hoping to discover a more suitable connector, the Laboratory tested two other types. One employed a screw clamp similar to a pin-vise in place of the Fahnestock clip. The more successful connector employed a clip formed of two 3/8" x 1-1/2" phosphor-bronze strips riveted together at the ends and attached to the connector strap. Multiple contact was made to the tube pin by the inner edges of three louvers pressed in each strip. This clip is easily attached to the tube pin and has the added advantage of freedom of motion in all directions of tube strain. Consideration should be given to the adoption of this connector, both for the present Model YE Equipment and for such future equipment as may be purchased. Relays are accessible through the lower access doors.

(5) The keying relay is mounted on the front panel under a box cover. The keying contacts may be observed through a two-inch diameter circular window. Two thumb screws hold the box cover in place.

(6) The antenna terminals, formed by two 7/8-inch end seals, are mounted rigidly to the transmitter frame and project 1-1/2 inches above the top of the transmitter. They are located approximately 8-1/4 inches from the rear of the Unit and 9-1/2 inches from the right hand side. This is in agreement with requirements of Reference (j).

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145. Par. 3-38. The two side and the rear shields are perforated with 3/8-inch diameter holes, 513 performations to the square foot. The tube doors are similarly perforated. The carrier tuning and lower access doors together with the top and bottom decks are not perforated. The side and rear shields are held in place by 11/16-inch diameter fine knurled thumb screws finished in black nickel. These screws are secured loosely by rolled shoulders to the shield to prevent loss. The screws are pointed for guiding into floating nuts on the transmitter frame. Lock washers lock the screws when they are screwed tight. The top shield is secured by round head black nickeled screws. The maximum length of any shield is 36-5/8 inches; specifications limit the length to 48 inches maximum. Shields can be replaced easily and quickly by placing in position and turning screws. Shields of the same size are interchangeable.

146. Par. 3-40. Six hinged access doors are provided on the front panel of the transmitter. The mounting hinges are of the piano type with one-half visible. Hinges are brass with black nickel finish on exposed surfaces. The access doors are of sufficient size to permit replacement of tubes without difficulty. The dimensions of the doors are listed below:

Access Door	Size of Opening	Size of Door
Carrier Tube	5" x 21-3/4"	5-1/4" x 23-1/2"
Carrier Tuning	5-13/16" x 22-3/4"	6-1/4" x 23-1/2"
Modulator Tube	5-1/2" x 7-3/4"	6-1/2" x 8-1/4"
Relay	11-1/4" x 8-1/2"	12" x 9"

(Note: The first dimension in each group indicates indicates width, and the second gives height.)

All doors overlap the panel openings. The doors have beveled edges and square corners, while the door openings have rounded corners. Nickel plated stops are provided on all doors to protect the hinges and hold the doors in an open position. These stops do not release automatically. The long vertical doors are fastened by two latches of sturdy construction and positive action. Door knobs are bakelite and are provided with etched name plates to indicate the locking direction. The construction of the modulation oscillator is such that the chassis and a portion of the front panel may be removed from the temperature compartment by sliding them forward. Two rubber covered handles, mounted vertically one on either side of the removable panel, assist in the removal of the unit. Four large screws fitted with knobs similar to door

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knobs, hold the panel and chassis in place.

147. Par. 3-41. An insulated hand rail is provided on the front panel adjacent to each side of the transmitter. Dimensions of the hand rail are given below:

Outside diameter of rail	-- 1"
Overall length	-- 24-7/8"
Top of hand rail to deck	-- 57"
Clearance between rail and panel	-- 1-3/8"
Side of set to center of rail	-- 11/16"

148. Par. 3-42. High potential d-c is prevented from reaching the antenna circuit by the construction of the output circuit. R-f coupling to the transmission line is through an inductive coupling loop with air-gap insulation. A considerable misalignment of the coupling loop would have to occur to apply d-c potential to the antenna system, and since the neutral plane of the antenna system is grounded, the application of a d-c potential to the antenna would immediately operate the transmitter overload protection to remove the d-c voltage. Additionally, if some condition did cause the application of d-c potentials to the antenna, its d-c resistance is so low that no appreciable potential would exist prior to the opening of the overload relay.

149. Par. 3-43-1. In order to expedite adjustment of the equipment to modulating frequencies for which the equipment has not been previously calibrated, coupling and terminating facilities have been provided to facilitate the use of standard frequency measuring equipment.

150. Par. 3-43-2. Coupling for the r-f pick-up is provided by capacitor C-179 in the plate circuit of the modulation oscillator tube. The r-f terminal 17A is connected to this capacitor through a lead covered cable. The other side of the circuit is grounded through terminal 16A. Terminals 16A and 17A are located on the terminal board.

151. Par. 3-43-3. The coupling circuit provides 300 to 380 millivolts output over the frequency range of 540 to 830 kilocycles, as illustrated in Table 43.

152. Par. 3-43-4. The output phone jack is located 31 inches from deck level on the left hand side and approximately 3 inches from the edge of the front panel. It is a double circuit jack with both sides ungrounded. Connections are made to terminals 18A and 19A on the terminal board by means of lead covered cable. The jack accommodates phone plugs Navy Types 49001 and 49034.

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153. Par. 3-43-5. The coupling circuit terminals are marked "R.F. Modulation Coupling for Frequency Meter." The output phone jack is identified by a plate marked "Frequency Meter Audio Output."

154. Par. 3-44. The "Antenna Terminal" consists of two 7/8-inch end seals to accommodate a twin 7/8-inch coaxial transmission line. The end seals are supported in an inverted vertical position by a metal bracket with their upper ends projecting 1-1/2-inch above the top of the transmitter.

(a) It was observed that a collar had been soldered to each end seal. Since the gas-tightness of the end seals depends upon neoprene rings, some fear was felt that the effectiveness of the neoprene may have been reduced by the application of heat to the end seals. However, the end seals successfully held pressure of 35 pounds for a period of several weeks.

(b) Each end seal is provided with a plug for draining the line and a gas admission valve similar to Communication Products, Inc., Type 337 Valve. The location of the admission valve is such that there is just sufficient clearance between the valve and end seal bracket to apply a valve connector similar to Communication Products, Inc., Type 468 Connector. The addition of a right angle elbow fitting between the admission valve and the end seal would place the valve in a much more convenient location; however, to make this change to the present equipment would require cutting a clearance hole in the mounting bracket to permit screwing the elbow fitting into the end seal. It is recommended that future equipments be modified to make the gas admission valves more accessible.

(c) Sufficient hard drawn coaxial 7/8-inch transmission line was supplied to form 250 feet of twin 7/8-inch coaxial transmission line.

(d) The outer conductors of the line are grounded to the transmitter frame through the end seals and mounting bracket. The outer conductors or shields are, therefore, at ground potential and may be mounted against the structure of the ship. The power is carried by the pair of inner conductors. The output circuit couples to the P.A. tank circuit by a coupling loop in such a manner that the transmitter output is balanced to ground. The output impedance

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of the transmitter is such that it worked successfully into the twin 7/8-inch coaxial transmission line.

(e) Eighty inner conductor couplings of the solderless type were supplied with the Model YE Equipment received at the Laboratory. However, in view of the higher line losses introduced by these connectors, they should be used only at the extreme ends of the line, where ease and rapidity of disconnection are desired. So far as is known, the inner conductor couplings supplied with the other Model YE Equipments in the Service were the straight pin type which are soldered in place.

(f) Where long vertical runs are necessary, the weight of the inner conductor should be carried on anchor joints designed in accordance with sheet 10-A of Naval Research Laboratory Specifications RA 62A 231. All future equipments should be provided with these anchor joints.

155. Par. 3-45. As permitted by Reference (j), vacuum tube rectifiers and associated d-c meters were employed in place of thermocouple instruments to indicate transmission line currents. As pointed out in Paragraph 64 of this report, the rectifiers were not connected one in each leg of the output circuit, as required by this paragraph of the specifications, but were coupled to each leg of the output circuit by a common loop. Tests described in Paragraph 64 indicate that the meters were not actuated individually by the currents in each leg of the output circuit, but by the combined current in the circuit. No comparison was made between the currents in the output circuit and that shown on the meters. As previously pointed out, both meters indicated the same current when one leg of the circuit was broken. If the meters were truly indicative of current, the meter for the broken side should have read zero. In future equipment the meter circuits should be so constituted as to indicate the individual currents of each leg of the output circuit.

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SECTION VI (POWER EQUIPMENT)

156. Par. 6-1. The following paragraphs of this report comment in detail upon the operation and performance of the power equipment supplied with the Model YE equipment.

157. Par. 6-2. The power equipment of the Model YE equipment under test is designed for operation from a 440-volt, 60-cycle, 3-phase, power source. The motor is capable of operation on 220 and 440 volts, when connected as indicated on the nameplate. The motor starter furnished is designed for 440-volt operation and all tests were conducted at this potential. The construction of the starter box is such that the relay panel had to be removed to mount the box, since the mounting holes are within outline of this panel. The location of the mounting holes in future equipment should be modified to permit more convenient mounting.

158. Par. 6-3. The supply line voltage was varied from 10% above to 10% below normal, with satisfactory performance on the part of the motor-generator set. No facilities for producing the specified ±5% frequency variation were available, and hence this test could not be conducted.

159. Par. 6-4. Full power locked key tests were conducted at several different frequencies and under widely varying conditions of ambient temperature and humidity. No overheating, breakdowns or failure of any kind were noted in the power equipment.

160. Par. 6-5. The power required from the supply line is shown in Table 44 for various conditions of operation. The specified maximum input of 3.2 kilowatts for a-c operation was not exceeded in any case. Modulated full power locked key operation required approximately 2.3 kilowatts.

161. Par. 6-6. Power for the filament transformers is supplied by a 440/115-volt distribution transformer T101 located near the rear on the lower deck of the transmitter. This transformer is provided with links permitting operation on 220 and 440 volts. For both connections the secondary voltage is 115 volts. The filament transformers are designed for 115-volt primary operation and are also provided with a tap for 110-volt operation.

162. Par. 6-7. Motor driven generators are used to supply the vacuum tube plate, screen grid and control grid potentials.

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163. Par. 6-8. D-C excitation for the plate generator is supplied by the bias generator. The bias generator is a self-excited unit and is rated at 250 volts, 0.5 amperes. Actual measured output is 250 volts, 0.532 amperes. However, of the 0.532 ampere load, 0.150 amperes are required for excitation of the bias generator itself, leaving an external load current of 0.382 amperes, which is within the rating of the generator. The plate generator is rated at 750 volts, 1.3 amperes. The measured output is 1.025 amperes at the maximum load condition, which is within the generator rating. No generator overheating was noted during the course of tests.

164. Par. 6-9. The power equipment consists of two units; a 3-horsepower, 440/220-volt, 60-cycle, 3-phase motor, driving a combined main plate and bias generator unit, both mounted on a common bedplate.

165. Par. 6-10. The motor generator equipment, as supplied for a-c, is of the two-unit four-bearing type. Since only an a-c motor was submitted, it was impossible to determine whether a d-c motor could be substituted for the a-c unit without requiring movement of the generators or machining of the base.

166. Par. 6-11. The length of the longest armature assembly used in the equipment is 28-1/8 inches. The specifications allow a maximum length of 36 inches.

167. Par. 6-12. The design of the motor generator involves the use of two single-commutator generator armatures combined on the same shaft and supported within a single frame on two bearings. The field construction is such that individual field control is provided for the output potential of each armature.

168. Par. 6-14. The design of the equipment does not employ two or more generators connected in series with one another.

169. Par. 6-15. The coupling used between machines is of the conventional six-bolt type with a fabric disk-like mid-section. The bolt ends are protected by the overhang of the coupling flanges. The drip guards form complete protection between the motor and generator frames. The coupling is substantial enough to withstand intermittent stresses due to keying and other normal strains, as evidenced by many hours of successful operation during continuous keying.

170. Par. 6-16. The motor and generator are mounted on a fabricated bedplate of substantial construction. The

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bedplate is provided with two pairs of base holes, 1-3/32 inches in diameter, located near the ends of the base, to permit insertion of a rope or cable for lifting the entire assembly. Any individual unit may be removed from the assembly without disturbing the others or moving the bedplate. Each unit is secured to the bedplate by four 3/8" x 16' cap screws. Tapered dowel pins, two per unit at diagonal corners, are used to position the units. The taper of the dowel could not be determined without disassembling the equipment. The dowels are without heads, as required by the governing specifications, and this defect should be remedied. No shims appear to have been used for alignment purposes. The bedplate flanges are drilled with four 17/32-inch holes for bolting the equipment to the deck.

171. Par. 6-17. All motor and generator frames are grounded to the bedplate. The metal cover plates and boxes for terminal blocks are securely mounted and grounded to the frames. Terminal cover plates are not deformed in any way by the application of a 250-pound weight and no damage resulted from this test. Terminal cover plate is held by four No. 10/24 steel screws.

172. Par. 6-18. Each individual unit is provided with a lifting eyebolt. A nameplate is affixed in a prominent place warning against lifting the entire set with the eyebolt. Four 1-3/32-inch holes are provided at the ends of the bedplate for lifting the motor-generator assembly.

173. Par. 6-19. The dimensions of the motor-generator are listed in Table 9. The measured width of 15-1/2 inches is slightly in excess of the specification allowance of 15-1/4 inches, but it is within the specification limit if the terminal cover plate is removed. The limiting dimensions appearing in Table 9 were taken from reference (k). In future equipment the "width" dimension should be modified to conform with the specifications.

174. Par. 6-20. The motor generator is equipped with four ball bearings. The bearings could not be examined without disassembly, so the type of bearing used is not known. End thrust has been taken-up in both directions on each unit.

175. Par. 6-21. Only the generator was equipped with a nameplate specifying the Navy designation of the lubricant to be used. The motor is not similarly equipped. Suitable motor lubrication nameplates should be supplied to comply with the specifications.

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176. Par. 6-22. Only one end of the motor-generator shaft was accessible for examination without a complete disassembly. The shaft end had been stamped with the designations "Radio" and "YE."

177. Par. 6-23. The generator connection box contains fuses to adequately protect the units from short circuit or heavy overloads at points external to the generator. Details of these fuses are given in Table 3. The clearances between any metal part of the fuse holders and the metal terminal cover is at least 3/4 inch in all cases. The effectiveness of the protection was proved by some accidental overloads and short circuits in the transmitter. The fuses successfully opened the circuit in all cases. The inside of the terminal box is lined with a substantial layer of mica to lessen the possibility of flash-over or arc-over.

178. Par. 6-30. Such data as could be obtained without disassembling the equipment, to determine compliance with this paragraph of the specifications, are listed below:

(1) Prime Mover: 440-volt, 60-cycle, 3-phase motor.
(2) Degree of enclosure: Semi-enclosed, drip-proof.
(3) Method of cooling: Self-Ventilated.
(4) Rated voltage: 750/250.
(5) Class of insulation: Class A (According to RCA engineering data)
(6) Kilowatt capacity: 1.10 kw.
(7) Time rating: Continuous duty.
(8) Service application: For use with Radio Transmitters.
(9) Ambient Temperature of Reference: Not given; nameplate indicates a temperature rise of 40°C.
(10) Overload capacity: Not determined.
(11) Bearings: Ball; type unknown.

179. Par. 6-31. The voltage regulation of the generators is indicated in Table 45. In all cases the regulation is within the 5% limit imposed by the specifications. The ripple voltages of the generators are listed in Table 46. It will be noted that the plate generator contains ripple voltages varying from 0.487% to 0.635%, which exceeds the specification limit of 0.25%. However, the total audio ripple on the transmitter carrier was well within the specification limit of 2%; in fact, it was considerably below 1%. Inasmuch as the principle reason for placing a limit on generator ripple is to prevent excessive carrier ripple, and since the carrier ripple now has a reasonably low value, there appears no reason to further reduce the generator ripple. Accordingly, it is suggested that no efforts

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be made to reduce the generator ripple below the value found in the existing Model YE equipment.

180. Par. 6-33. Data on the driving motor which could be obtained without disassembly are shown below:

(1) Ambient temperature of reference: Not stated; a temperature rise of 40°C is indicated on the nameplate.
(2) Class of insulation: Not determined.
(3) Degree of enclosure: Semi-enclosed, drip-proof.
(4) Method of cooling: Natural ventilation.
(5) Speed classification: Constant.
(6) Duty classification: Continuous.
(7) Frequency: 60 cycle.
(8) Voltage: 440/220, 3-phase.
(9) Classification (3-phase): Squirrel cage induction motor.
(10) Sub-classification: unknown.
(11) Type of bearings: Ball.
(12) Rated speed: 1760 r.p.m.
(13) Rated horsepower: 3 h.p.

181. Par. 6-34. The data on the a-c motor starter are listed below:

(1) Ambient temperature of reference: Unknown.
(2) Class of insulation: Unknown.
(3) Degree of enclosure: Protected drip-proof.
(4) Degree of shock-proofness: Successfully withstood vibration and shock tests to which entire equipment was subjected.
(5) Control function: Motor starting.
(6) Type of construction: Magnetic Controller.
(7) Operation of control circuit: Semiautomatic.
(8) Type of Master Switch: Toggle Switch.
(9) Proximity of Master Switch: Distant Master Control.
(10) Duty Period: Heavy starting.
(11) Kinds of protection: Fuse and thermal overload.
(12) Starter dimensions: See Table 9. The Starter dimensions are within the requirements of reference (k).

Note: The starter is not equipped with a hand operated disconnect switch in the main line. A magnetic latch prevents the starter door being opened when

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440 volts are present. However, the latch does not prevent the voltage from being applied when the door is open. For a detailed discussion, see Paragraph 49 of this report.

182. Par. 6-35. The high voltage filters, which consist of capacitors only, are located within the transmitter frame.

183. Par. 6-36. The door of the starter is mounted on hinges with removable pins which are secured against loss by means of short chains. No difficulty was experienced in removing the door.

184. General Comments on Power Equipment.

(1) The motor-generator and motor starter are painted with a blue-gray finish.

(2) The motor and generator are rendered drip-proof by means of cylindrical covers of the frame diameter over the commutators and coupling. The outer ends of the generator and motor are sealed. Ventilation is provided by perforations in the lower quarter segment of the end housings of the machines.

(3) Lubrication fittings have been provided in the form of grease cups.

(4) The bias generator brushes are 3/8" x 5/8" x 1-3/32". Plate generator brushes are 3/8" x 5/8" x 1-1/8".

(5) Both generators have salient field poles.

(6) The bias generator has a commutator 1 inch wide, undercut. Brushes are not staggered.

(7) Plate generator has a commutator 1 inch wide, undercut. Brush track is 19/32-inch wide. Brushes are not staggered.

(8) The generator has a cast frame and welded angle feet. The outer end is in the form of a bell and the inner end is in the form of a spider.

(9) The motor has a cast frame and feet. The outer end is formed by a cast bell, and the inner end is formed by a cast spider.

(10) The motor terminals are flexible leads with lugs. No terminal block is used.

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(11) Phenolic insulation has been used in the brush-holders of the plate generator. In this application, the potential applied (750 volts) exceeds the specification limit of 500 volts for such class of insulation.

SECTION IX (DRAWINGS AND INSTRUCTION BOOKS)

185. The preliminary instruction book furnished with the Model YE Transmitting Equipment was well arranged and contained data and instructions necessary to operate and service the transmitting equipment. However, it lacked photographs of the equipment. Certain discrepancies which were noted in the text of the instruction book are listed below, together with the paragraph concerned.

(a) Par. 3.22. The normal oven temperature is stated as 75°C, whereas the oven operates at a nominal value of 70°C.

(b) Par. 3.31. In this paragraph the blower is designated as B102, while it is shown as B101 on the schematic diagram W303226.

(c) Par. 3.32(b). The blower is referred to as B104, but is shown on the wiring diagram as B102.

(d) Par. 3.33(c). The circuit arrangement is such that only one side of the 115-volt line is broken; not both lines as implied.

(e) Par. 4.37(a). The Motor Starter is not equipped with a disconnect switch as is indicated in the text.

(f) Par. 4.37(b). The relays required for d-c operation should be indicated as has been done for a-c operation.

(g) Par. 4.38(a). The blower B102 does not start in the manner indicated.

(h) Par. 4.38(e). The heater indicator light referred to is shown as I101 on the schematic diagram and as I104 in the instruction book.

(i) Par. 4.39(b). For d-c operation I109 is a blue lamp, and attention should be drawn to this fact.

(j) Par. 4.40(c). Indicator lamp I106 is the red light, not I102 as stated in the text.

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(k) Par. 4.50(10). The designation of Control "H" should be "Second Amplifier," not "Frequency Doubler," in order to agree with transmitter control nameplate designation.

(l) Par. 4.50(12). In referring to controls, there should be used the same designations that appear on the transmitter, such as "Third Amplifier" in place of "IPA."

(m) Par. 4.52. It should be pointed out that the transmitter can be shut down only if the remote control switch is in the "off" position. If this switch is closed, the transmitter cannot be shut down locally.

(n) Par. 4.47(2). Use the expression "Power Amplifier" in place of "Final Amplifier" to agree with the designations appearing on the transmitter controls.

(o) Par. 4.47(2). Indicate whether 0.5 reading is for the modulated or unmodulated condition of the carrier.

(p) On Page 11 use the new Navy type numbers for tubes as listed below.

Old	New
38616	6A6
38807	807
38826	826
38829	829
38955	955

(Note: The "old" type numbers for tubes were in use at the time of award of this contract; but subsequently, a "new" type number system has been adopted. The instruction book should designate tubes with type numbers of the kind in use at the present time.)

Tests Conducted to Determine the Performance of Complete YE Equipment

186. In Paragraph 1(e) of reference (a), the Bureau requested the Naval Research Laboratory to conduct tests to determine the performance of the complete Model YE equipment. There was available at the Laboratory, Antenna Array Equipment No. 2, which was mounted to simulate a shipboard installation with the array well above the surrounding objects. The transmitter was connected to the input terminals of the

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antenna array equipment by a 230-foot twin 7/8-inch coaxial transmission line. The control connections between the Model YE Drive Unit, Type CFI-66018, the Control Unit, Type CFI-23145, and transmitting equipment were made in accordance with Ford Instrument Company's Drawing B-3050. The necessary adjustments to position the center of the radio beam with respect to the automatic keying were made in accordance with the Antenna Instruction Book supplied under Contract NOs-66637. For test purposes, a syncro-generator was connected in the circuit to represent a ship's gyro-compass repeater. The syncro-generator could be manually rotated to any desired angle, thus producing a simulated change in ship's course. In testing the remote control features, the remote control switch, transmitter test key and local start switch were placed in the "off" position before power was applied to the equipment. At the same time, the transmitter plate switch was closed to give full remote control. Then power was applied. Moving the remote control switch to the "Manual" position started the motor generator. After the 45-second time delay period, plate voltage was applied to the transmitter, causing it to emit carrier power. This also started the keying mechanism and array drive, and energized the red "Manual" lamp on the Control Unit. When the array passed an "Over-the-bow" heading, the monitor circuit indicated the transmitter keying on the white "Signal" lamp, operating from a cam switch in the Drive Unit and relay K-104 in the transmitter. The cam switch, which was set to close 15 degrees before the array passed over the bow and open 15 degrees thereafter, is connected in series with the contacts of K-104 so that transmitter keying is indicated only through an arc of 30 degrees. Rotation of the "Ship Course" dial resulted in a corresponding change in array position. Placing the control switch in the "Standby" position energized the yellow "Standby" lamp, stopped the rotation of the array and keying mechanism, and removed the transmitter plate power. The equipment was then in a condition for immediate operation upon moving the control switch to the "Manual" or "Gyro" position. Moving the switch to "Gyro" resulted in the same operation as in "Manual," except that changes in ship's course were followed by the array in accordance with changing the setting of the syncro-generator. The "substitute" gyro repeater (syncro-generator) was rotated, and it was noted that a corresponding displacement of the array resulted. The complete equipment shut down when the control switch was placed in the "OFF" position. All indicating lamps on the control unit were then extinguished. Two interlocks prevent erroneous operation of the control circuits. The control switch is prevented from directly moving into the "Manual" position by a stopping pin which must first be withdrawn before this form of operation can be selected. This is necessary, since Manual

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operation is in the nature of emergency operation and should not be used except on special occasions. An interlock makes it necessary that the ship's course dial be at zero to enter or leave "Manual" position, thus removing any correction introduced by manual operation, and permitting the gyro-repeater to operate from the same reference point at all times. The interlock also unlocks the "Ship Course" operating crank for operation other than "manual" to prevent the introduction of erroneous displacement by accidental movement of the Manual course adjustment. The control circuits performed successfully for numerous tests of from two to six hours' duration over a period of nearly four months.

187. Tests on the complete Model YE equipment were conducted under conditions which simulated a shipboard installation. No quantitative measurement of the power in the antenna array was possible, but relative performance of the equipment was determined by noting the degree of directivity and comparing the relative signal intensities as indicated on a diode detector. The characteristics of this detector are discussed in NRL Report No. R-1755. The meter readings and dial settings of the transmitter for operation through a 230-foot twin line into the antenna array are given in Table 48. During these tests, the twin lines were adjusted so that each had approximately the same length and the antenna array was equipped with an added element over the drive shaft. A discussion of the advantage of this added element will be found in Paragraph 188(a).

188. Further tests were undertaken to determine and improve, if possible, the directive characteristic of the antenna array and to study the effects of varying the length of either of the twin lines.

(a) Tests showed that two undesired lobes were present in the pattern at 90° and 270° relative to the main lobe. This was found to be the case when using array adjustments determined as being the optimum in previous tests using as a power source a test oscillator coupled directly to the input terminals of the antenna array. The ratio of the amplitude of the main lobe to that of either undesired lobe, when using the complete Model YE equipment through a 230-foot twin line was found to be approximately 9 to 1 as measured by a detector having substantially a square law response. Since this ratio was considerably less than had been previously obtained using the test oscillator, numerous adjustments in the length of the array elements were made to increase the ratio, but little improvement resulted. However, a considerable improvement resulted by adding a tuned element directly over the drive

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shaft. This necessitated the readjustment of the length of certain other elements, notably the directors and the antenna. Some readjustment of antenna coupling was also required. The construction and mounting of this element are shown in Enclosure (A), of reference (i); namely, Naval Research Laboratory Sketch 66F326B. The element lengths as readjusted after the addition of the new element, to give optimum performance, and the length of the new element are given in Table 47. The modification resulted in a lobe ratio of 16 to 1. The directive pattern is illustrated in Plate 19. It should be pointed out here that some variation in the lobe ratio was observed from day to day, even though no change of array adjustment had been made. The day to day ratio varied between 17.7 to 1 and 12.5 to 1. On the day that the 248 mc operation was tested, the lobe ratio was 13.5 to 1, as indicated in Paragraph 189. While the ratio did drop to 12.5 to 1, the value of 16 to 1 was repeated several times and was consequently used as most nearly the correct value. The Bureau has already taken steps to have this extra element installed on all Model YE equipments now in use in the Naval Service.

(b) A series of tests were performed in which the length of one of the twin lines was varied, while the length of the other remained fixed. The variations were made in one or two-inch steps, until one side of the line had been shortened by 36 inches. Originally, each of the twin lines were within approximately six inches of being equal in length. Varying the length of one side of the twin line resulted in certain changes in the transmitter and antenna array operation, but had little, if any, effect on the directivity of the array. As the length was varied, the power radiated from the antenna array remained normal until one line was shortened by 24 inches. Thereafter, it gradually decreased to nearly zero as the line was further shortened to 29 inches. After additional shortening, the power output recovered toward normal rapidly and reached normal value when one side of the line was shortened by 33 inches. Radiated power throughout the remainder of the range tested was normal. The transmitter coupling adjustment required to maintain normal loading of the power amplifier went through a cycle as the length of one side of the line was varied. A minimum for the setting of the coupling adjustment was reached when the length of one side was reduced by 10 inches. Further shortening of the one line required increased transmitter coupling, and the coupling limit was reached when the line was shortened by 13 inches. Over the limits from 13 to 20 inches, the coupling required was beyond the range of the transmitter adjustment, and the output fell off slightly in this region. As the length of one line was further shortened, the coupling decreased and finally returned to the original value when the line had been shortened 36 inches.

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A further result of shortening one side of the line was an overloading of the modulator tube, as evidenced by increased modulator plate current and by reduced output (or transmission line) current change when modulation was applied. This condition was most pronounced when one line was shortened by 36 inches. Under this condition, the modulator plate current increased from a normal value of approximately 180 milliamperes to 300 milliamperes. Also the increase in the readings of the transmission line current meters which occurs on application of modulation, and which is normally 20%, fell to a value of 14%, which indicates that the percentage modulation was below normal value. Since the monitor relay K-104 functions from the modulation component of the output, the energization applied to the relay circuit is decreased in proportion. The current reduction was great enough that the relay failed to operate as pointed out in Paragraph 122 above. Equalizing the length of the two lines resulted in normal operation of the equipment. Anticipating the possibility that on shipboard installations the sides of the line may be of different lengths as a result of necessary bends of different radii, a means of compensation was studied. It took the form of a trombone in each side of the line, by which there could be added a length to the shorter side of the line. In the tests conducted, a side of the line was shortened in steps, and the necessary trombone adjustment made for satisfactory operation. It was found, however, that no correspondence between the variation in the side length and the trombone adjustment resulted. In fact, in some cases, the trombone in the longer side of the line had to be increased in length to obtain the desired performance. The trombone adjustment in the main was obtained by a "cut and try" procedure. A relatively short change in trombone adjustment, as compared to variation in line length, was recuired in most cases. As an example, while the one side of the line was shortened by as much as 36 inches, the corresponding change in length of the trombone was approximately 4 inches. It is believed that the same results would have been obtained had length of the short side of the line been increased by "bowing" that side outward in the form of a loop. This means would likely recuire less space than the trombone. The trombone used in these tests was not of a design which afforded gas-tightness; furthermore, a gas-tight trombone would be difficult to construct.

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Test of the Model YE Equipment at 248 Megacycles

189. In Paragraph 6 of reference (a), the Bureau instructed the Laboratory to determine the degree of performance of the complete Model YE equipment at a frequency of 248 mc with the antenna array adjusted as employed for use at 246 mc. A 13777.8 kc crystal was furnished by the Contractor for the purpose of the test. After the transmitter was adjusted to the new frequency, power was applied to the antenna array adjusted for 246 mc. The dial settings and meter readings obtained are listed in the right-hand column of Table 48. No difficulty was experienced in tuning to the new frequency and it was unnecessary to readjust Controls "S," "T" and "U." While no accurate measurement of the change in radiated power could be made, from observation of the diode detector, it is estimated that the field strength was decreased by not more than 10% as compared to that obtained at 246 mc. The lobe ratio was 10.2 to 1 as compared to 13.5 to 1 for 246 mc as measured immediately before the change-over. It is considered that the loss in directivity and power, resulting from operation of the 246 mc array at 248 mc is not sufficient to impair the performance of the equipment at the new frequency and, therefore, it will not be necessary to readjust the antenna array to operate at the higher frequency.

SUMMARY OF DEFECTS

190. A summary of the defects noted in the tests on the Model YE Equipment is given below. Certain of the defects were of such nature as to permit correction at this Laboratory by Laboratory personnel, or by a Contractor's representative. Inasmuch as the YE Equipment under test was not to be returned to the Contractor, but was to be immediately placed in service, the defects were corrected in all cases where feasible before the Equipment was released by this Laboratory. Where corrective measures were applied, this fact is indicated either by the placing of an asterisk prior to the defect, or by a sentence or phrase appended to the defect. The numerals appearing at the end of each statement refer to the paragraph of this report wherein the item is discussed in detail.

(1) *Upon delivery, the inner conductor of one transmission line fitting on the transmitter unit was bent out of alignment, 12, 30.

(2) Nine wire-wound vitreous enamel resistors were not provided with type numbers; seven wire-wound vitreous enamel resistor mountings did not have

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affixed to their symbol marking tags the Navy type number of the pertinent resistor; none of the composition resistor mountings were marked to indicate the type number of the unit or the resistance value; an end cap broke from one "resistor-suppressor" unit during the tests, and this unit was renewed, 33(d), 80.

(3) *In two instances, the engraving filler "flowed" from the engraving indentations during high ambient temperature conditions, 39.

(4) A brush support made of plastic insulation is used in the plate generator at a potential of 750 volts, whereas, the specifications restrict the use of such insulation to applications not exceeding 500 volts, 42, 184(1).

(5) Certain of the fuse mountings are not provided with permanent markings showing voltage and current ratings and the circuit symbol number of the fuse, 45, 46, 79(b); the primary circuit of the distribution transformer has not been provided with adequate fuse protection, 45; no symbol marking tags are used to designate the starter components, and the schematic wiring diagram does not include the circuits of the starter, 79(a); several minor discrepancies occur in symbol markings for the various transmitter components, and furthermore, the marking of components is not consistent with the wiring diagram in a few instances, however, as many of these defects were remedied before the release of the equipment as was feasible, 79(c).

(6) *A copper strap, providing a ground connection to an internal chassis, broke during the vibration tests, 49, 57, 106.

(7) No interlocked 440-volt line disconnect switch has been provided in the starter, 49, 180.

(8) The wax coating "dripped-off" three small fixed condensers during tests at high ambient temperatures, 51.

(9) The vacuum tube employed in the second amplifier stage is overloaded in the event of failure of grid excitation, 52, 54(a); one pair of tubes used in the fourth amplifier stage failed, how-

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ever, this defect was remedied by changing the value of the grid resistor, 54(b); the power amplifier tubes became unstable after a short period of operation, as evidenced by a gradual increase in plate current, but this condition was remedied by using tubes of improved design which were submitted for the purpose by the Contractor, 54(c); during the course of the tests, a broken grid seal occurred in a power amplifier tube, 54(d); the sockets and socket arrangements for the Types 826 and 829 vacuum tubes could possibly be improved, 54(e); connectors used for the plates of the Type 829 tube could likely be improved, 144(4).

(10) The neutralizing condensers are not provided with a stop, permitting their plates to come in contact with one another, thereby short circuiting the plate generator, 55(a), 72.

(11) The plate voltage control does not permit a sufficiently fine adjustment of plate potential, 55(b).

(12) All tuning controls are not located on the front panel; certain of the controls, whose adjustment is effected inside the body of the transmitter, were not provided with a designating letter or a descriptive phrase, but this defect was partially corrected, 60, 61, 99, 124.

(13) The meters for indicating transmission line currents are not adapted to read the currents in each individual line; the nameplates for these instruments are marked "Antenna Current," whereas the specifications require the designation to be "Transmission Line Current;" 64, 155.

(14) No lock washers are used under the heads of machine screws employed for securing meters to the front panel, 65, 94.

(15) At some positions of certain main tuning dials, only one significant figure is visible, 71; the knob of one of the modulating oscillator controls was not pinned to its shaft, and this defect was corrected, 72; one control and its associated dial lock were placed so closely together that operation of the dial lock often caused the control knob to be rotated, and two other dial locks did not

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entirely secure the controls against accidental movement, 129.

(16) Insufficient control was provided by the filament rheostat to permit adjustment of filament voltage to the normal value when supply line voltage was 10% below normal, 78(a), 82, 143; the filament rheostat did not control the filament potential applied to the modulation oscillator tube, 141.

(17) Variation of the supply line voltage by a factor of 10% caused a greater change in the output frequency of the modulation oscillator than had been anticipated, 78(b), 118.

(18) *The Contractor deemed it advisable to replace six fixed mica condensers during the course of the tests, 92.

(19) A misalignment was present which caused breakage of the thermometer upon installation, and this defect was corrected, 110; the variation in temperature of the modulation oscillator compartment during changes in ambient temperature was greater than is ordinarily found in most analogous Naval radio equipment, 113.

(20) The modulation meter did not indicate correctly when operating at plate potentials considerably different from the normal value of 750 volts, 121, 133.

(21) The monitor circuit did not perform its intended function when the physical length of one of the twin lines differed from the other by a certain factor, 122, 188(b).

(22) The modulator calibration chart is located at a point which presents some inconvenience when removing or inserting the cards, 125(a).

(23) No information is provided to indicate the proper connections of the primary windings of the distribution transformer for either of the operating voltages, 141, 142.

(24) The clearance beneath the bottom of the transmitter unit and the deck to which it is secured is slightly less than required by the specifications, 144(3).

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(25) The present design caused some inconvenience in replacing the modulation oscillator tube, 144(4).

(26) The gas admission valves to the 7/8-inch transmission lines could advantageously be made more accessible, 154(b); all transmission line inner conductor connectors provided were of the "solderless" type, but the "solder" type are considered preferable, 154(e); no transmission line anchor joints were provided, and the use of such devices is considered necessary where long vertical runs of the transmission line are required, 154(f).

(27) The holes for mounting the starter box to a bulkhead could be more advantageously placed, 157; the dowel pins used to position the units of the motor generator were of the "headless" type, 170; the overall width of the motor generator slightly exceeded the specification limit, 173; the motor unit was not provided with a lubrication nameplate, 175; the ripple content of the plate generator output exceeded the specification limit, 179.

(28) No photographs were included in the instruction book; several minor errors and discrepancies occurred in the instruction book, 185.

CONCLUSIONS

191. The Model YE Transmitting Equipment, as submitted, is capable of meeting the requirements of the Naval Service. However, a few minor objectionable features were found during the course of the tests, and these have been discussed in detail herein.

192. The frequency stability and accuracy requirements of the governing specifications have been met in all respects, and the power output obtained conforms with specified requirements.

193. The appearance, construction and performance of the equipment are such as to comply for the most part with the usual Navy standards.

194. Inasmuch as the frequency of the carrier is controlled by a crystal, a frequency stability of high order is attained.

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Table 1

Model YE Transmitting Equipment
CHECK OF ESSENTIAL METERS USED IN THE TRANSMITTER
Test as per paragraph 2-2 of Specifications RE 13A 528B

Plate Voltmeter Westinghouse, Type NX-35 (M-118)	True Volts (standard)
392.0	389.0
500.0	500.0
591.0	588.0
690.0	683.0
802.0	808.0

P.A. Plate Ammeter (Total) Westinghouse, Type NX-35 (M-109)	True Current (standard)
100.0 ma.	108.0 ma.
200.0	204.0
250.0	255.0
300.0	303.0
400.0	408.0
500.0	519.0

P.A. Grid Ammeter Westinghouse, Type NX-35 (M-108)	True Current (standard)
10.0 ma.	10.9 ma.
20.0	20.0
30.0	30.6
40.0	40.5
50.0	51.1
60.0	61.8
70.0	73.0
80.0	83.3
90.0	93.2
100.0	105.0
150.0	152.0

(Continued)

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Table 1 (Cont'd)

P.A. Plate Ammeter (Individual) Westinghouse, Type NX-35 (M-110)	True Current (standard)
50.0 ma.	50.2 ma.
100.0	101.0
150.0	148.0
200.0	200.0

P.A. Plate Ammeter (Individual) Westinghouse, Type NX-35 (M-111)	True Current (standard)
50.0 ma.	48.5 ma.
100.0	96.8
150.0	145.0
200.0	194.0

4th Amp. Plate Ammeter Westinghouse, Type NX-35 (M-107)	True Current (standard)
100.0 ma.	103.0 ma.
200.0	200.0
300.0	300.0
400.0	401.0
500.0	501.0

4th Amp. Grid Ammeter Westinghouse, Type NX-35 (M-106)	True Current (standard)
10.0 ma.	10.0 ma.
20.0	19.7
30.0	29.9
40.0	40.0
50.0	49.9
60.0	59.8
70.0	69.8
80.0	79.2
90.0	89.8
100.0	99.7

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Table 1 (Cont'd)

Bias Voltmeter Westinghouse, Type NX-35 (M-117)	True Volts (standard)
335	314
283	270
259	250
214	208
168	160
121	114
90	85
44	40

Filament Voltmeter Westinghouse, Type NA-35 (M-112)	True Volts (standard)
1.00	1.00
2.01	2.00
2.98	3.00
3.95	4.00
4.45	4.50
4.97	5.00
5.50	5.50
6.00	6.00
6.30	6.50
7.00	7.00
7.50	7.50

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(Data obtained at a Plate Voltage of 750)
Test as per Par. 2-2 of Specifications RE 13A 528B

Res. No.	Rated Ohms	Style	Navy Type No.	Permitted by Specs. Watts	Volts	Max. R.	Measured Watts	Volts	Resis.
R-101	27,000	See Note 2		1	-	1 meg.	0.002	7.5	27,600
R-102	400	E	CAO-E	10	350	6,000	0.2	8.5	404
R-103		See Note 4							
R-110	27,000	See Note 2		1	-	1 meg.	0.7	130.	26,000
R-109	27,000	See Note 2		1	-	1 meg.	0.7	131.	26,700
R-106	27,000	See Note 2		1	-	1 meg.	See Note 3		
R-107	600	E	CAO-E	10	350	6,000	2.2	36.8	613
R-108		See Note 4							
R-105	47,000	See Note 2		1	-	1 meg.	0.7	170.	43,800
R-104	47,000	See Note 2		1	-	1 meg.	0.6	167.	42,800
R-111	10,000	See Note 1		1	-	1 meg.	1.0	99.7	9,970
R-112	10,000	See Note 1		1	-	1 meg.	1.0	98.4	9,840
R-113	10,000	See Note 1		1	-	1 meg.	1.0	97.9	9,790
R-114	100	E	63514E	10	350	6,000	0.9	9.3	99.3
R-115	16,000	D	63093E	24	625	18,000	7.3	339.	15,750.
R-116		See Note 4							
R-117	100,000	See Note 2		1	-	1 meg.	0.15	120.	95,900
MR-118	1 megohm	-	CAY63754	-	-	-	Voltmeter Multiplier		
R-120	3,700	See Note 2		1	-	1 meg.	0.7	47.4	3,382
R-122	100	E	63514E	10	350	6,000	0.02	1.3	99.7
R-123	100	E	63514E	10	350	6,000	0.01	1.3	98.5
R-124	12,000	D	63091E	24	625	18,000	8.8	320.	11,620
R-125		See Note 2							
R-126	250	See Note 1		1	-	1 meg.	0.43	12.3	350
R-127	14,000	B	CAO-E	60	1200	50,000	17.6	504.	14,400
R-130	5,000	D	63085E	24	625	18,000	4.8	153.5	4,950
R-131	5,000	D	63085E	24	625	18,000	5.8	169.7	4,984
R-132	Rheostat (see below)								
R-140	125	A	63187E	80	1650	75,000	23.2	53.3	122.5

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Res. No.	Rated Ohms	Style	Navy Type No.	Permitted by Specs. Watts	Volts	Max. R.	Measured Watts	Volts	Resis.
R-141	125	A	63187E	80	1650	75,000	23.5	54.2	124.5
R-142	125	A	63187E	80	1650	75,000	23.7	54.5	125.3
R-143	125	A	63187E	80	1650	75,000	23.2	53.3	122.5
R-144	125	A	63187E	80	1650	75,000	23.2	53.3	122.6
R-149	Oscillator oven heater.		--	--	--	--	303.0	118	46.2
R-159	600	E	CAO-E	10	350	6,000	See Note 3		613.3
R-160	20,000	C	63485E	28	775	25,000	See Note 3		19,270
R-161	20,000	C	63485E	28	775	25,000	See Note 3		19,680
R-162	800	E	CAO-E	10	350	6,000	4.1	57.1	798
R-163	800	E	CAO-E	10	350	6,000	3.9	56.0	807
R-164	10,000	D	63090E	24	625	18,000	0.5	22.5	997
R-165	10,000	D	63090E	24	625	18,000	0.6	24.1	995
R-166	Rheostat (see below).								
R-167	500	E	63278E	10	350	6,000	--	--	496.2
R-170	3,500	E	CAO-E	10	350	6,000	3.4	34.6	3,456
R-171	See Note 4								
R-172	See Note 4								
R-173	See Note 4								
R-174	See Note 4								
R-175	See Note 4								
R-176	See Note 4								
R-177	18,000	D	63049E	24	625	18,000	2.5	210	18,400
R-178	750	D	63510E	24	625	18,000	6.3	69.0	758
R-179	750	D	63510E	24	625	18,000	6.3	68.9	756
R-180	750	D	63510E	24	625	18,000	6.3	68.9	756
R-181	750	D	63510E	24	625	18,000	0.2	11.2	749
R-182	400	E	CAO-E	10	350	6,000	0.6	14.9	402
R-183	400	E	CAO-E	10	350	6,000	0.6	14.9	403
R-184	See Note 4								
R-185	175	B	63127E	60	1200	50,000	6.1	32	169
R-186	600	B	63137E	60	1200	50,000	13.5	90.0	599
R-187	Rheostat (see below).								
R-190	5,000	D	63085E	24	625	18,000	0.5	49.8	4,980

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Res. No.	Rated Ohms	Style	Navy Type No.	Permitted by Specs. Watts	Volts	Max. R.	Measured Watts	Volts	Resis.
R-191	4,000	D	63083E	24	625	18,000	4.8	140	4,130
R-192	Rheostat (see below).								
R-193	5,000	D	63085E	24	625	18,000	2.8	119.2	4,990
R-194	175	B	63127E	60	1,200	50,000	6.1	32.2	169.4
R-195	175	B	63127E	60	1,200	50,000	6.2	32.6	171.4
R-196	620,000	-	—	1	—	1 meg.	0.4	513	630,000
R-197	Rheostat (see below).								
R-198	5,000	E	63015E	10	350	6,000	0.04	14.8	4,930
R-199	Rheostat (see below).								
R-203	13,000	See Note 2		1	—	1 meg.	0.6	86.6	12,550
R-204	47,000	See Note 2		1	—	1 meg.	0.6	158	44,300
R-205	47,000	See Note 2		1	—	1 meg.	0.6	155	43,100
R-206	5,000	D	63085E	24	625	18,000	7.8	197	4,990
R-207	10,000	D	63090E	24	625	18,000	7.2	267	9,940
R-208	820,000	See Note 2		1	—	1 meg.	See Note 3		
R-210	13,000	See Note 2		1	—	1 meg.	0.6	86.5	12,910
R-211	See Note 4								
R-212	See Note 4								

R-132 - Power Amplifier Grid Balancing Potentiometer
Mfr.: Ohmite Mfg. Co.
Type: Model H
Voltage Insulation: 300
Ohms: 1040
Diameter of body: 1-1/2".
Max. Dimension (over lugs): 1-7/8".
Extreme extension behind mounting panel: 1-7/16".

R-166 - Filament Rheostat
Mfr.: Ohmite Mfg. Co.
Type: Model L
(Cont'd on next page)

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Table 2 (Cont'd)

R-166 - (Continued)
Watts: 150
Ohms: 15
Max. Amps.: 3.16
Diameter of body: 4"
Max. Diameter (over studs): 4-3/8"
Extreme extension behind panel: 2-3/4".

R-187 - Bias Rheostat
Mfr.: Ohmite Mfg. Co.
Type: Model K
Voltage Insulation: 300
Ohms: 176
Diameter of body: 2-7/8".
Max. Dimension (over studs): 3-1/2".
Extreme extension behind mounting panel: 1-15/16".

R-192 - Percentage Modulation Rheostat
Mfr.: Ohmite Mfg. Co.
Type: Model L
Watts: 75
Ohms: 7,500
Max. Amps.: 0.1
Diameter of body: 4"
Max. dimension (over studs): 4-3/8".
Extreme extension behind panel: 2-3/4".

R-197 - H.V. Plate Rheostat
Mfr.: Ward Leonard Electric Co.
Type: 12537-62-49 and 12537-69
Watts: 900
Ohms: 10,000
Max. Amps.: .25 - .30
Diameter of body: 6-1/2".
Max. Dimension (over studs): 7-1/8".
Extreme extension behind panel: 6-5/8".

R-199 - Monitor Bias Rheostat
Mfr.: Ohmite Mfg. Co.
Type: Model H
Voltage Insulation: 300
Ohms: 1040
Diameter of body: 1-1/2".
Max. Dimension (over lugs): 1-7/8".
Extreme extension behind mounting panel: 1-7/16".

(Continued)

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Table 2 (Cont'd)

Note 1: Ceramic composition resistor: ferrule end with pigtail. Resistance value indicated by color code and stamped numerals.

Note 2: Carbonated composition: pigtails molded in ends. Resistance value indicated by color code.

Note 3: Inaccessible for measuring. No sign of heating.

Note 4: Parasitic choke. Forms a single unit with suppressor coil. Coil covers resistance color marking.

Note 5: All wire-wound resistors are prefixed by CAO, except R-167 and R-198, which are prefixed by CHD.

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Table 3

Model YE Transmitting Equipment
LIST OF FUSES
Test as per Par. 2-10 of Specifications RE 13A 528B

Low Voltage Fuses

rt o.	Function	Marking	Mfr.	Rating	Measured Current
ıe	Control Line	-	Trico Fuse Mfg. Co.	10A	.2A; 115-v.
ıe	Main Line	-	Trico Fuse Mfg. Co.	15A	2.6A; 440-v.
ıe	Main Line	-	Trico Fuse Mfg. Co.	15A	2.7A; 440-v.
)3	Sec. Cont. Trans.	1022	GE Co.	10A	6.6A; 115-v.
)4	Sec. Cont. Trans.	1022	GE Co.	10A	6.5A; 115-v.
)5	Heater	1022	GE Co.	6A	3.0A; 115-v.
)6	Heater	1022	GE Co.	6A	3.0A; 115-v.

(All the above are 250-volt renewable link fuses.)

High Voltage Fuses

;t o.	Function	Marking	Mfr.	Rating	Measured Current
)1	Bias Gen.		Western Fuse Co.	1A, 250-v.	0.55A; 250-v.
)2	Bias Gen.		Western Fuse Co.	1A, 250-v.	0.41A; 250-v.
)3	Plate Gen.	2018A	Littelfuse Co.	1-1/2A, 1000-v.	1.1A; 750-v.

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Table 4

Model YE Transmitting Equipment
OVEN THERMAL PROTECTION
Test as per Par. 2-10 of Specifications RE 13A 528B

Time	Temp. °C.	Freq. KCS	Thermal Overload Switch
1125	68.9	649.390	Closed
1130	72.5	.378	"
1135	75.0	.355	"
1140	77.3	.355	"
1145	76.6	.323	"
1150	80.5	.300	"
1155	82.6	.280	"
1200	84.5	.268	"
1205	86.0	.251	"
1210	87.0	.241	Open
1215	83.0	.245	"
1218	81.2	.253	Closed

Test made with thermal regulator disconnected.

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Table 5

Model YE Transmitting Equipment
ANTENNA SYSTEM SHORT CIRCUITED,
OPEN CIRCUITED AND GROUNDED.
Test as per Par. 2-16 of Specifications RE 13A 528B

Test Condition	Plate Volts	Plate Current	Antenna Current	Antenna Current
mal	750	250	0.26	0.27
rted	750	*	*	*
t Line Open	750	300	0.40	0.40
ht Line Open	750	290	0.60	0.60
t Line Grounded	750	290	0.22	0.22
ht Line Grounded	750	250	0.30	0.31

*: Excess plate current tripped tube overload relay.
No damage to tubes.

Test conducted at output terminals of transmitter.

Load Condition: Antenna fed through 230 feet of double 7/8" twin concentric line.

Carrier Frequency: 246 Mcs.

Modulation Frequency: 800 kcs.



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Table 6

Model YE Transmitting Equipment
VACUUM TUBE POTENTIALS AND CURRENTS
Test as per Par. 2-17 of Specifications RE 13A 528B

	H.F. Osc.	1st Amp.	2nd Amp.	3rd Amp.	4th Amp. Top	4th Amp. Bot.
d leak bias, d-c volts:	7.5	73.0	278.0	39.0	485	485
ed bias, d-c volts:	-	-	-	-	-	-
hode bias, d-c volts:	11.0	1.4	12.5	35.0	-	-
al bias, d-c volts:	18.5	74.4	290.5	74.0	485	485
een-ground, d-c volts:	120.0	270.0	150.0	155.0	-	-
te-ground, d-c volts:	480.0	480.0	475.0	472.0	755	755
d current, d-c ma.:	0.3	2.7	9.4	10.4	(33 total)	
een current, d-c ma.:	2.7	3.9	20.0	25.3	-	-
te current, d-c ma.:	18.0	41.0	65.0	111.0	(185 total)	

	PA			
	Top Unmod.	Bottom Unmod.	Top Mod.	Bottom Mod.
d leak bias, d-c volts:	194	170	190	169
ed bias, d-c volts:	-	-	-	-
node bias, d-c volts:	-	-	-	-
al bias, d-c volts:	194	170	190	169
een-ground, d-c volts:	-	-	-	-
te-ground, d-c volts:	750	750	750	750
d current, d-c ma.:	35	34	34	33
een current, d-c ma.:	-	-	-	-
te current, d-c ma.:	(250 total)		(230 total)	

(Continued)

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Table 6 (Cont'd)

	Monitor 1st Demodulator		Monitor 2nd Demodulator
	Unmod.	Mod.	
id leak bias, d-c volts:	13.2	17.6	-
eed bias, d-c volts:	-	-	-
node bias, d-c volts:	-	-	14.0
al bias, d-c volts:	13.2	17.6	14.0
een-ground, d-c volts:	-	-	-
te-ground, d-c volts:	95.0	110.0	290.0
id current, d-c ma.:	0.3	0.4	1.1
een current, d-c ma.:	-	-	-
te current, d-c ma.:	7.9	6.6	8.7

	Mod. Osc.	Modulator (3 tubes)		Modulator Rectifier
		Unmod.	Mod.	
id leak bias, d-c volts:	70.0	-	39.8	-
eed bias, d-c volts:	-	240	30.3	-
node bias, d-c volts:	-	-	-	-
al bias, d-c volts:	70.0	240	70.1	-
een-ground, d-c volts:	225.0	315	200.0	-
te-ground, d-c volts:	480.0	750	610.0	490.0
id current, d-c ma.:	1.8	0	13.0	-
een current, d-c ma.:	2.5	0	14.0	-
te current, d-c ma.:	23.5	0	275.0	0.8

[redacted]

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Table 7

Model YE Transmitting Equipment
LIST OF CONTROLS AND METERS
Data as per paragraph 2-23 of Specifications RE 13A 528B

trol ter	Control Marking	Dial Marking	Direction of Rotation
A	Osc. Range	5 points	clockwise
B	Oscillator Tuning	0-2500	clockwise
C	Osc. Plate Tuning	0-100	clockwise
D	Mod. Plate Tuning	0-100	clockwise
E	Osc. Plate Tuning H.F.	0-100	clockwise
F	1st Amp. Plate Tuning	0-100	clockwise
G	2nd Amp. Grid Tuning	0-100	clockwise
H	2nd Amp. Plate Tuning	0-100	clockwise
J	3rd Amp. Grid Tuning	0-100	clockwise
K	3rd Amp. Plate Tuning	0-100	clockwise
L	4th Amp. Grid Tuning	0-100	clockwise
M	4th Amp. Plate Tuning	0-2000	clockwise
N	P.A. Grid Tuning	0-2000	clockwise
P	P.A. Plate Tuning	0-1913	clockwise
Q	Antenna Coupling	0-2000	clockwise
R	Neut. Adjust.	None	-
S*	None	0-12	Slides left to right
T*	None	0-8	Slides right to left
U*	None	0-7	Slides back to front

ese controls are shorting bars; S across the 4th Amplifier Plate ing Frame, T across P.A. Grid Tuning Frame and U across P.A. Plate ing Frame. These controls are accessible only by removing cover tes, which are held in place by R.H. screws.

trols E to Q, inclusive, are recessed in the front panel and are ered by a 6-1/4" by 23-1/2" door. Adjustment of these controls is e with a Tuning Screwdriver.

trol R is located within the transmitter, adjustable through the e door perforations with a neutralizing screwdriver.

t Key: Toggle-Type
Down: Momentary contact
Horizontal: Off
Up: On

(Continued)

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Table 7 (Cont'd)

al Start Switch: Toggle Type
Down: Off
Up: On

te Switch: Toggle Type
Down: Off
Up: On

rgency Switch: Push Button Type
Top button, black in red circle: Stop,
Bottom button, white: On.

ament Voltage Rheostat - increases clockwise.
centage Modulation Rheostat - increases clockwise.
te Voltage Rheostat - increases clockwise.
illator Calibration - oil cup cover, screw lock beneath.
quency Meter Audio Output Jack.
ing Relay - has metal cover with non-breakable watch
glass window.
ament Indicator Light - clear.
ter Start Indicator Light - blue.
illator Heater Indicator Light - amber.
illator Filament Indicator Light - clear.
s Voltage Indicator Light - green.
te Voltage Indicator Light - red.
rload Relay Indicator Light - amber.
iter Modulator Overload Relay Reset Button - Red target indication.
er Amplifier Overload Relay Reset Button - Red target indication.
ılator Calibration Chart
ısmitter Calibration Chart - on rear of tuning compartment door.
tralizing Screwdriver - stowed on clips on rear of tuning
compartment door.
ing Screwdriver - stowed on clips on rear of tuning compartment
loor. Used to adjust dials E to Q, inclusive.

ers

l of Westinghouse manufacture with anti-glare glass.)

(Continued)

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Table 7 (Cont'd)

Nameplate Marking	Range	Type	Serial No.
ament Voltage	0-7.5-v a-c	NA-35	none
te Voltage	*0-1000-v d-c	NX-35	none
Osc. Screen Current	0-10 ma. d-c	NX-35	none
Osc. Plate Current	0-100 ma. d-c	NX-35	none
ulator Grid Current	0-25 ma. d-c	NX-35	none
ulator Plate Current	0-500 ma. d-c	NX-35	none
ulation Percentage	0-100 per cent	NX-35	none
s Voltage	*0-400-v d-c	NX-35	none
Osc. Plate Current	0-100 ma. d-c	NX-35	none
Amp. Plate Current	0-100 ma. d-c	NX-35	none
Amp. Plate Current	0-200 ma. d-c	NX-35	none
Amp. Grid Current	0-25 ma. d-c	NX-35	none
Amp. Plate Current	0-300 ma. d-c	NX-35	none
Amp. Grid Current	0-100 ma. d-c	NX-35	none
Amp. Plate Current	0-500 ma. d-c	NX-35	none
. Grid Current	0-150 ma. d-c	NX-35	none
. Plate Current	0-500 ma. d-c	NX-35	none
enna Current	0-1 amp. r-f	NX-35	none
enna Current	0-1 amp. r-f	NX-35	none
. Plate Current	0-200 ma. d-c	NX-35	none
. Plate Current	0-200 ma. d-c	NX-35	none

00 ohms per volt.

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Table 8

Model YE Transmitting Equipment
NAMEPLATE DATA
Data as per paragraph 2-26 of Specifications RE 13A 528B

Transmitter Unit

1. (Size: 3" wide; 2" high)

Transmitter
Type CRV - 52135
Frequency Range 200 to 250 mcs.
Supply: 440/3/60
Weight 850 lbs. Serial 3
A unit of Model YE Equipment
Manufactured for
Navy Department - Bu. of Ships
by
RCA Manufacturing Co., Inc.
Camden, N.J., U.S.A.
Contract No. 69090 Contract Date: 31 Oct. 1939

2. (Size: 4" wide; 4-1/2" high)

Homing Beacon Equipment
Model YE Serial 6
Frequency Range: 200 to 250 mcs.
Supply: 440 volts - 60 cycles
Output: 50-W (A2) Supply 440/3/60

Equipment Consists of Following Units:
RCA Manufacturing Co., Inc.
CRV-52135 Radio Transmitter
CC-21435 Motor Generator
CAE-21440 Magnetic Controller
--- Ford Instrument Co. ---
CFI-23145 Control Unit
CFI-66018 Antenna and Drive Unit

(Continued)

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Table 8 (Cont'd)

See License Notice Inside
Navy Department
Bureau of Ships
Contractors
RCA Manufacturing Co., Inc.
Camden, N.J., U.S.A.
Contract NOs-69090 Contract Date: 31 Oct. 1939

---Ford Instrument Co.---
Long Island City, New York, U.S.A.
Contract NOs-66637 Contract Date: 12 May 1939.

Motor Generator Unit

3. (Size: 3-1/8" wide; 2-3/8" high)

CC21437
Type N225X H.P. 3
Volts 220-440 Amps. 8-4 R.P.M. 1760
Cycles 60 Phase 3
Cont. Duty 40°C. Serial No. 80722
Contr. NOs-69090 Bu. RNV. Eng.
Date 1940
Continental Electric Co., Inc.
Newark, N. J., U.S.A.

4. (Size: 1-1/2" wide; 1" high)

This eyebolt must not be used when hoisting the entire motor generator set. Use only for hoisting this individual unit.
(Above on motor)

(Continued)

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Table 8 (Cont'd)

5. (Size: 3-1/8" wide; 1-3/4" high)

Motor Generator Set CC-21435
Motor Type CC-21437
Generator Type CC-21438
Power Supply 220/440-volt 3 PH 60 cycles A-C
Weight: 475 Lbs. Serial 3
A Unit of Model YE Homing Beacon Equipment
Manufactured For
Navy Department Bureau of Engineering
By
Continental Electric Company
Newark, N. J., U.S.A.
Contract NOs-69090 Contract Date: 31 Oct. 1939

(Above on Bedplate)

6. (Size: 1-3/4" wide; 1-1/4" high)

3-phase connections

Low V Line			High V Line		
1	2	3	1	2	3
4	5	6	4	5	6
7	8	9	7	8	9

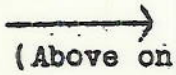
(Above on motor)

7. (Size: 3-1/8" wide; 2-3/8" high)

CC-21438
Type D224P
Volts: 750-250. Amps.: 1,3-.5 R.P.M. 1760
WDG. CPD.
Cont. Duty 40°C. Serial No. 80714
Contr. NOs-69090 Bu. RNV. Eng.
Date 1940
Continental Electric Co., Inc.
Newark, N.J., U.S.A.

8. (Size: 2-1/2" wide; 3/4" high)

Rotation



(Above on generator)

(Continued)

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Table 8 (Cont'd)

9. (Size: 1-1/2" wide; 1" high)

This eyebolt must not be used
when hoisting the entire
motor generator set. Use
only for hoisting this
individual unit.
(Above on generator)

10. (Size: 1-1/2" wide; 1" high)

For Lubrication
use
Navy Grade A
Grease
(Above on end of generator)

11. (Size: 2" wide; 1" high)

ND Spec. 14L3
(Above on end of generator)

Starter Unit

12. (Size: 2-1/2" wide; 1-1/2" high)

Cutler - Hammer
Motor Control
C-H
(Above on Outside Cover)

13. (Size: 3" wide; 1-15/16" high)

No. B492093B3	3 H.P.
Duty Stg.	440-V.
Type Mag.	4.3-A.
C.O. NOs 69090	Yr. 1940
Spec. 17C10 and RCA	Bu. Eng.
U.S.S.	3 PH.

Aux. Motor-Generator
Cutler-Hammer
New York Inc. Milwaukee

(Above inside Starter Box)

(Continued)

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Table 8 (Cont'd)

14. (Size: 3" wide; 2" high)

Magnetic Controller
Type CAE-21440 Duty Stg.
H.P. 3 440 Volts A.C. 4.3-A.
Control Volts 115 Volts A.C.
Weight: 34 Lbs. Serial 3
A Unit of Model YE Radio Equipment
Cont. NOs 69090 of 31 October 1939
Manufactured For
Navy Department Bureau of Ships
By
Cutler-Hammer, Inc., Milwaukee, Wis.

(Above inside Starter Box)

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Table 9

Model YE Transmitting Equipment
LIST OF DIMENSIONS AND WEIGHTS
as per Par. 2-32; 2-33; 3-29; 6-19; 6-34-12 of Spec. RE 13A 528B

Transmitter Unit	Measured	Specifications
Height:	71-3/8"*	72"
Width:	31-1/4"	32"
Depth:	23-1/8"	24"
Weight (with tubes):	840 lbs.	

*Transmission line termination protrudes 1-1/2" above top of transmitter.

Motor Generator	Measured	Specifieations
Length:	43"	44"
Height:	14-1/2"	14-1/2"
Width:	15-1/2"**	15-1/4"
Weight:	460 lbs.	

**Outside the specification limits with the cover on the generator terminal box.

Starter Unit	Measured	Specifications
Height:	13-1/2"	14"
Width:	13-5/16"	13-1/2"
Depth:	9"	9-7/8"
Weight:	34-1/2 lbs.	

Total weight of equipment: 1334-1/2 lbs.

Specification limit: 1500 lbs.

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Table 10

Model YE Transmitting Equipment
DETERMINATION OF POWER OUTPUT WITHOUT TRANSMISSION LINE
Test as per Paragraph 3-1 of Specifications RE 13A 528B

Control or Meter	Carrier Freq. 246 Mcs. Modulation Freq. 550 Kcs.	Carrier Freq. 246 Mcs. Modulation Freq. 800 Kcs.	Carrier Freq. 225 Mcs. Modulation Freq. 550 Kcs.	Carrier Freq. 225 Mcs. Modulation Freq. 800 Kcs.
A	1	5	1	5
B	1178	1069	1178	1069
C	20	72	20	72
D	16	73	16	73
E	75	75	59	59
F	50	50	30	30
G	80	80	69	69
H	61	61	41.5	41.5
J	75	75	43	43
K	69	69	50	50
L	93	93	75	75
M	484	484	1009	1009
N	1453	1453	1008	1008
P	1020	1020	561	561
Q	758	758	675	675
R	-	-	-	-
S	10	10	6.6	6.6
T	7.1	7.1	5.5	5.5
U	3.8	3.8	0.5	0.5
Osc. I_{sg} (ma.)	2.0	2.1	2.3	2.5
Osc. I_p (ma.)	28.5	23	33	34
I_g (ma.)	7	10	14	14
I_p (ma.)	195	185	185	190
Osc. I_p (ma.)	16	16	16	17
Amp. I_p (ma.)	42	42	48	48
Amp. I_p (ma.)	68	68	60	59
Amp. I_g (ma.)	11.2	11.2	11	11
Amp. I_p (ma.)	187	187	*90	*91
Amp. I_g (ma.)	55	55	*20	*20
Amp. I_p (ma.)	230	230	*150	*152
I_g (ma.)	67	67	60	60
I_p (ma.)	250	250	250	250
I_1 (amps.)	0.40	0.40	0.44	0.45
I_2 (amps.)	0.41	0.41	0.43	0.44
I_p-1 (ma.)	165	165	166	167
I_p-2 (ma.)	165	165	168	168

(Continued)

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Table 10 (Cont'd)

Control or Meter	Carrier Freq. 246 Mcs. Modulation Freq. 550 Kcs.	Carrier Freq. 246 Mcs. Modulation Freq. 800 Kcs.	Carrier Freq. 225 Mcs. Modulation Freq. 550 Kcs.	Carrier Freq. 225 Mcs. Modulation Freq. 800 Kcs.
, Volts	6.5	6.5	6.5	6.5
s Volts	250	250	250	250
Cent Modulation	80	80	80	80
te Volts	750	750	750	750
, Watts Output	110	110	113	112
od. Watts Output	88	88	90.5	89.6
ts Required	--	--	--	--

oupling between 3rd and 4th Amplifier reduced by mfr.

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Table 11

Model YE Transmitting Equipment
ERMINATION OF POWER OUTPUT THROUGH 230-FOOT DOUBLE TRANSMISSION LINE
Test as per Par. 3-1 of Specifications RE 13A 528B

Control or Meter	Carrier Freq. 246 Mcs. Modulation Freq. 550 Kcs.	800 Kcs.
A	1	5
B	1168	1058
C	18	72
D	16	63
E	75	75
F	50	50
G	81	81
H	61	61
J	75	75
K	69	69
L	94	94
M	516	516
N	851	851
P	1550	1550
Q	1097	1097
R	--	--
S	10	10
T	7.1	7.1
U	3.8	3.8
. Osc. I_{sg} (ma.)	1.95	2.2
. Osc. I_p (ma.)	31.0	24.0
. I_g (ma.)	11.8	10.4
. I_p (ma.)	178.0	167.0
. Osc. I_p (ma.)	15.5	15.5
Amp. I_p (ma.)	44.0	44.0
Amp. I_p (ma.)	67.0	67.0
Amp. I_g (ma.)	14.2	14.4
Amp. I_p (ma.)	120.0	122.0
Amp. I_g (ma.)	34.5	35.0
Amp. I_p (ma.)	198.0	198.0
. I_g (ma.)	66.0	65.5
. I_p (ma.)	250.0	252.0
. I_1 (amps.)	0.35	0.36
. I_2 (amps.)	0.36	0.36
. I_p-1 (ma.)	172.0	172.0
. I_p-2 (ma.)	175.0	175.0

(Continued)

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Table 11 (Cont'd)

Control or Meter	Carrier Freq. 246 Mcs. Modulation Freq. 550 Kcs.	800 Kcs.
Volts	6.5	6.5
; Volts	250.0	250.0
Cent Mod.	80.0	80.0
;e Volts	750.0	750.0
Watts Output	60.5	61.5
)d. Watts Output	54.0	54.0
)d. Watts Required	50.0	50.0

Power Loss in 230-foot Line

Modulated: 2.5 DB; 44.5%
Unmodulated: 2.1 DB; 38.6%

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Table 12

Model YE Transmitting Equipment
EFFECT OF OVEN TEMPERATURE CHANGE ON MODULATION FREQUENCY
Test as per Par. 3-7 of Specifications RE 13A 528B

Time	Oven Temp. Degrees C.	Modulation Frequency Kcs.
0800	20.5	650.810
0810	37.4	.645
0820	43.0	.582
0830	49.9	.505
0840	56.1	.415
0850	60.5	.305
0900	65.8	.230
0910	67.3	.186
0920	68.0	.170
0930	*68.4	.155
0940	68.6	.147
0950	68.7	.142
1000	68.9	.139
1010	69.0	.139
1020	69.0	.138

*Thermostat began to regulate.

Total frequency drift during warm-up period: 672 cycles; 0.103%.

Heating Time: 2 hrs. 10 min.

Specification Allowance: 3 hrs.

Note: Thermometer used for this test had long exposed scale.

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Table 13

Model YE Transmitting Equipment
LOCKED KEY OPERATION FOR TWO HOURS
Test as per Par. 3-6-1 and 3-7-1 of Specifications RE 13A 528B

e	Amb. Temp.	Oven Temp.	Carrier Freq. Mcs.	Modulator Freq. Kcs.	Plate Volts	% Mod.	Mod. Watts Output
0	21.5	68.5	224.991342	550.747	670	74	99.0
0	21.5	68.8	224.990280	550.745	670	74	96.5
0	21.5	69.0	224.990010	550.742	665	74	94.7
0	21.6	69.0	224.989794	550.745	665	74	93.0
0	21.8	69.0	224.989740	500.742	662	74	92.0
0	22.0	69.0	224.989632	500.741	661	74	91.0
0	22.0	69.0	224.989560	500.742	661	74	90.5
0	21.8	69.1	224.989470	500.742	661	74	90.5
0	22.0	69.1	224.989434	500.743	660	74	90.5
0	22.4	69.2	224.989398	500.740	660	74	90.5
0	22.1	69.1	224.989362	500.740	661	74	90.5
0	22.0	69.1	224.989488	500.740	661	74	90.0
0	21.9	69.1	224.989344	500.740	661	74	90.0

imum carrier frequency change: 1998 cycles; 0.00089%.

imum modulation frequency change: 7 cycles; 0.0013%.

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Table 14

Model YE Transmitting Equipment
LOCKED KEY OPERATION FOR TWO HOURS
Test as per Par. 3-6-1 and 3-7-1 of Specifications RE 13A 528B

e	Amb. Temp.	Oven Temp.	Carrier Freq. Mcs.	Modulator Freq. Kcs.	Plate Volts	% Mod.	Mod. Watts Output
)	22.4	68.8	224.991324	800.725	661	75	95.0
)	22.6	69.0	224.989776	800.712	661	74	92.5
)	22.9	69.0	224.989632	800.710	661	74	92.5
)	22.6	69.1	224.989470	800.708	661	74	92.0
)	22.4	69.1	224.989398	800.705	661	74	91.5
)	22.2	69.1	224.989398	800.704	661	74	90.5
)	22.1	69.2	224.989380	800.701	661	74	90.5
)	22.5	69.2	224.989290	800.700	661	74	90.5
)	23.1	69.2	224.989218	800.700	661	74	90.5
)	23.1	69.2	224.989200	800.700	661	74	90.5
)	22.8	69.2	224.989200	800.697	661	74	90.5
)	22.5	69.2	224.989218	800.697	661	74	90.0
)	22.2	69.2	224.989380	800.700	661	74	90.0

lmum carrier frequency change: 2124 cycles; 0.000945%.

lmum modulation frequency change: 28 cycles; 0.0035%.

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Table 15

Model YE Transmitting Equipment
CHANGE OF TUBES
(H.F. Oscillator Circuit)
Test as per Par. 3-6-2 of Specifications RE 13A 528B

ıbe Jo.	Tube Mfr.	Carrier Frequency Mcs.	Deviation from Original Freq. Cycles	Per Cent
ginal	RCA	224.987940		
	RCA	.986950	990	0.00044
	GE	.988516	576	0.000256
	GE	.987220	720	0.000320
	RCA	.987130	810	0.000360
	RCA	.987922	18	0.000008
ginal	RCA	.987940		
.mum deviation from original frequency:			990	0.00044%

ıbe Jo.	Tube Mfr.	Carrier Frequency Mcs.	Deviation from Mean Freq. Cycles	Per Cent
ginal	RCA	224.987940	327	0.000145
	RCA	.986950	663	0.000294
	GE	.988516	903	0.000402
	GE	.987220	393	0.000175
	RCA	.987130	483	0.000215
	RCA	.987922	309	0.000137
	Mean:	224.987613	513	0.000228

e tests were conducted at a plate voltage of 670 volts.

[redacted]

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Table 16

Model YE Transmitting Equipment
CHANGE OF TUBES
(Low Frequency Oscillator Circuit)
Test as per Par. 3-7-2 of Specifications RE 13A 528B

ıbe No.	Tube Mfr.	Frequency Kcs.	Deviation from Original Freq. Cycles	Per Cent
ginal	RCA	550.619		
L	RCA	.600	19	0.00345
2	GE	.630	11	0.00200
3	GE	.638	19	0.00345
4	RCA	.665	46	0.00835
5	RCA	.690	71	0.01290
ginal	RCA	.619		
imum deviation from original frequency:			71	0.01290

ginal	RCA	800.440		
L	RCA	.472	32	0.00400
2	GE	.474	34	0.00425
3	GE	.490	50	0.00625
4	RCA	.535	95	0.01188
5	RCA	.527	87	0.01088
ginal	RCA	.440		
imum deviation from original frequency:			95	0.01188

(Continued)

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Table 16 (Cont'd)

ıbe o.	Tube Mfr.	Frequency Kcs.	Deviation from Mean Freq. Cycles	Per Cent
;inal	RCA	550.619	21	0.00382
	RCA	.600	40	0.00727
	GE	.630	10	0.00182
	GE	.638	2	0.00036
	RCA	.665	25	0.00455
	RCA	.690	50	0.00910
	Mean:	550.640	24.6	0.00448

be o.	Tube Mfr.	Frequency Kcs.	Deviation from Mean Freq. Cycles	Per Cent
inal	RCA	800.440	49	0.00612
	RCA	.472	17	0.00212
	GE	.474	15	0.00187
	GE	.490	1	0.00012
	RCA	.535	46	0.00575
	RCA	.527	38	0.00475
	Mean:	800.489	27.6	0.00345

e tests were conducted at plate voltage of 670 volts.

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Table 17

Model YE Transmitting Equipment
VARIATIONS IN AMBIENT TEMPERATURE
Test as per Par. 3-6-3 and 3-7-3 of Specifications RE 13A 528B

Amb. Temp.	Oven Temp.	Rel. Humid.	Carrier Frequency Mcs.	Modulation Frequency Kcs.	P.A. E_p	P.A. I_p	Mod. Watts Out	Line Volts
49.5	71.5	33.5	224.983764	550.635	670	222	83.5	450
51.0	71.0	28.0	.984340	.630	670	220	83.5	447
50.5	71.5	34.0	.983620	.628	665	220	81.5	445
50.2	71.5	32.0	.983512	.625	660	220	81.0	448
49.5	71.5	33.5	.983458	.620	660	218	80.5	444
40.2	70.5	33.5	.984988	.622	660	220	82.5	447
39.5	70.5	32.5	.985510	.624	660	220	83.5	447
40.2	70.5	31.5	.985600	.621	660	220	84.3	444
39.0	70.5	34.0	.985618	.622	660	220	84.3	444
40.2	70.5	31.5	.985744	.622	660	220	84.9	444
31.2	70.0	35.5	.986320	.621	660	221	87.5	442
29.0	67.5	26.0	.986824	.625	665	223	91.0	440
29.0	69.5	35.0	.986824	.635	670	223	91.0	446
*21.5	68.6	41.0	.987274	.638	670	224	94.0	446
29.5	69.0	35.0	.986878	.640	670	222	93.0	445
21.0	68.2	33.0	.987724	.640	675	226	95.0	446
17.5	68.5	34.0	.987796	.646	675	228	96.0	448
19.0	68.2	36.0	.987904	.650	675	228	96.5	448
19.2	68.2	36.0	.987958	.648	680	229	96.5	446
19.0	68.2	30.0	.987904	.649	680	229	96.5	446
9.5	67.6	36.0	.988588	.650	685	231	100.0	444
10.0	67.2	38.0	.988696	.655	685	232	100.5	448
9.7	67.1	36.0	.988786	.660	695	233	101.2	445
9.5	67.1	36.0	.988750	.659	685	233	100.5	445
10.2	67.1	38.0	.988822	.664	690	233	101.8	452
+.2	66.5	-	.989326	.667	695	238	104.0	450
0.0	66.1	-	.989416	.670	700	240	105.1	455
+.8	66.1	-	.989434	.675	700	240	105.1	458
.8	66.0	-	.989560	.675	700	240	105.1	456
.8	66.0	-	.989380	.675	700	240	105.1	456

*eam pressure dropped.

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Table 17 (Cont'd)

SUMMARY

›erature Change Degrees C.	Carrier Cycles Change per 10 Degrees C.	Per Cent Change per 1 Degree C.
50 - 40	2286	0.000101
40 - 30	1134	0.0000504
30 - 20	1026	0.0000456
20 - 10	918	0.0000408
10 - 0	558	0.0000248

›erature Change Degrees C.	Carrier Cycles Change Total	Per Cent Change Total
50 - 0	5922	0.00263

›erature Change Degrees C.	Modulation Cycles Change per 10 Degrees C.	Per Cent Change per 1 Degree C.
50 - 40	2	0.000036
40 - 30	18	0.000327
30 - 20	9	0.000163
20 - 10	15	0.000272
10 - 0	11	0.000200

erature Change Degrees C.	Modulation Cycles Change Total	Per Cent Change Total
50 - 0	55	0.0100

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Table 18

Model YE Transmitting Equipment
VARIATIONS IN AMBIENT TEMPERATURE
Test as per Par. 3-6-3 and 3-7-3 of Specifications RE 13A 528B

Amb. Temp.	Oven Temp.	Rel. Humid.	Carrier Frequency Mcs.	Modulation Frequency Kcs.	P.A. E_p	P.A. I_p	Mod. Watts Out.	Line Volts
50.0	71.1	28.5	224.983890	800.710	655	220	85.2	446
50.0	71.3	28.5	.983836	.702	680	230	90.4	447
49.0	71.3	31.0	.983800	.700	680	228	90.4	448
50.0	71.3	29.0	.983890	.695	680	229	90.4	447
49.5	71.3	30.0	.983944	.700	680	229	90.0	452
40.5	70.5	33.5	.985204	.695	680	229	92.5	448
39.5	70.3	35.0	.985762	.695	680	230	93.5	448
40.2	70.3	31.5	.986050	.695	685	230	93.5	445
40.0	70.3	31.5	.985870	.692	685	231	98.0	445
40.0	70.3	31.5	.985924	.689	685	231	98.0	445
29.5	70.3	41.0	.986374	.689	685	232	97.0	449
29.5	69.0	32.5	.986680	.701	690	232	98.5	449
30.2	69.5	31.0	.986752	.710	695	234	99.0	452
29.2	69.3	32.5	.986824	.715	695	235	100.0	456
29.2	69.3	28.0	.986806	.713	695	235	100.0	452
20.5	68.6	35.0	.987058	.712	699	236	102.0	452
19.5	68.5	37.0	.987400	.717	700	237	104.5	452
19.2	68.5	33.0	.987634	.718	700	238	105.0	445
19.0	68.2	34.5	.987688	.721	700	240	105.0	452
19.2	68.3	34.5	.987634	.720	700	240	105.5	452
9.5	67.5	42.0	.988174	.722	705	241	108.0	450
10.0	67.5	38.0	.988480	.729	710	242	109.5	453
9.5	67.3	42.0	.988570	.732	715	244	110.5	454
11.0	67.3	35.0	.988642	.732	715	242	109.5	450
10.5	67.2	39.0	.988480	.736	715	245	110.5	455
0.5	66.6	-	.988840	.728	715	245	111.0	448
0.8	66.5	-	.989164	.740	720	248	112.5	448
0.5	66.5	-	.989200	.741	720	250	113.5	452
0.5	66.0	-	.989542	.748	725	251	115.0	452
0.5	66.0	-	.989398	.748	725	251	115.0	452

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Table 18 (Cont'd)

SUMMARY

erature Change Degrees C.	Carrier Cycles Change per 10 Degrees C.	Per Cent Change per 1 Degree C.
50 - 40	1980	0.000088
40 - 30	882	0.000039
30 - 20	828	0.000037
20 - 10	846	0.000038
10 - 0	918	0.000041

erature Change Degrees C.	Carrier Cycles Change Total	Per Cent Change Total
50 - 0	5454	0.00242

erature Change Degrees C.	Modulation Cycles Change per 10 Degrees C.	Per Cent Change per 1 Degree C.
50 - 40	11	0.000137
40 - 30	24	0.000300
30 - 20	7	0.000087
20 - 10	16	0.000200
10 - 0	12	0.000150

erature Change Total	Modulation Cycles Change Total	Per Cent Change Total
50 - 0	70	0.00875

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Table 19

Model YE Transmitting Equipment
VARIATIONS IN HUMIDITY
Test as per Par. 3-6-4 and 3-7-4 of Specifications RE 13A 528B

Amb. Temp.	Rel. Humid.	Carrier Frequency Mcs.	Modulation Frequency Kcs.	P.A. E_p	P.A. I_p	Mod. Watts Out	Line Volts
39.5	31.0	224.988786	550.651	758	252	115.5	450
40.0	29.0	.988750	.652	755	251	115.5	453
39.5	31.0	.988804	.650	755	251	114.5	451
40.0	83.0	.988480	.651	755	252	114.5	455
40.0	96.0	.988210	.642	760	251	113.0	450
40.0	97.0	.988030	.638	760	251	113.5	451
41.0	97.0	.987940	.631	760	252	113.5	451
41.0	100.0	.987940	.629	760	252	113.5	450
41.0	97.0	.987940	.622	760	252	113.5	450
39.0	68.0	.988030	.621	760	252	113.5	451
38.2	44.0	.988984	.625	755	252	115.5	454
40.0	37.0	.989218	.627	755	252	115.5	451
40.0	35.0	.988984	.625	740	245	109.0	451
39.5	33.0	.989020	.623	740	245	109.0	448
39.5	32.0	.989020	.630	755	251	113.5	450
39.5	32.0	.989020	.630	755	252	114.0	448
40.0	31.5	.988984	.632	755	252	113.5	451
39.8	31.0	.989020	.632	750	250	113.5	450
39.5	29.0	.989020	.635	755	251	114.0	450
40.0	29.0	.989200	.635	755	251	114.7	452
40.0	29.0	.989200	.638	755	251	115.0	455

ier frequency at end of first test period: 224.988804 mcs.
ier frequency of greatest subsecuent change: 224.987940 mcs.
mum frequency change: 864 cycles; 0.000384%.

lation frequency at end of first test period: 550.650 kcs.
lation frequency of greatest subsequent change: 550.622 kcs.
mum frequency change: 28 cycles; 0.00508%.

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Table 20

Model YE Transmitting Equipment
VARIATIONS IN HUMIDITY
Test as per Par. 3-6-4 and 3-7-4 of Specifications RE 13A 528B

Amb. Temp.	Rel. Humid.	Carrier Frequency Mcs.	Modulation Frequency Kcs.	P.A. E_p	P.A. I_p	Mod. Watts Out	Line Volts
39.3	29	224.988822	800.612	755	250	115.0	444.0
39.5	29	.988840	.615	750	249	114.0	451.0
40.0	29	.988804	.612	750	249	113.5	448.0
40.0	93	.988570	.612	750	248	112.5	448.0
40.0	95	.988336	.600	750	249	112.5	448.0
40.0	95	.988300	.599	750	249	112.5	448.0
40.0	97	.988282	.582	750	248	112.5	444.0
40.2	97	.988300	.578	750	249	113.0	444.0
40.0	97	.988264	.582	750	249	112.5	449.0
39.7	58	.988480	.575	750	250	113.5	448.0
41.0	46	.988804	.585	750	249	114.0	450.0
39.5	35	.988804	.589	750	248	113.5	450.0
39.5	31	.988930	.582	750	248	114.0	444.0
39.7	30	.988984	.590	750	248	114.0	440.0
40.0	30	.989020	.584	750	248	113.5	441.0
39.5	30	.989020	.584	750	248	113.5	440.5
39.5	30	.989056	.589	750	249	113.5	444.0

ier frequency at end of first test period: 224.988804 mcs.
ier frequency of greatest subsequent changes: 224.988300 mcs.
mum frequency change: 504 cycles; 0.000224%.

lation frequency at end of first test period: 800.612 kcs.
lation frequency of greatest subsequent change: 800.578 kcs.
mum frequency change: 34 cycles; 0.00425%.

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Table 21

Model YE Transmitting Equipment
INCLINATION TEST
Test as per Par. 3-6-5 and 3-7-5 of Specifications RE 13A 528B

Carrier Max. Freq. Mcs.	Carrier Difference Cycles	Carrier Min. Freq. Mcs.	Test Condition
Inclination: Front to Back at 550 Kcs. Modulation			
224.989632			Stationary
.989632	18	224.989614	Inclination
.989794	18	.989776	"
.989938	18	.989920	"
.990100	18	.990082	"
.990280	18	.990262	"
.990424	18	.990406	"
.990478	18	.990460	"
.990478			Stationary
.989704			Stationary

mum frequency change during test from frequency at start of
: 846 cycles; 0.000376%.

mum frequency change at any two points in the inclination cycles
. to min.): 18 cycles; 0.000008%.

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Table 21 (Cont'd)

Carrier Max. Freq. Mcs.	Carrier Difference Cycles	Carrier Min. Freq. Mcs.	Test Condition
Inclination: Front to Back at 800 Kcs. Modulation			
224.989812			Stationary
.989776	18	224.989758	Inclination
.989830	18	.989812	"
.989902	18	.989884	"
.990010	18	.990028	"
.990100	18	.990082	"
.990118	18	.990100	"
.990280	18	.990262	"
.990280			Stationary

mum frequency change during test from frequency at start of test:
cycles; 0.000208%.

mum frequency change at any two points in the inclination cycles
. to min.): 18 cycles; 0.000008%.

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Table 22

Model YE Transmitting Equipment
INCLINATION TEST
Test as per Par. 3-6-5 and 3-7-5 of Specifications RE 13A 528B

Modulation Maximum Freq. Kcs.	Modulation Difference Cycles	Modulation Minimum Freq. Kcs.	Test Condition
	Inclination: Front to Back		
550.596			Stationary
.594	4	550.598	Inclination
.593	4	.597	"
.594	4	.598	"
.594	4	.598	"
.595	4	.599	"
.595	4	.599	"
.595	4	.599	"
.598			Stationary

mum frequency change during test from frequency at start of test:
cycles; 0.000545%.
mum frequency change at any two points in the inclination cycles
max. to min.): 4 cycles; 0.000727%.

	Inclination: Front to Back		
		800.625	Stationary
800.630	11	.619	Inclination
.629	11	.618	"
.629	11	.618	"
.630	11	.619	"
.629	11	.618	"
.629	11	.618	"
.631	11	.620	"
		.625	Stationary

mum frequency change during test from frequency at start of test:
cycles; 0.000875%.
mum frequency change at any two points in the inclination cycles
max. to min.): 11 cycles; 0.00137%.

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Table 23

Model YE Transmitting Equipment
INCLINATION TEST
Test as per Par. 3-6-5 and 3-7-5 of Specifications RE 13A 528B

Carrier Maximum Freq. Mcs.	Carrier Difference Cycles	Carrier Minimum Freq. Mcs.	Test Condition
Inclination: Side to Side at 550 Kcs. Modulation			
224.989686			Stationary
.989668	18	224.989650	Inclination
.989686	36	.989686	"
.989776	36	.989740	"
.989920	18	.989902	"
.990100	36	.990064	"
.990244	72	.990172	"
.990262	90	.990172	"
.990244			Stationary

mum frequency change during test from frequency at start of test: 58 cycles; 0.000248%.
mum frequency change at any two points in the inclination cycles max. to min.): 90 cycles; 0.00004%.

Inclination: Side to Side at 800 Kcs. Modulation			
224.989542			Stationary
.989524	36	224.989488	Inclination
.989578	36	.989542	"
.989722	54	.989668	"
.989848	72	.989776	"
.990010	72	.989938	"
.990100	72	.990028	"
.990118	18	.990100	"
.990118			Stationary

num frequency change during test from frequency at start of test: 76 cycles; 0.000256%.
num frequency change at any two points in the inclination cycle max. to min.): 72 cycles; 0.000032%.

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Table 24

Model YE Transmitting Equipment
INCLINATION TEST
Test as per Par. 3-6-5 and 3-7-5 of Specifications RE 13A 528B

Modulation Maximum Freq. Kcs.	Modulation Difference Cycles	Modulation Minimum Freq. Kcs.	Test Condition
	Inclination: Side to Side		
550.596			Stationary
.595	2	550.597	Inclination
.593	2	.595	"
.596	1	.597	"
.585	2	.587	"
.582	2	.584	"
.584	2	.586	"
.585	2	.587	"
.585			Stationary

num frequency change during test from frequency at start of test:
4 cycles; 0.00254%.
mum frequency change at any two points in the inclination cycles
max. to min.): 2 cycles; 0.000364%.

	Inclination: Side to Side		
		800.570	Stationary
800.568	5	.563	Inclination
.565	5	.560	"
.575	5	.570	"
.576	5	.571	"
.575	5	.577	"
.574	4	.570	"
.565	5	.560	"
		.561	Stationary

num frequency change during test from frequency at start of test:
) cycles; 0.00125%.
num frequency change at any two points in the inclination cycles
max. to min.): 5 cycles; 0.000625%.

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Table 25

Model YE Transmitting Equipment
VIBRATION
Test as per Par. 3-6-6 and 3-7-6 of Specifications RE 13A 528B

Carrier Freq. Mcs.	Modulation Freq. Kcs.	Plate Volts	P.A. I_p	Modulated Watts	Test Condition
224.988300	550.638	750	250	103	No Vibration
.988300	.637	750	250	103	Vibration
.988300	.638	750	250	103	"
.988264	.638	750	250	103	"
.988210	.639	750	250	103	"
.988156	.639	750	250	104	"
.988120	.639	750	250	103	"
.988102	.639	750	250	102	"
.988102	.639	750	250	102	No Vibration

.mum change of carrier frequency during test: 198 cycles;
).000088%.
.mum change of modulation frequency during test: 1 cycle;
).00018%.

224.987814	800.705	750	250	105	No Vibration
.987814	.710	750	250	105	Vibration
.987814	.709	750	250	105	"
.987814	.703	750	250	104	"
.987386	.705	750	250	104	"
.987976	.702	750	250	104	"
.988102	.701	750	250	104	"
.988192	.700	750	250	104	"
.988210	.700	750	250	104	No Vibration

mum change of carrier frequency during test: 396 cycles;
.000176%.
mum change of modulation frequency during test: 5 cycles;
.000625%.

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Table 20

Model YE Transmitting Equipment
SHOCK TEST
Test as per Par. 3-6-7 and 3-7-7 of Specifications RE 13A 528B

Shock Applied To	Carrier Frequency				Modulation Frequency			
	Before Shock	After Shock	Cycles Change	Per Cent Change	Before Shock	After Shock	Cycles Change	Per Cent Change
Front	224.988516	224.988498	18	0.000008	550.632	550.631	1	0.00018
R. Side	.988264	.988264	0	0	.639	.639	0	0
Back	.988174	.988138	36	0.000016	.639	.639	0	0
L. Side	.988030	.988030	0	0	.638	.639	1	0.00018
Front	224.987742	224.987760	18	0.000008	800.629	800.630	1	0.00013
R. Side	.987760	.987760	0	0	.631	.630	1	0.00013
Back	.987742	.987742	0	0	.630	.631	1	0.00013
L. Side	.987904	.987940	36	0.000016	.621	.625	4	0.00050

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Model YE Transmitting Equipment
VARIATION OF SUPPLY LINE VOLTAGE
Test as per Par. 3-6-8, 3-7-8 and 6-3 of Specifications RE 13A 528B

Line Volts	Line Freq.	Fil. Volts	Bias Volts	Plate Volts	Mod. Watts	Modulator Freq. Kc.	Modulator Freq. Change Cycles	Modulator Freq. Change Per Cent	Carrier Freq. Mc.	Carrier Freq. Change Cycles	Carrier Freq. Change Per Cent
					Minus to Plus 10% in 5 Minutes						
396	59.8	5.8	248	665	86.0	550.620	37	0.0067	224.989542	18	0.000008
440	59.8	6.5	249	666	89.5	550.657			.989524		
484	59.8	7.2	250	670	92.5	550.669	12	0.0022	.989452	72	0.000032
396	59.8	5.8	249	665	87.6	800.473	197	0.0246	224.989200	0	0
440	59.8	6.4	250	665	91.5	800.670			.989200		
484	59.8	7.2	250	670	95.0	800.702	32	0.0040	.989200	0	0
					Minus to Plus 10% in 1 Minute						
396	59.8	5.8	248	665	87.5	550.619	41	0.0075	224.989434	18	0.000008
440	59.8	6.5	249	665	90.5	550.660			.989416		
484	59.8	7.2	249	665	93.0	550.670	10	0.0018	.989380	36	0.000016
396	59.8	5.8	249	665	87.3	800.520	155	0.019	224.989182	0	0
440	59.8	6.6	249	665	90.5	800.675			.989182		
484	59.8	7.2	250	665	93.0	800.702	27	0.0034	.989110	72	0.000032
					Minus to Plus 5% in 5 Minutes						
418	59.8	6.2	248	665	89.0	550.648	12	0.0022	224.989542	36	0.000016
440	59.8	6.5	248	665	90.2	550.660			.989578		
462	59.8	6.8	248	665	91.5	550.667	7	0.0013	.989650	72	0.000032
418	59.8	6.2	249	665	88.5	800.640	39	0.00487	224.989452	54	0.000024
440	59.8	6.4	249	665	89.5	800.679			.989506		
462	59.8	6.8	250	665	90.2	800.693	14	0.0017	.989542	36	0.000016

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Line Volts	Line Freq.	Fil. Volts	Bias Volts	Plate Volts	Mod. Watts	Modulator Freq. Kc.	Modulator Freq. Change Cycles	Modulator Freq. Change Per Cent	Carrier Freq. Mc.	Carrier Freq. Change Cycles	Carrier Freq. Change Per Cent
					Minus to Plus 5% in 1 Minute						
418	59.8	6.1	248	665	94.0	550.647	13	0.0024	224.989758	0	0
440	59.8	6.5	248	665	90.2	550.660			.989758		
462	59.8	6.8	249	665	91.5	550.668	8	0.0015	.989740	18	0.000008
418	59.8	6.2	249	665	88.5	800.650	28	0.00350	224.989650	0	0
440	59.8	6.5	249	665	90.0	800.678			.989650		
462	59.8	6.8	249	665	91.0	800.696	18	0.0023	.989614	36	0.000016

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Table 28

Model YE Transmitting Equipment
VARIATION OF SUPPLY LINE VOLTAGE
Test as per Par. 3-6-8, 3-7-8 and 6-3 of Specs. RE 13A 528B

s	Freq.	Fil. Volts	Bias Volts	Plate Volts	Modulator Freq. Kcs.	Cycles	Per Cent
			Plus to Minus 10% in 1 Min.				
)	59.8	5.90	250.0	665	600.565	35	0.0058
)	59.8	6.50	251.0	665	.600	--	
,	59.8	7.20	252.0	665	.616	16	0.0027
)	59.8	5.80	250.0	665	650.570	40	0.0062
)	59.8	6.50	250.5	665	.610	--	
.	59.8	7.15	251.0	670	.621	11	0.0017
)	59.8	5.85	250.0	665	700.538	60	0.0076
)	59.8	6.50	250.5	665	.598	--	
.	59.8	7.20	251.0	665	.610	12	0.0017
)	59.8	5.80	250.0	670	750.549	53	0.0071
)	59.8	6.50	250.0	670	.602	--	
.	59.8	7.20	252.0	675	.618	16	0.0021
)	59.8	5.80	250.0	665	800.627	88	0.0100
)	59.8	6.50	250.0	665	.715	--	
.	59.8	7.15	251.0	670	.732	17	0.0021
)	59.8	5.80	250.0	665	850.560	82	0.0097
)	59.8	6.50	250.0	670	.642	--	
.	59.8	7.15	251.0	670	.660	18	0.0021

Carrier Frequency: 225 Mcs.

Antenna: Matched lamp load (100-watt lamp).

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Table 29

Model YE Transmitting Equipment
VARIATION OF SUPPLY LINE VOLTAGE
'est as per Par. 6-3, 3-6-8, 3-7-8 of Specifications RE 13A 528B

Line s	Freq.	Fil. Volts	Bias Volts	Plate Volts	Mod. Watts	Modulator Freq. Kcs.	Freq. Change Cycles	%
		Minus 10% in 10 min. - Plus 10% in 5 min.						
)	59.8	6.5	250.	665	91.5	550.612		
)	59.8	5.8	249.	660	87.6	550.513	99	0.0180
.	59.8	7.15	250.5	665	94.8	550.631	19	0.00345
)	59.8	6.5	250.5	665	92.	600.615		
)	59.8	5.8	250.0	660	87.5	*600.451	164	0.0273
.	59.8	7.2	250.5	665	95.	600.629	14	0.00233
)	59.8	6.5	250.	665	92.	650.625		
)	59.8	5.85	250.	665	87.5	*650.424	201	0.0309
.	59.8	7.2	251.0	668	95.	650.640	15	0.00231
)	59.8	6.5	250.	665	91.5	700.640		
)	59.8	5.85	250.	662	87.6	*700.440	200	0.0285
.	59.8	7.15	251.0	670	95.	700.652	12	0.00171
)	59.8	6.5	250.	665	91.8	750.600		
)	59.8	5.8	250.	662	87.5	*750.411	189	0.0252
.	59.8	7.18	250.5	665	94.8	750.618	18	0.0024
)	59.8	6.5	251.	665	92.	800.718		
)	59.8	5.8	250.	665	87.3	*800.490	228	0.0285
.	59.8	7.1	251.	670	95.	800.731	13	0.0016
)	59.8	6.5	250.5	665	91.5	850.634		
)	59.8	5.85	250.	661	87.6	*850.415	119	0.0140
.	59.8	7.1	251.	665	95.	850.650	16	0.0019

'west point on temperature cycle.

'rier Frequency: 225 mc.

'enna: Matched lamp load (100-watt lamp).

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Table 30

Model YE Transmitting Equipment
CHANGE FROM UNMODULATED CONDITION
TO KEYED MODULATION CONDITION OF THE CARRIER FREQUENCY
Test as per Par. 3-6-9 of Specifications RE 13A 528B

e	Carrier Frequency Mcs.	Per Cent Modulation	Output Power Watts	Test Condition
0	224.989056	0	92.0	Unmodulated
5	.987670	0	92.0	"
5	.987670	80	118.0	Keyed Modulation
0	.987508	80	118.0	" "
5	.987400	80	118.0	" "
0	.987364	80	116.5	" "

imum frequency variation during the 45-minute keyed period:
06 cycles; 0.000136%.

e: Modulation at a frequency of 800 kc. keyed at the rate of
15 w.p.m.

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Table 31

Model YE Transmitting Equipment
CHANGE FROM CONTINUOUSLY KEYED CONDITION TO INTERMITTENTLY KEYED CONDITION OF THE MODULATING FREQUENCY
Test as per Par. 3-7-9 of Specifications RE 13A 528B

quency at end of min. continuous keying (kcs.)	Frequency at end of 10 sec. dash after 20 min. pause (kcs.)	Change in Freq. Cycles	Per Cent
550.312	550.310	2	0.00036
800.303	800.299	4	0.00050

e: Transmitter delivering unmodulated power to the antenna during the 20-minute pause.

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Table 32

Model YE Transmitting Equipment
SUMMARY OF CARRIER FREQUENCY STABILITY TESTS
Test as per Par. 3-8 of Specifications RE 13A 528B

t No.	Maximum Frequency Variation %	% Frequency Variation to Determine Total	Specification Limits
-1 (a)	0.00089		--
(b)	0.00094	0.00094	--
-2	0.0004	0.0004	--
-3 (a)	0.0026	0.0026	--
(b)	0.0024		--
-4 (a)	0.00038	0.00038	--
(b)	0.00022		--
-5 (a)	0.00037	0.00037	--
(b)	0.00021		--
-6 (a)	0.00009		--
(b)	0.00018	0.00018	--
-7 (a)	0.000008		--
(b)	0.000016	0.000016	--
-8 (a)	0.000008		--
(b)	0.000032	0.000032	--
-9	0.00014	0.00014	--
al		0.0051%	0.012%

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Table 33

Model YE Transmitting Equipment
SUMMARY OF MODULATION FREQUENCY STABILITY TESTS
Test as per Par. 3-8 of Specifications RE 13A 528B

st No.	Maximum Frequency Variation % 550 KC	800 KC	% Frequency Variation to Determine Total	Specification Limit
-7-1	0.0013	0.0035	0.0035	--
-7-2	0.013	0.012	0.013	--
-7-3	0.010	0.0087	0.010	--
-7-4	0.0051	0.0042	0.0051	--
-7-5	0.0025	0.00125	0.0025	--
-7-6	0.00018	0.00062	0.00062	--
-7-7	0.00018	0.0005	0.0005	--
-7-8	0.0180	0.028	0.031 *	--
-7-9	0.00036	0.0005	0.0005	--
otal			0.0667%	0.10%

* This variation occurred at 650 KC.

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Table 34

Model YE Transmitting Equipment
PERCENTAGE MODULATION CAPABILITY OVER MODULATION FREQUENCY RANGE
Test as per Par. 3-9 of Specifications RE 13A 528B

Freq. Kc.	Per Cent Modulation		Plate Volts	Modulated Watts Output	Unmodulated Watts Output
	Meter	*Actual			
550	80.0	81.0	750	111.0	88.0
600	80.0	82.0	750	111.0	88.0
650	80.0	81.0	750	111.0	88.0
700	80.0	81.0	750	111.0	88.0
750	80.0	81.0	750	110.5	88.0
800	80.0	81.0	750	111.0	88.0

Note: Carrier frequency throughout test: 246 mc.

* Measured by means of deflection on oscilloscope.

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Table 35

Model YE Transmitting Equipment
OVERLAP AND LIMITING FREQUENCY OF MASTER OSCILLATOR
Test as per Par. 3-14 of Specifications RE 13A 528B

trol A	Control B	Frequency Kc	Overlap Kc	Mean Freq. Kc	% Overlap
cification Limit		540.00			
			18.97	530.51	3.57
1	0	521.03			
1	2500	598.90			
			22.03	587.88	3.75
2	0	576.87			
2	2500	663.43			
			28.45	649.75	4.17
3	0	635.98			
3	2500	731.28			
			39.06	711.75	5.42
4	0	692.22			
4	2500	796.04			
			39.29	776.39	5.07
5	0	756.75			
5	2500	879.10			
			49.10	854.55	5.74
cification Limit		830.00			

Minimum Percentage Overlap: 3.57%.

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Table 36

Model YE Transmitting Equipment
ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCY
Test as per Par. 3-14 of Specifications RE 13A 528B

al No.	Frequency Kcs.	Time Seconds	Deviation in Frequency Cycles	Per Cent
ginal	550.602			
1	.598	17	4	0.00073
2	.597	18	5	0.00091
3	.607	18	5	0.00091
4	.600	22	2	0.00036
5	.605	21	3	0.00054
		Average Deviation:	3.8	0.00069
		Maximum Deviation:	5	0.00091
ginal	800.280	-	-	-
1	/285	20	5	0.00062
2	.266	17	14	0.00170
3	.282	18	2	0.00024
4	.270	18	10	0.00125
5	.274	22	6	0.00075
		Average Deviation:	7.4	0.00090
		Maximum Deviation:	14	0.00170

cification Requirement: Average of 5 trials: 0.003%
No trial to exceed: 0.005%

e: Transmitter was pre-heated for 30 minutes before the above tests were conducted.

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Table 37

Model YE Transmitting Equipment
TEST FOR LOST MOTION, BACKLASH, AND TORQUE LASH
Test as per Par. 3-15 of Specifications RE 13A 528B

.al).	Frequency Approached From Clockwise Direction	Frequency Approached From Counterclockwise Direction	Cycles	Per Cent
	550.237	550.241	4	0.000727
	.235	.240	5	0.000909
	.237	.239	2	0.000363
	.237	.240	3	0.000550
	.233	.240	7	0.001270
		Average:	4.2	0.000764
	Average permitted by Specifications:			0.005

.tial frequency: 550.237
›quency of maximum departure: 550.241 and 550.233
'ference: 4 cycles; 0.000727%.
'mitted by Specifications: 0.008%

800.265	800.275	10	0.0012
.266	.274	8	0.0010
.265	.275	10	0.0012
.265	.273	8	0.0010
.266	.274	8	0.0010
	Average:	8.8	0.0011
Average permitted by Specifications:			0.005

.tial frequency: 800.265
›quency of maximum departure: 800.275
'ference: 10 cycles; 0.0012%
'mitted by Specifications: 0.008%.

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Model YE Transmitting Equipment
CALIBRATION OF MODULATOR OSCILLATOR DIAL - KC. PER DIVISION
Test as per Par. 3-16 of Specifications RE 13A 528B

Control "A"	Control "B"	Control "C"	Control "D"	Frequency Kc.	Divisions Change	Kc. Change	Kc. per Division	% per Division
1	0000	9.2	6.0	521.035				
	0500	10.8	7.8	526.705	500	5.67	0.011	0.0025
	1000	17.9	13.5	542.864	500	16.16	0.032	0.0059
	1500	25.9	21.0	566.867	500	24.00	0.048	0.0084
	2000	34.0	27.0	588.576	500	21.71	0.043	0.0074
	2500	35.5	30.0	598.906	500	10.33	0.020	0.0033
2	0000	28.0	24.0	576.873				
	0500	30.5	25.5	583.217	500	6.34	0.013	0.0022
	1000	35.5	30.0	601.113	500	17.89	0.036	0.0059
	1500	44.0	37.0	627.857	500	26.74	0.054	0.0085
	2000	48.5	40.5	651.842	500	23.98	0.048	0.0074
	2500	52.0	44.0	663.433	500	11.59	0.023	0.0035
3	0000	45.0	38.5	635.983				
	0500	47.0	40.5	642.931	500	6.95	0.014	0.0022
	1000	52.0	43.5	662.696	500	19.76	0.039	0.0059
	1500	56.5	49.5	692.272	500	29.57	0.059	0.0085
	2000	61.0	53.0	718.800	500	26.53	0.053	0.0074
	2500	63.0	55.0	731.280	500	12.48	0.025	0.0034
4	0000	56.0	49.0	692.224				
	0500	58.0	50.0	699.872	500	7.65	0.015	0.0022
	1000	61.5	54.0	721.184	500	21.31	0.042	0.0059
	1500	67.0	57.0	753.360	500	32.17	0.064	0.0085
	2000	70.6	61.5	782.170	500	28.81	0.057	0.0074
	2500	72.0	62.5	796.040	500	13.87	0.028	0.0035

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Control "A"	Control "B"	Control "C"	Control "D"	Frequency Kc.	Divisions Change	Kc. Change	Kc. per Division	% per Division
5	0000	56.5	58.0	756.746				
	0500	69.0	59.5	772.800	500	16.05	0.032	0.0042
	1000	72.5	62.5	796.652	500	23.85	0.048	0.0060
	1500	76.0	66.0	832.133	500	35.48	0.071	0.0085
	2000	80.0	69.0	863.833	500	31.70	0.063	0.0073
	2500	81.4	70.0	879.096	500	15.26	0.030	0.0034

Specification Requirement: Not to exceed 0.01 nor less than 0.001 per cent.

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Table 39

Model YE Transmitting Equipment
EFFECT OF DIAL LOCKS
Test as per Par. 3-17 of Specifications RE 13A 528B

ıtrol	Direction of Approach	Frequency KCS. Not Locked	Frequency KCS. Locked	Frequency Change Cycles	Frequency Change Per Cent
'B"	Clockwise	550.236	500.233	3	0.00055
'B"	Counter C.	.239	.237	2	0.00036
'C"	Clockwise	.237	.237	0	0
'C"	Counter C.	.237	.236	1	0.00018
'D"	Clockwise	.237	.237	0	0
'D"	Counter C.	.237	.237	0	0
'B"	Clockwise	800.265	800.261	4	0.0005
'B"	Counter C.	.267	.264	3	0.00037
'C"	Clockwise	.264	.263	1	0.00012
'C"	Counter C.	.266	.264	2	0.00024
'D"	Clockwise	.264	.264	0	0
'D"	Counter C.	.264	.264	0	0
'E"	Clockwise	12,499.455	12,499.455	0	0
'E"	Counter C.	.446	.446	0	0
'F"	Clockwise	.446	.446	0	0
'F"	Counter C.	.444	.444	0	0

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Table 40

Model YE Transmitting Equipment
MAINTENANCE OF NORMAL VOLTAGES WHEN CHANGING MODULATOR FREQUENCY
Test as per Par. 3-19 of Specifications RE 13A 528B

Modulation Frequency Kcs.	Plate Volts	Bias Volts	Filament Volts
550	680	251	6.5
675	680	251	6.5
800	680	251	6.5

Note: Voltage controls remained fixed during this test.

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Model YE Transmitting Equipment
OPERATION OF POWER OUTPUT CONTROL
Test as per Par. 3-25 of Specifications RE 13A 528B

Modulated Power Output Watts	% Power	Plate Volts	Per Cent Mod. Measured	Per Cent Mod. Meter	Mod. Frequency Kc.	Modulation Frequency Change Cycles	Modulation Frequency Change Per Cent	Carrier Frequency Mc.	Carrier Frequency Change Cycles	Carrier Frequency Change Per Cent
123.0	100.0	750	-	80.0	550.586			224.990154		
98.5	80.0	670	-	69.0	.570	16	0.0029	.989884	270	0.000120
84.5	68.7	620	-	61.0	.558	28	0.0051	.989660	494	0.000220
61.0	49.6	530	-	51.5	.537	49	0.0089	.989436	718	0.000319
30.7	25.0	410	-	36.0	.501	85	0.0155	.989472	682	0.000303
25.0	20.3	390*	-	34.0	550.494	92	0.0167	224.989490	664	0.000295
116.5	100.0	750	80	80.0	800.571			224.989902		
98.5	84.5	680	83	71.0	.555	16	0.0020	.989704	198	0.000088
88.0	75.5	635	84	68.5	.540	31	0.0039	.989542	360	0.000160
60.0	51.5	530	82	52.0	.530	41	0.0051	.989326	576	0.000256
29.1	25.0	402	82	34.5	.505	66	0.0082	.989218	684	0.000304
25.0	21.4	390*	81	33.0	800.500	71	0.0089	224.989164	738	0.000328

Note: * denotes minimum generator voltage obtained.

The above range of modulated power output was continuously varied from 100% to below 25% by means of the generator field rheostat, while the set was transmitting.

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Table 42

Model YE Transmitting Equipment
VOLTAGE REGULATION OF FILAMENTS
Test as per Par. 3-36 of Specifications RE 13A 528B

Circuit	Key Open Volts	Key Closed Volts	Regulation Per Cent
.e	440	440	0
.01 Secondary	115	115	0
.01 Crystal Osc.*	6.53	6.53	0
.02 1st Amplifier*	6.53	6.53	0
.03 2nd Amplifier*	6.53	6.53	0
.04 3rd Amplifier*	6.53	6.53	0
.05 4th Amplifier-Bottom	7.78	7.78	0
.06 4th Amplifier-Top	7.85	7.85	0
.07 P.A. - Top	7.85	7.85	0
.08 P.A. - Bottom	7.85	7.85	0
.09 Modulator Oscillator	6.60	6.60	0
10 Modulator Amplifier*	6.58	6.58	0
11 Modulator Amplifier*	6.58	6.58	0
12 Modulator Amplifier*	6.58	6.58	0
13 Modulator Rectifier*	6.58	6.58	0
14 Monitor 1st Demod.	6.58	6.58	0
15 Monitor 1st Demod.	6.58	6.58	0
16 Monitor 2nd Demod.	6.58	6.58	0

ese sockets were inaccessible. Voltage measured at nearest accessible point to socket.

t Condition: Carrier frequency 225 mc.; Modulation frequency 550 kc. Filament voltmeter set at 6.5 volts with key open.

adequacy of the filament rheostat was checked with the following results:

Line Volts	Max. Fil. Volts	Min. Fil. Volts
484	-	5.9
396	6.3	-

Normal voltage is 6.5 volts.

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Table 43

Model YE Transmitting Equipment
RADIO FREQUENCY VOLTAGE AVAILABLE FOR CALIBRATION
Test as per Par. 3-43 of Specifications RE 13A 528B

Modulation Frequency Kcs.	R.F. Potentials - Millivolts
550	380
600	300
650	300
675	380
700	320
750	330
800	340

Note: Potentials were measured by a G.R. 726-A Vacuum Tube Voltmeter through 3 feet of 2-conductor, shielded cable, shunted by a 75-ohm non-inductive resistor at the meter end.

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Table 44

Model YE Transmitting Equipment
POWER REQUIRED FROM SUPPLY LINES
Test as per Par. 6-5 of Specifications RE 13A 528B

	Starting	Stand-by - Heater On
ver Input (kw.)	12.8	1.15
ıe Current "A" Amps.	26.4	3.94
ıe Current "B" Amps.	19.1	1.97
ıe Voltage	448.0	453.0

246 mc. - Modulated 650 kc.

	Key Open, Heater On	Keyed 15 w.p.m.	Key Locked, Heater On
ver Input (kw.)	2.12	2.23	2.30
ıe Current "A" Amps.	4.62	4.67	4.71
ıe Current "B" Amps.	2.55	2.62	2.73
ıe Voltage	452.0	449.0	448.0
' Mod. Power Output (watts)	-	111.0	111.0
' Unmod. Pwr. Output (watts)	88.0	-	-

ıa at ±10% of line voltage - 246 mc., Mod. 650 kc.

ıe Volts	Power Input (kw.)	Mod. Power Output (Watts)
396	2.21	106
440	2.28	110
484	2.36	115

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Table 45

Model YE Transmitting Equipment
REGULATION OF GENERATORS
Test as per Par. 6-31 of Specifications RE 13A 528B

Generator	Voltage Key Open	Voltage Key Closed	Per Cent Regulation
H.V. Plate	670	670	0.0
Bias	254	253	0.4

Data taken at 225 mc. carrier and 550 kc. modulation.

Antenna: 100-watt lamp with matching network.

Specification Requirements: 5%

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Table 46

Model YE Transmitting Equipment
MEASUREMENT OF GENERATOR RIPPLE
Test as per Par. 6-31 of Specifications RE 13A 528B

ıerator	D-C Output Voltage	RMS Ripple Voltage	% Ripple	Position of Key
'. Plate	670	4.25	0.635	Open
'. Plate	670	3.70	0.552	Closed
'. Plate	750	4.00	0.533	Open
'. Plate	750	3.65	0.487	Closed
.s	254	0.025	0.010	Open
.s	253	0.025	0.010	Closed

H.V. Plate Filter consists of a 4 µf capacitance only.

Bias filter consists of a 10 µf capacitance only.

Specification Requirement: 0.25%.

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Table 47

Model YE Transmitting Equipment
ARRAY ELEMENT DIMENSIONS WITH
ELEMENT ATOP DRIVE SHAFT

Element No.	Length in Inches	Element No.	Length in Inches
1-T	11.02	1-B	10.95
2-T	9.39	2-B	11.26
3-T	9.42	3-B	11.00
4-T	9.17	4-B	10.09
5-T	8.99	5-B	9.54
6-T	9.00	6-B	9.33
7-T	11.46	7-B	11.52
8-T	11.52	8-B	11.45
9-T	11.55	9-B	11.70
10-T	11.48	10-B	11.52
11-T	11.61	11-B	11.50
12-T	10.93	12-B	11.48
13-T	11.69	13-B	11.66
14-T	11.23	14-B	11.80
15-T	12.07	15-B	11.52
16-T	11.37	16-B	11.45
17-T	11.35	17-B	11.40
18-T	11.37	18-B	11.23
19-T	11.66	19-B	11.46
20-T	11.57	20-B	11.54
21-T	10.63	21-B	11.54
22-T	11.05	22-B	11.76

All the above dimensions are measured from the nearest surface of the horizontal support to the end of the telescopic member of the element without the end cap screw in place.

Length of element placed above the drive mast - 8.59 inches. Measurement taken between the upper surface of supporting member and the end of telescoping member without the end cap screw in place.

Antenna Coupling Dimensions on Elements 1-T and 1-B:

Coupling 1-T - 3.38".
Coupling 1-B - 3.47".

These measurements are made between the nearest surface of the horizontal support and the nearest surface of the coupling connector block.

All dimensions are accurate to within plus or minus 0.01".

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Table 48

Model YE Transmitting Equipment
OUTPUT TESTS INTO ANTENNA ARRAY THROUGH 230-FOOT TWIN LINE
Test as per Paragraph 1e and 6 of Reference (a)

Control or Meter	Carrier Freq. 246 Mc. Modulation Freq. 800 Kc.	Carrier Freq. 248 Mc. Modulation Freq. 800 Kc.
A	5	5
B	1058	1058
C	72	72
D	63	63
E	75	75
F	50	50
G	80	82
H	60	61
J	75	77
K	69	72
L	94	95
M	522	571
N	897	1405
P	1252	1411
Q	1390	2000
R	-	-
S	10	10
T	7.1	7.1
U	3.8	3.8
. Osc. I_{sg} (ma.)	2.2	2.1
. Osc. I_p (ma.)	23.5	24.
. I_g (ma.)	11.	10.5
. I_p (ma.)	183.	168.
F. Osc. I_p (ma.)	18.	18.
Amp. I_p (ma.)	59.	54.
Amp. I_p (ma.)	70.	62.
Amp. I_g (ma.)	12.4	8.8
Amp. I_p (ma.)	120.	122.
Amp. I_g (ma.)	34.	35.
Amp. I_p (ma.)	215.	220.
. I_g (ma.)	69.	66.
. I_p (ma.)	250.	250.
. I_1 (amps.)	0.36	0.38
. I_2 (amps.)	0.36	0.38
. I_{p-1} (ma.)	170.	170.
. I_{p-2} (ma.)	168.	170.

(Continued)

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Table 48 (Cont'd)

Control or Meter	Carrier Freq. 246 Mc. Modulation Freq. 800 Kc.	Carrier Freq. 248 Mc. Modulation Freq. 800 Kc.
. Volts	6.5	6.5
s Volts	250.	250.
Cent Mod.	80.	80.
te Volts	750.	750.

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PLATE 1

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PLATE 2

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PLATE 3

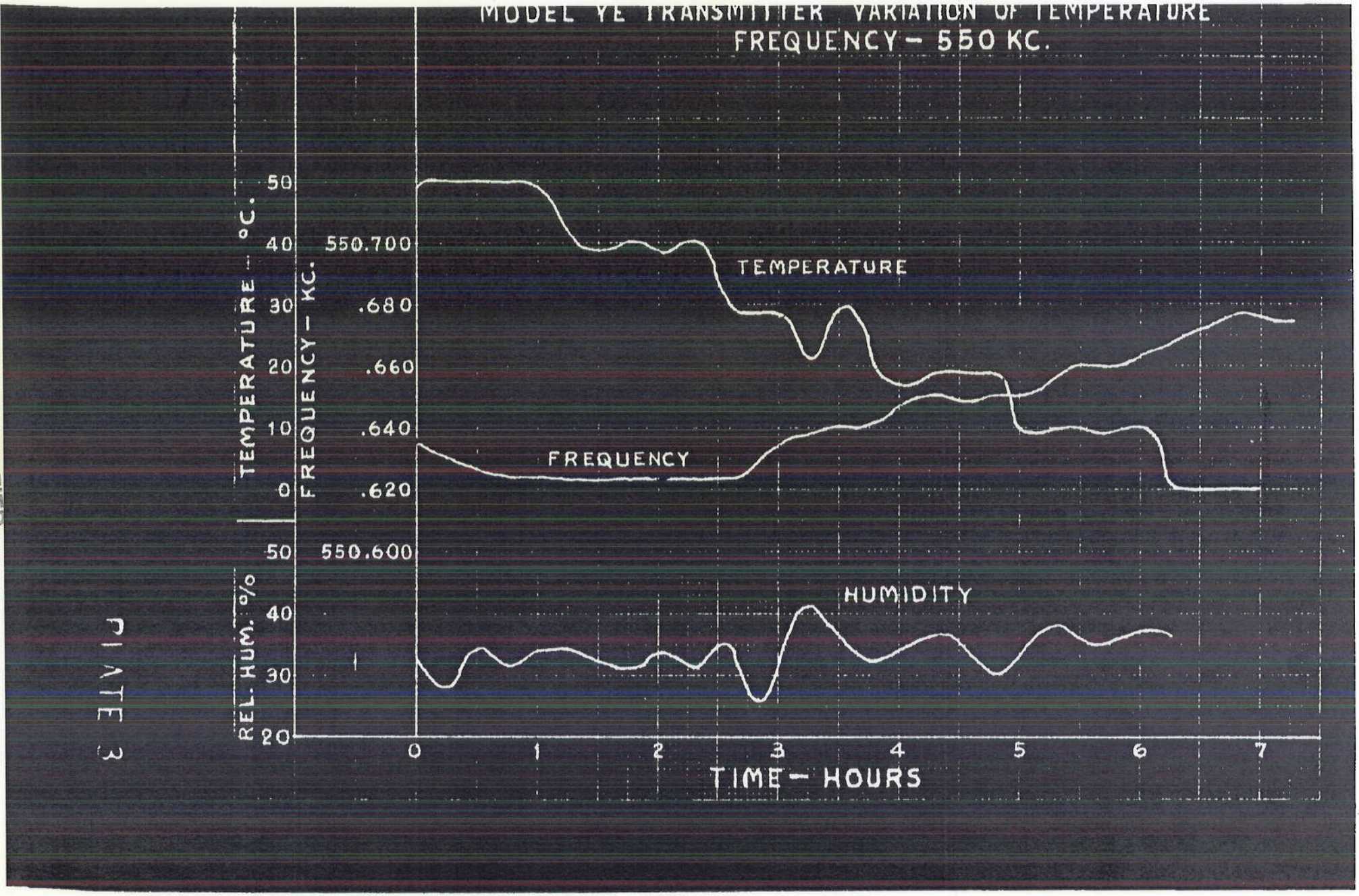
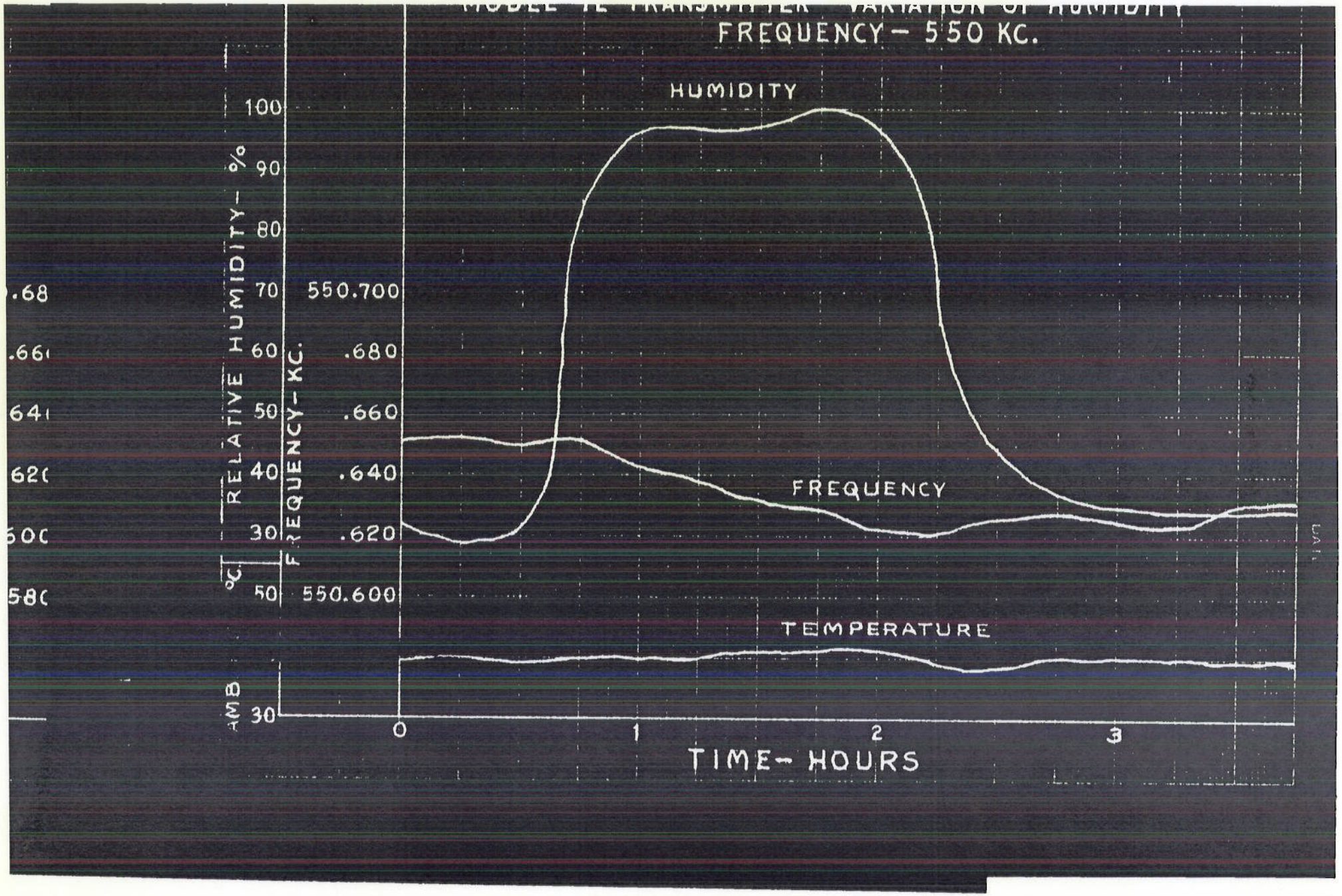


PLATE 4

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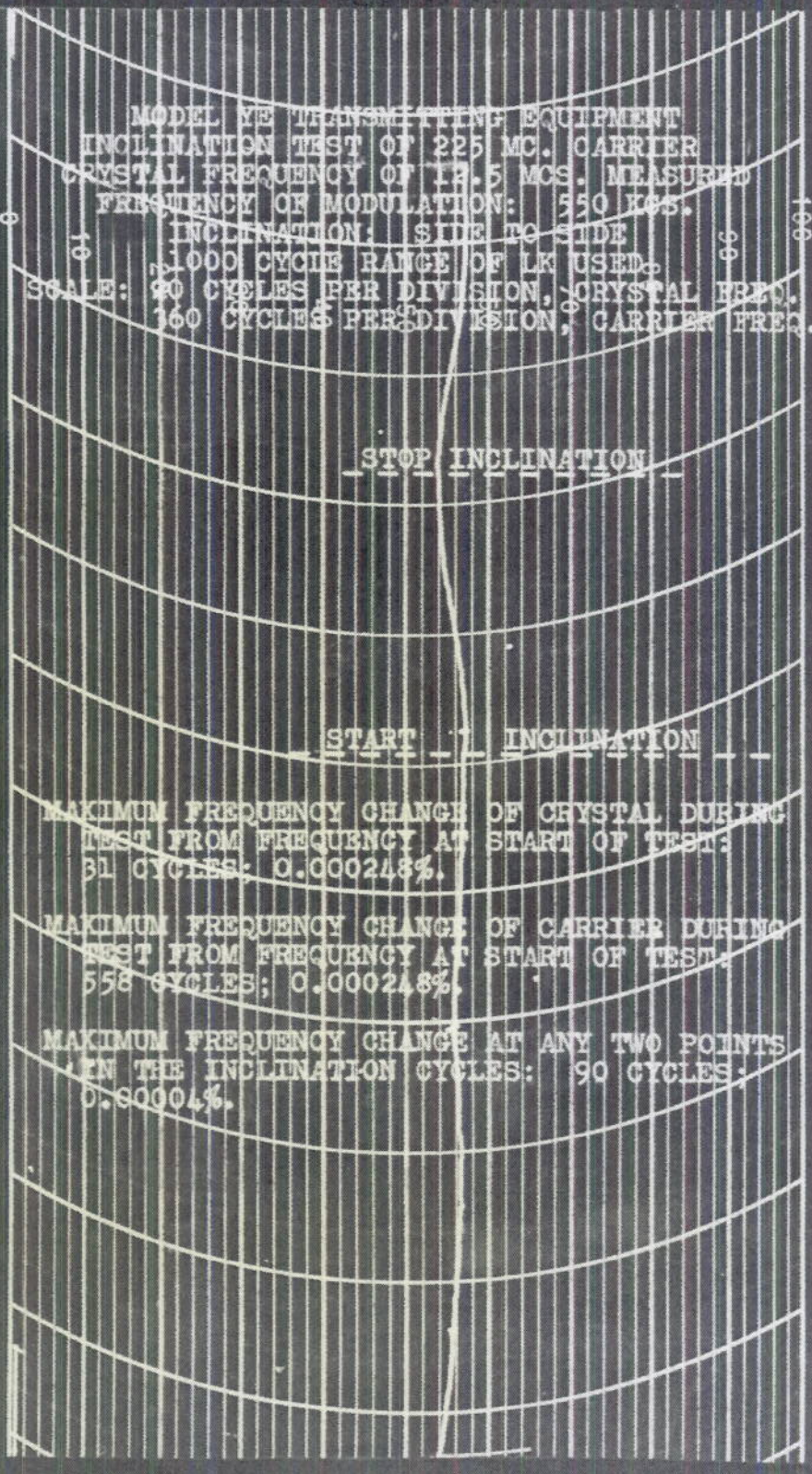


Plate 7

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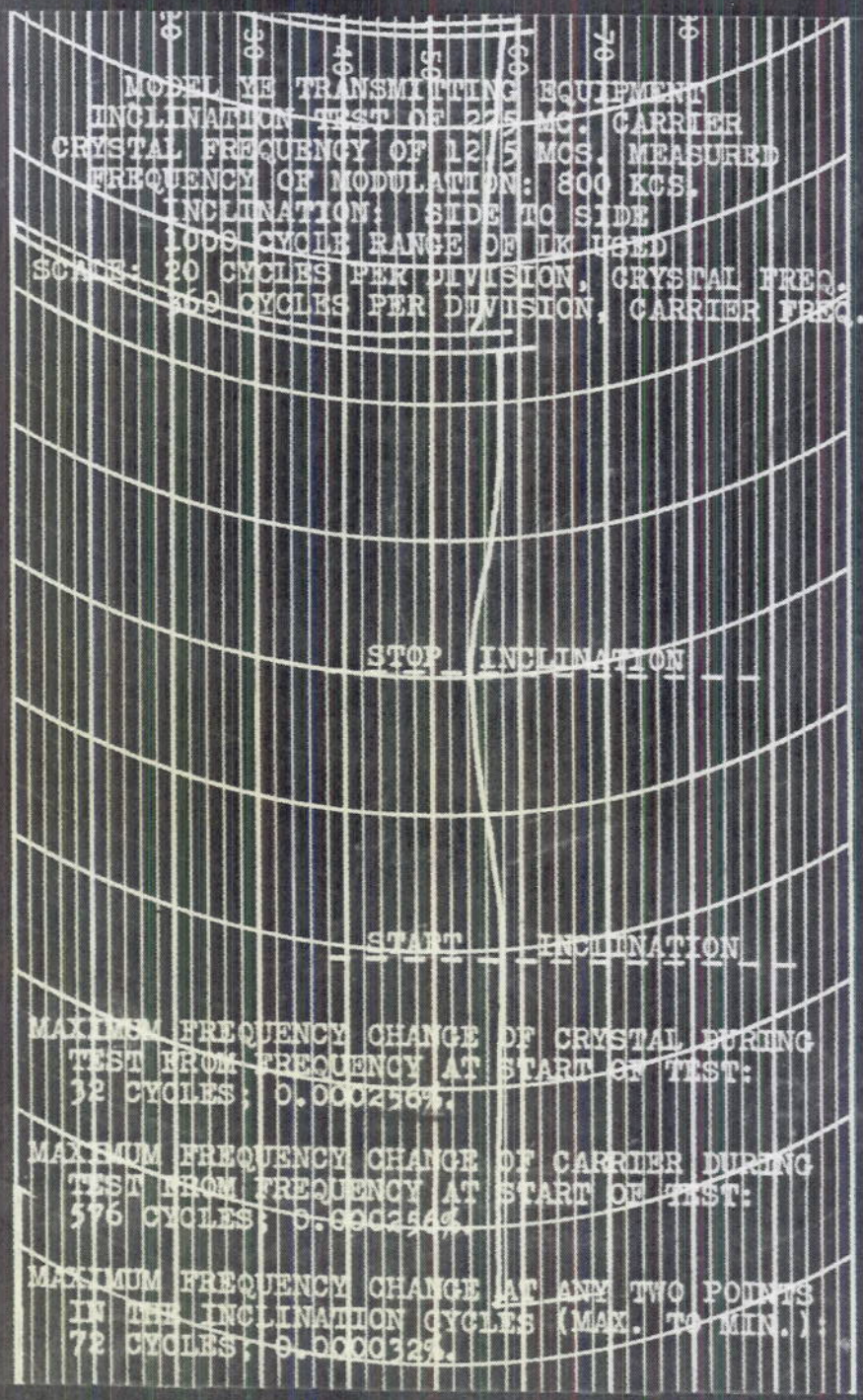


Plate 8

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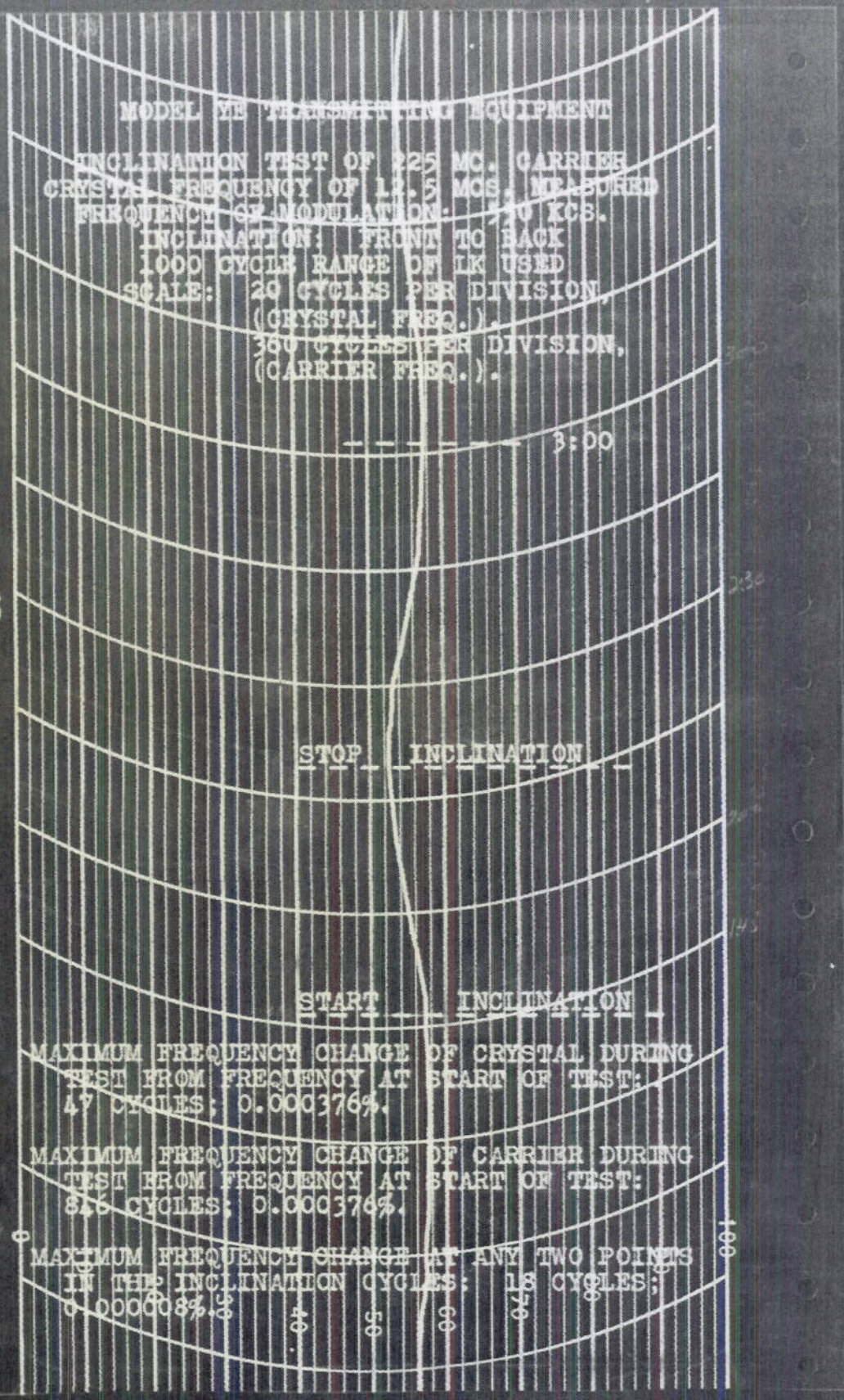
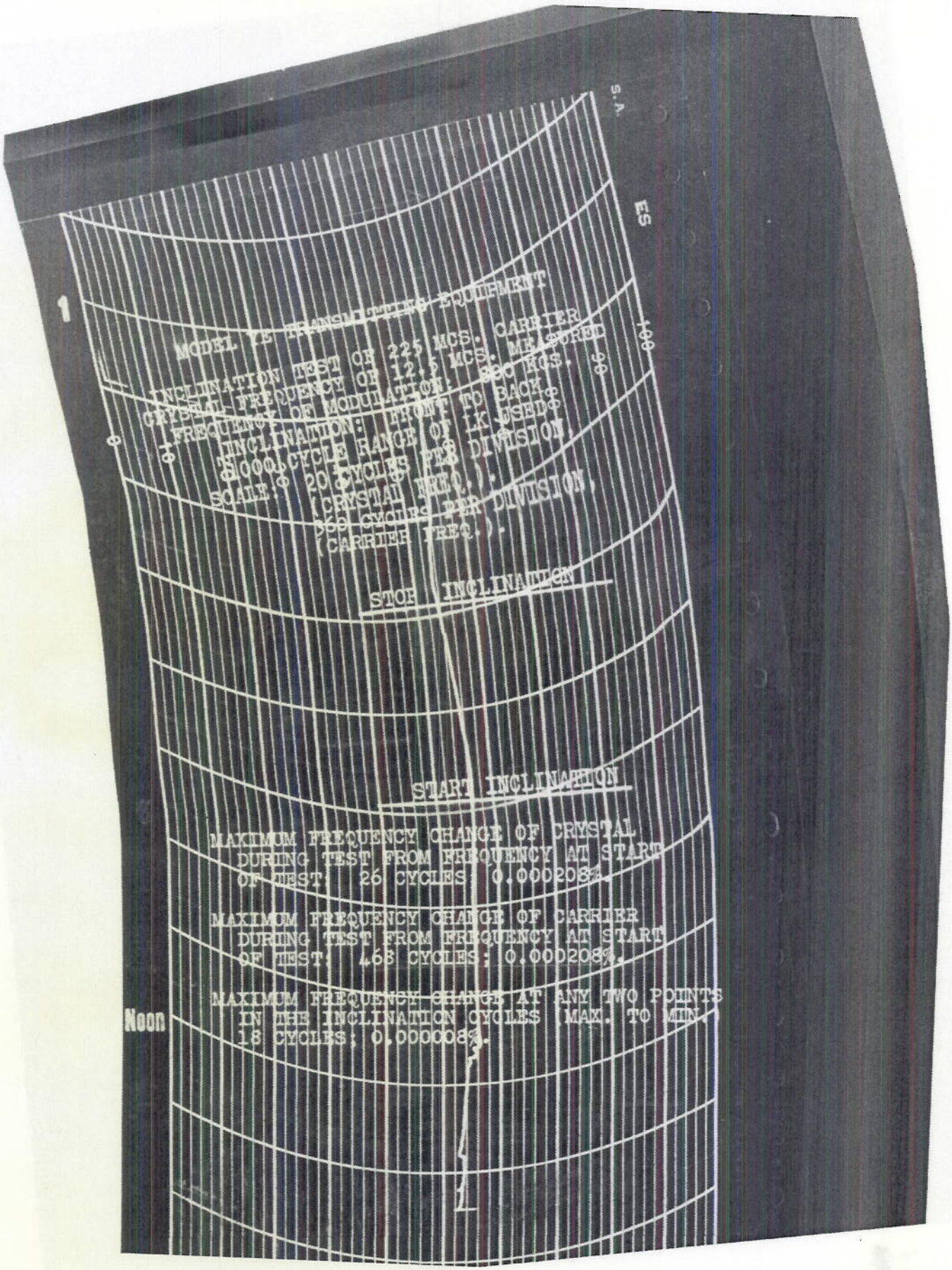


Plate 9

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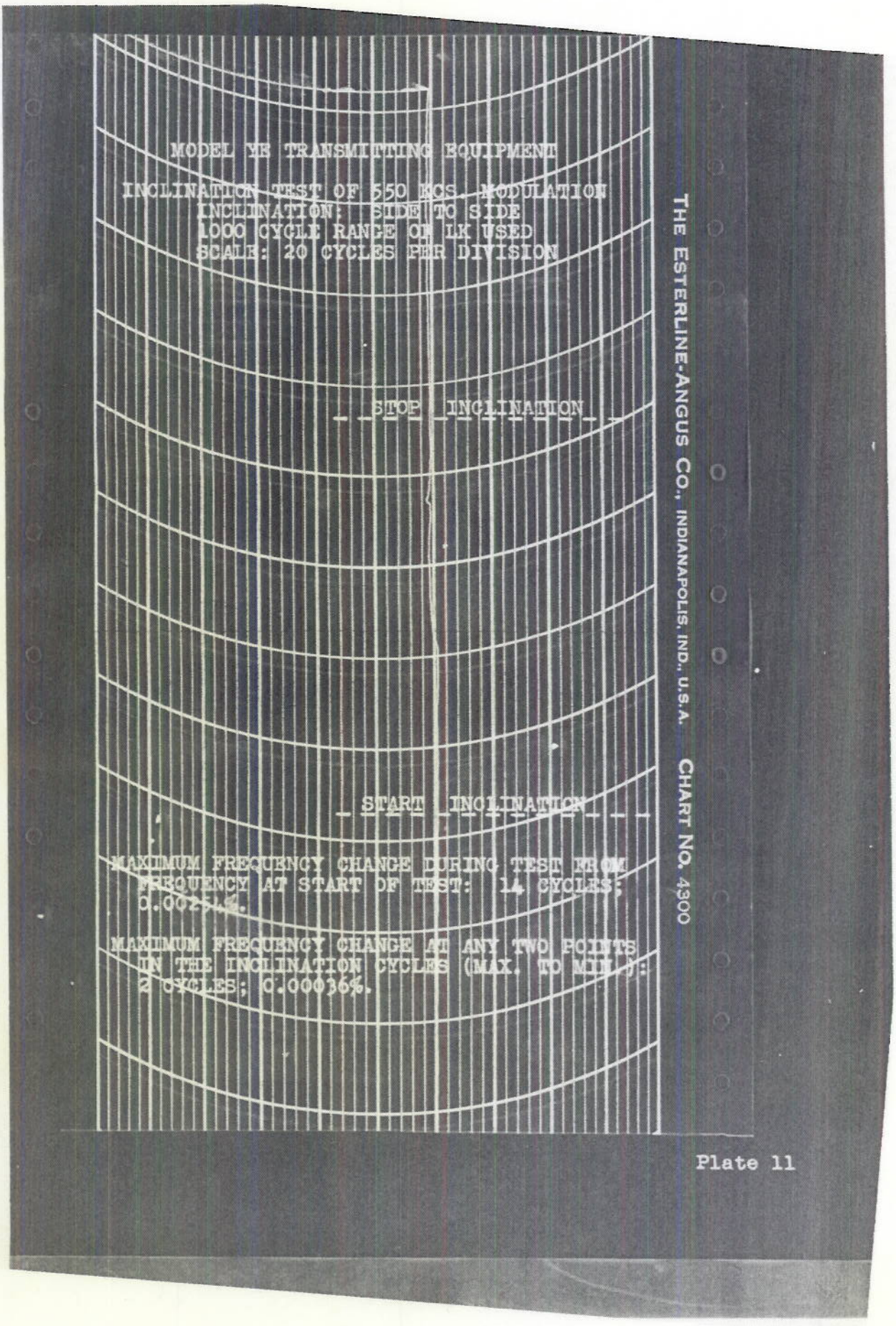


Plate 11

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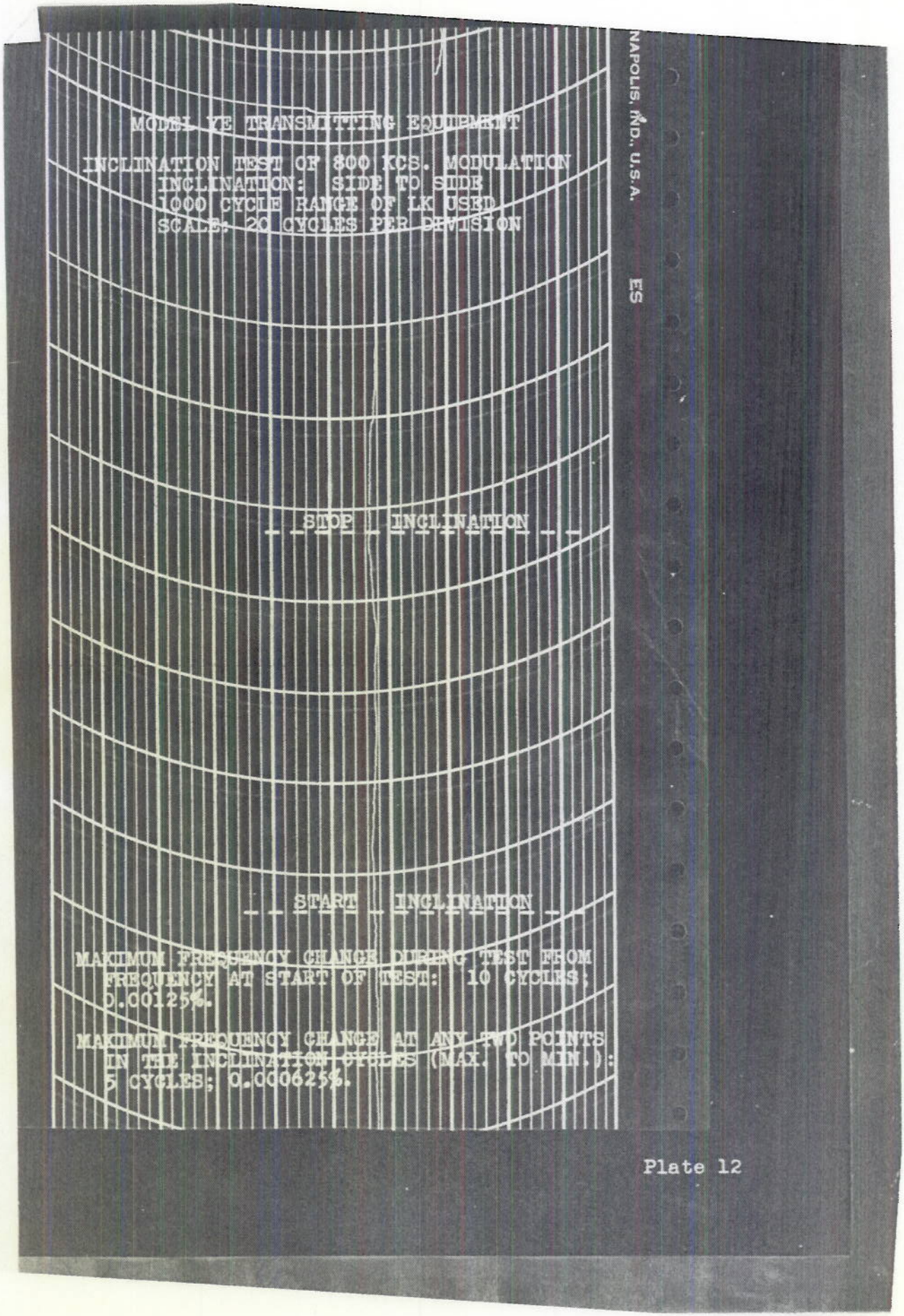


Plate 12

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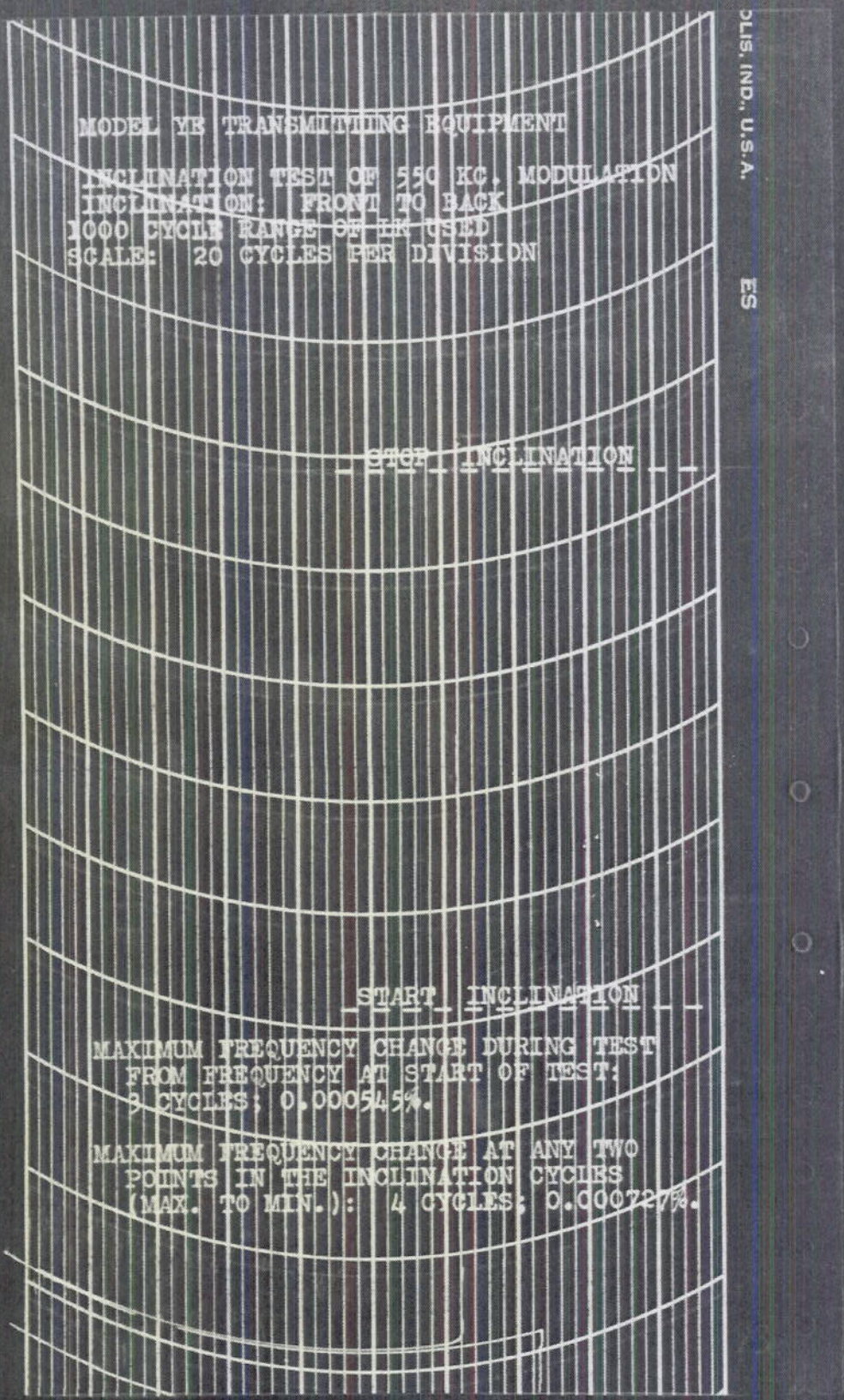


Plate 13

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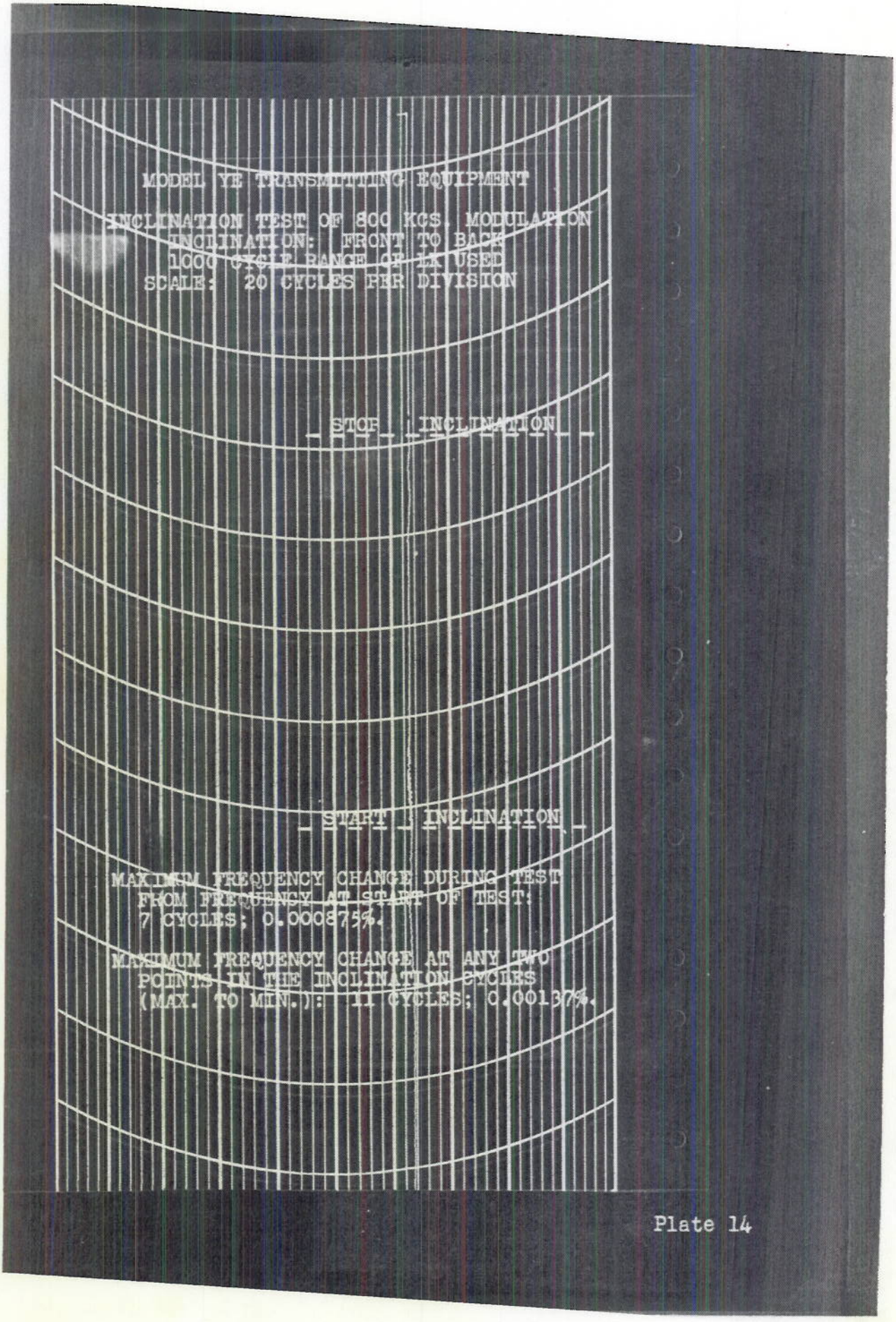


Plate 14

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Plate 15

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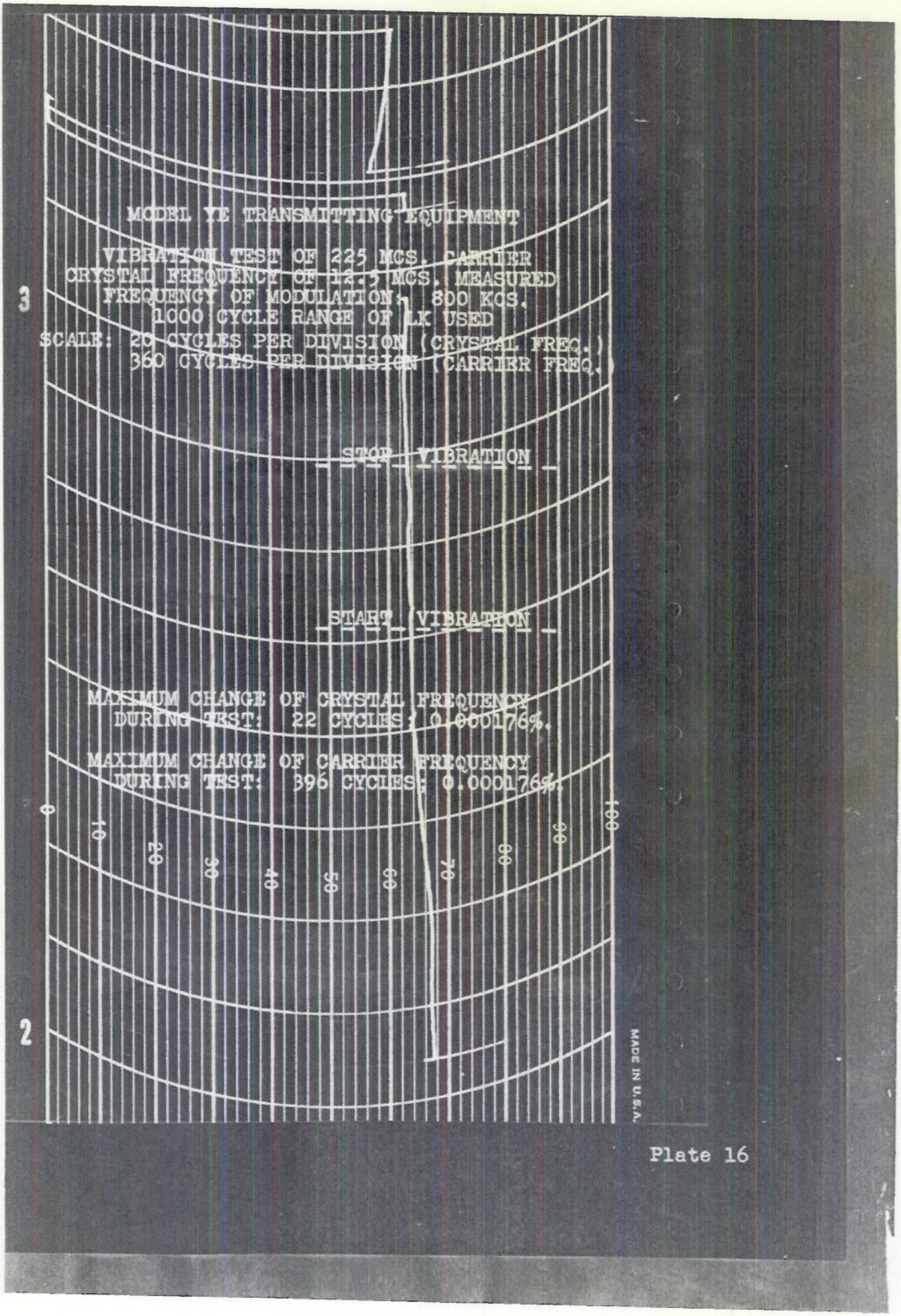


Plate 16

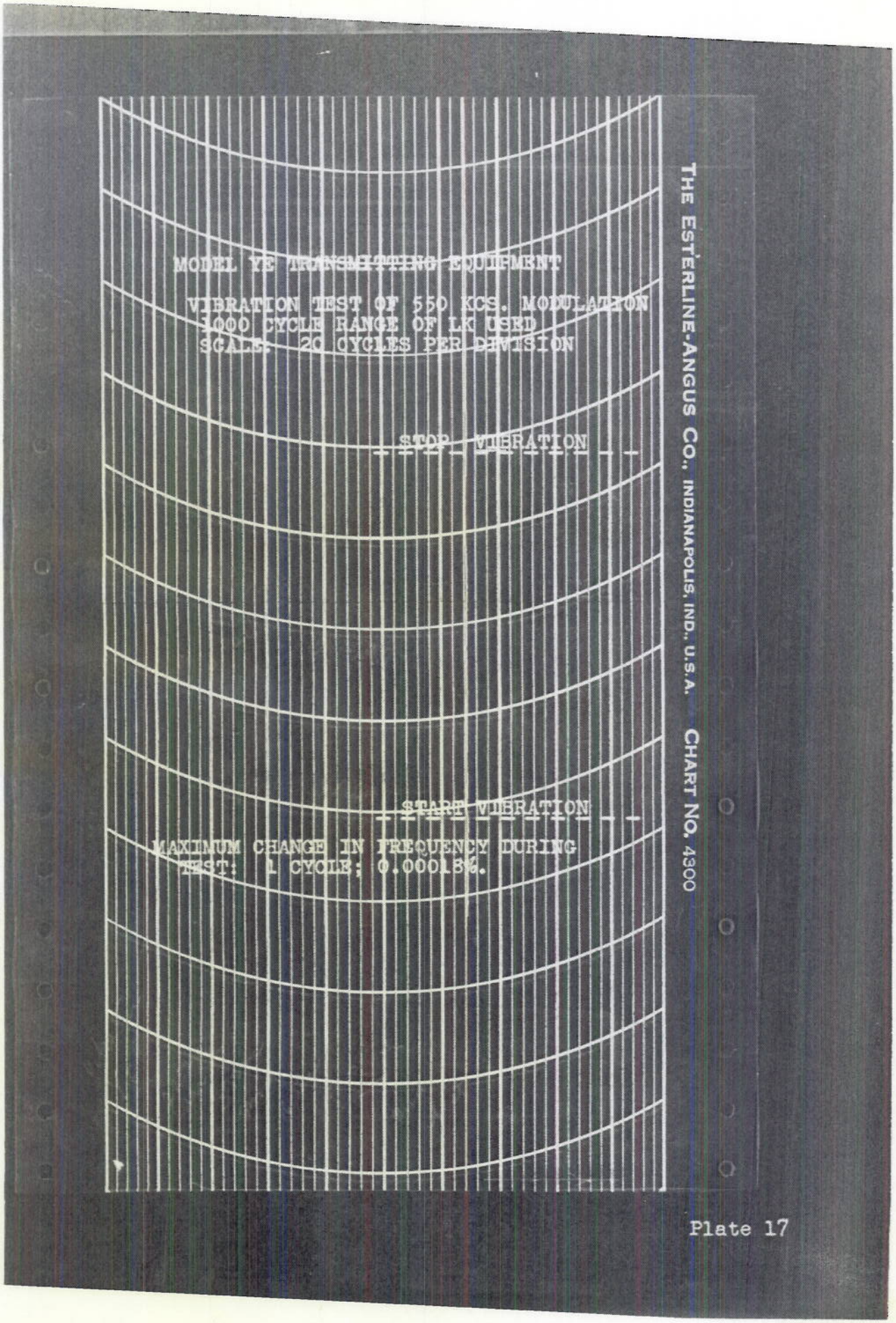


Plate 17

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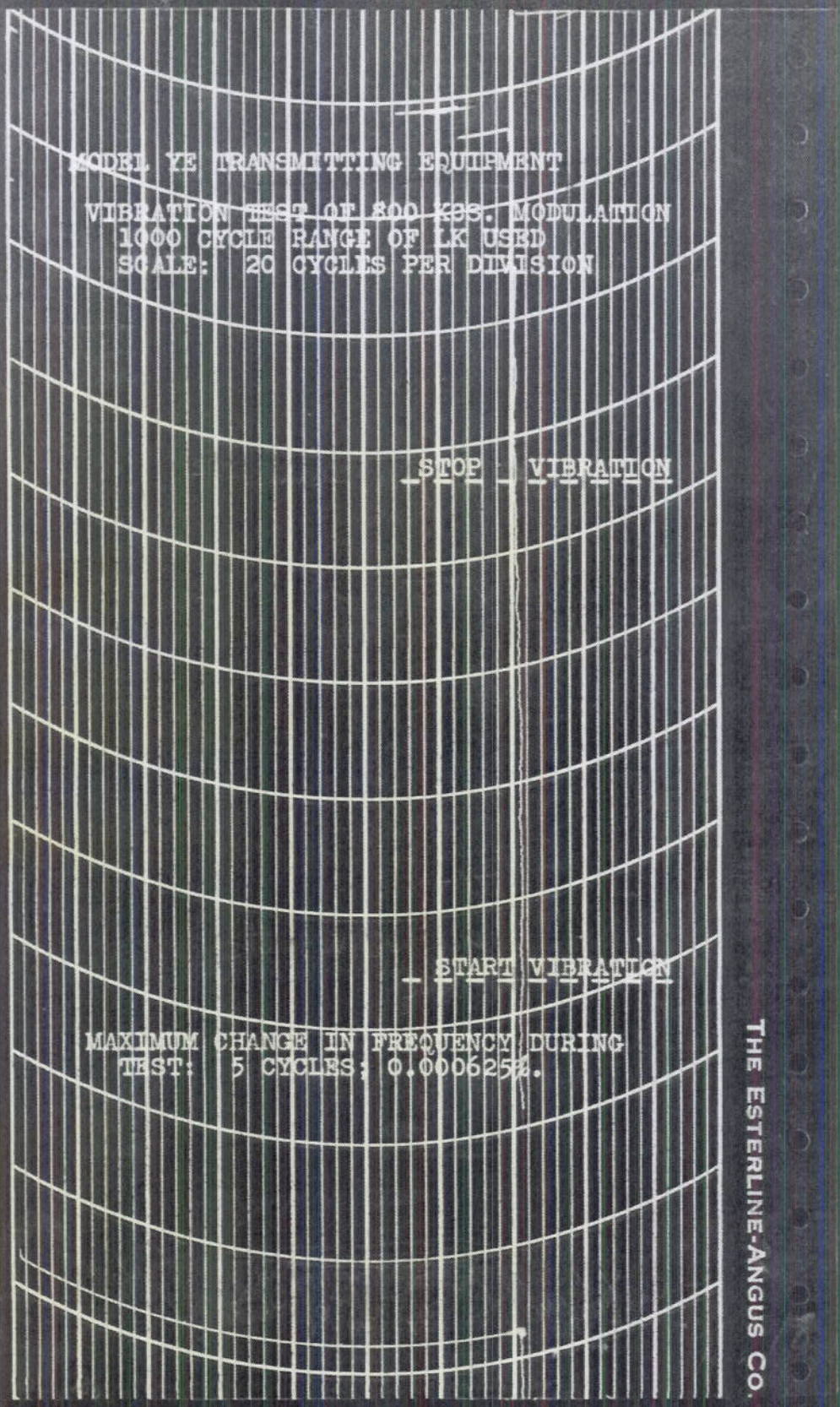


Plate 18

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