FR-1730

7 May 1941

NRL Report No. R-1730
BuShips Problem R3-7C

NAVY DEPARTMENT

Report on

Test of Model XTBT Speaker-Amplifier Unit

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WASHINGTON, D. C.

Number of Pages: Text - 13 Tables - 2 Plates - 8

Authorization: BuEng. Ltr. S-NP14/N8(1-31-DRC) of 2 Feb. 1940.

Date of Test: 16 October 1940 to 6 February 1941.

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APPENDICES

AUTHORIZATION OF TEST

1. The tests reported below were authorized by reference (a). Other data are listed as reference (b) to (l) inclusive.

References: (a) BuEng. Ltr. [illegible] of [illegible] February 19[illegible] to Director, NRL, Anacostia, D.C.
(b) BuEng. Specifications RE 13A 554a.
(c) BuEng. Specifications RE 13A 555a.
(d) BuEng. Specifications RE 13A [illegible].
(e) BuEng. Specifications RE 13A [illegible].
(f) RCA Mfg. Co. Descriptive Specification No. [illegible]-174-[illegible], of [illegible] February 193[illegible].
(g) Radio-Contract C-NOs 56508 Model [illegible] Equipments RCA Mfg. Co. Camden, N.J., Contractor.
(h) Contract Notes: BuEng. Ltr. C-NOs-[illegible] of November [illegible], 1938 to [illegible], Phila.
(i) RCA Mfg. Co. Instruction Book for Model ARA Receiving Equipment, Model IB-3[illegible]34.
(j) RCA Mfg. Co. Instruction Book for Speaker-Amplifier Unit. Model IB-3[illegible].
(k) NRL Report No. R-1730 on ARA Receiver Tests.
(l) NRL Report No. R-1727 on ATST Transmitter Tests.

OBJECT OF TEST

2. The object of the tests was to determine compliance with the governing specifications, references (b), (c) and (e).

ABSTRACT OF TESTS

3. The Model [illegible] Speaker-Amplifier Unit was given a general inspection for mechanical construction (see par. 10 and 11) and wiring (see par. 20(i)). To comply with references (b) and (c) the electrical tests listed below were carried out:

(a) Input Impedance.
(b) Amplifier Gain.
(c) Amplifier Output Distortion.
(d) Amplifier Frequency Characteristic.
(e) Over-all Frequency Characteristics.
(f) Loud-Speaker Efficiency.
(g) Gain-Control Characteristics.
(h) Output Hum and Noise Level.
(i) Power Requirement.

[redacted]

Conclusions

(a) The model XTBT Speaker-Amplifier Unit meets the requirements of the governing specifications, with some qualifications which are mentioned in the following recommendations. It is strongly constructed, reliable and not adversely affected by mechanical vibrations, with a minor exception. It is better equipped for protection against gunfire than similar equipment known to the Laboratory.

(b) Excellent materials and good design are evident throughout the Unit with very minor exceptions. However, the use of corrosive materials has not been kept to an absolute minimum.

(c) It is concluded that the Unit with suggested modifications is suitable for use in the Naval Service.

[redacted]

Recommendations

(a) That a terminal strip of non-hygroscopic material be substituted on the speaker assembly for the strip of fish paper (or similar material) furnished with the model equipment.

(b) That steps be taken to insure that the pilot lamp shall not be loosened during such vibration as may be encountered on Naval ships.

(c) That the marking of the line terminal on the main terminal board be marked to read "+115 V.±" and "-115 V.±" in lieu of the marking "1-A.C." and "2-A.C." on the model equipment.

(d) That the case be provided with three cable bushing bosses on the bottom and on each side of the cabinet, to conform to the governing specifications. Alternatively, it is recommended that consideration be given to providing the bottom of the unit with a water-tight plate, suitable for drilling at the time of installation, in lieu of the bosses. This method of leading in the cables would be in accord with the Bureau of Ships' recommendation relative to the remote telephone units.

(e) That the notch be eliminated from the fuse-board and that suitable fuse type designation be provided.

(f) That the brass chassis-support brackets be nickel-plated instead of finished in aluminum lacquer.

(g) That the commercial tube sockets be replaced by a Navy standard type of tube socket.

(h) That the designation "RCA" be deleted from the tube type numbers marked on the chassis near the tube sockets.

(i) That the felt covers over the apertures behind the loud-speaker diaphragm be more securely fastened in position.

MATERIAL UNDER TEST

4. The material under test comprised the Speaker-Amplifier Unit furnished by the RCA Mfg. Co. as a part of the XT3T transmitting equipment under contract, reference (g). It was delivered at the Laboratory for test on October 10, 1940.

METHOD OF TEST

5. The following instruments were used for electrical tests.

(a) Vacuum Tube Analyzing Equipment, Weston Electrical Instrument Corp., Model OD-A, Serial 395.

(b) Output Power Meter, General Radio Company, Type 583-A, Serial No. 67.

(c) Wave Analyzer, General Radio Company, Type 736-A, Serial No. 289.

(d) Wattmeter, General Electric Co., Model P-3, Serial No. 252618.

(e) A-C Ammeter, Weston Electrical Instrument Corp. Model 370, Serial No. 2731.

(f) D.C. Ammeter, Westinghouse Electric and Mfg. Co., USA Type SE 2495, Serial No. 913410.

(g) A-C Voltmeter, Westinghouse Electric and Mfg. Co., Style No. NO 24518-1, Serial No. 1317615.

(h) Volt-Ohmmeter, Weston Electrical Instrument Corp., Model 663.

(i) Impedance Bridge, General Radio Co., Type 650-A, Serial No. 1026.

(j) Electronic Voltmeters, Ballantine Laboratories, Inc., Model 300, Serial Nos. 115 and 194.

(k) Sound-Frequency Analyzer, Electrical Research Products, Inc. Type AA-277, Serial No. 14.

(l) Microphone, Electrical Research Products, Inc., Type 630-A.

(m) Beat Frequency Oscillator, General Radio Company, Type 513-B. Serial No. 34.

(n) Beat Frequency Oscillator, General Radio Company, Type 713-B, Serial No. 706.

[redacted]

6. Mechanical inspection disclosed excellent construction and workmanship with few minor exceptions. Before testing, the Unit was inspected for loosened or damaged components and for correct seating of vacuum tubes in their sockets. All components were securely mounted and the wiring to them was neat and well supported. However, one of the terminals to the loud speaker voice coil was loose in the fish paper supporting strip. This strip was secured to the speaker frame by rivets, one of which had partially ruptured the strip. The terminal strips for voice coil leads (mounted on the inside cover near the speaker) and for the power and a.f. input leads were of excellent construction with deeply recessed terminals providing long leakage paths and at the same time, ready access for attaching leads. The tube sockets were of a commercial phenolic type having non-Navy standard ring-secured mountings. Resistors were of Navy standard design and mounted securely on rugged supports. All condensers as well as the input and output transformers were mounted in metal cases with sealed-terminal posts. Toggle switches were of Navy approved type. Power line fuses were of the clip type and were mounted on a phenolic subpanel. The case could be opened through an angle of 180° providing ready access to all parts and wiring. The mechanical design is such that servicing should be especially rapid and easy.

7. Electrical and Acoustic Test Methods.

(a) The input impedance was determined by measuring the a-c resistance and reactance across the input terminals by means of an impedance bridge.

(b) The amplifier gain was determined by the ratio of measurements of output and input voltages of the amplifier when driven by a beat-frequency oscillator. Voltage measurements were carried out by high impedance electronic voltmeters which did not appreciably react on the circuits under test.

(c) The harmonic distortion in the amplifier output voltage was measured by means of a selective wave analyzer.

(d) The amplifier frequency characteristic was determined by repeating gain measurements, made as noted under (b) above, at several different frequencies.

(e) The overall frequency characteristics were made by a comparison of electrical input and acoustic output at several frequencies. Acoustic output measurements were made in the soundproof room and utilizing the microphone and sound-level meter of the Interior Communication Division of this Laboratory. A slight "warble" was imparted to the note by manual variation of the beat-frequency oscillator tuning control.

(f) The loud speaker efficiency was determined by measuring the acoustic output power for a given electrical input to the speaker voice coil. Acoustic measurements were made as described under (e) above.

(g) The gain control characteristics were measured as explained under (b) above, repeated for several gain-control settings.

[redacted]

(h) Output hum and noise level determinations were made with the aid of an electronic voltmeter and a wave analyzer connected across the leads to the loud speaker voice coil.

DATA RECORDED DURING TEST

8. Data for all tests are presented in Tables 1 to 2 inclusive and in Plates 1 to 8 inclusive.

PROBABLE ERRORS IN RESULTS

9. Estimates of the probable errors in the results of tests are given in the following tabulation:

Name of Test	Estimated Overall Accuracy
Input Impedance (no load condition)	± 5%
Amplifier Gain	± .5 db.
Amplifier Output Distortion	± 5%
Amplifier Frequency Characteristics	± .5 db.
Overall Frequency Characteristics	± 2 db.
Loud Speaker Efficiency	± 10%
Gain Control Characteristics	± 2 db.
Output Hum and Noise Level	± 10%
A-C Power Input	± 5%

RESULTS OF TESTS

10. The Speaker Amplifier Unit consists of a single stage push-pull audio-frequency amplifier, a loud speaker of permanent magnet type and a power supply for the amplifier. These components are secured to the inside of the cover of a strong cast aluminum alloy case designed for mounting on a bulkhead.

11. The electrostatically shielded input transformer is designed for 600 ohm balanced input and feeds, through a balanced volume control, the grids of the two push-pull amplifier tubes, type 35L6 - GT. The plates of these tubes are connected to the primary of the output transformer which has a secondary designed for 15 ohm output to the voice coil of the permanent-magnet speaker.

12. The power supply may be operated from either a-c or d-c 115 volt circuits. An a-c, d-c switch is provided for setting up the power supply circuits for either type of power source. In the d-c position this switch shorts out the rectifier tube type 35L6-GT and disconnects its heater, substituting for the latter a ballast resistor to maintain the heaters of the 35L6-GT amplifier tubes at the correct value. In the a-c position the rectifier tube is made operative and connected in the circuit for half-wave rectification. A filter is connected in the power supply output circuit to reduce the amplitude of a-c hum or d-c commutator ripple in the d-c voltage supplied to the plates of the amplifier tubes. The pilot lamp is connected across the 115 V. a-c or d-c power line. Both sides of this line are fused. The Speaker-Amplifier Unit is discussed in more detail in the following articles, using the paragraphs of the governing specification, reference (e), as a guide.

13. Par. 1-1. The XTBT Speaker-Amplifier Unit is generally suitable for shipboard use under unfavorable conditions likely to be encountered in the Naval Service.

14. Par. 1-2. The Unit is suitable for telephone reception. Reference Plate 1.

15. Par. 1-3. The Unit comprises a single-stage push-pull power amplifier, a permanent magnet type loud speaker and a power supply system which operates from the lighting circuits of the ship.

16. Par. 1-4. By throwing a switch mounted within the unit, either d-c or 60 cycle a-c 115 volt supply mains may be used.

17. Par. 1-5. The power consumed from the supply line is 27 watts at 115 volts, 60 cycles a-c with a power factor of 85%. At 120 volts d-c, the power consumed is 30 watts.

18. Par. 1-6. The weight of the complete unit is 39 pounds.

19. Par. 1-7. The nominal rating of the unit is as follows:

Electrical Input - 6 milliwatts, 600 ohms at 1000 cycles.
Electrical Output - 1.75 watts to speaker at 1000 cycles.
Acoustical Output - 10 dynes/cm^2 at 6 feet.

20. Par. 2-1. The applicable sections of the General Specifications for Radio and Underwater Sound Equipments, RE 13A 554B, are covered in the following discussion, with due regard being taken for the exceptions to the General Specifications noted in the subject paragraph of the controlling specifications.

(a) Temperature and humidity tests have not been carried out on this equipment. The design of all electrical circuits and controls is liberal. Fuses are provided in the power line. The construction of all controls is suitable for shipboard use.

[redacted]

(b) Ample provision for cooling is allowed in the large surface area of the unit. No louvres or ventilating openings are required due to the low power dissipation within the unit.

(c) No electrolytic condensers are employed in the unit.

(d) The unit is completely shielded electrically by the case which is secured to the bulkhead during operation and hence at ground potential.

(e) The circuits are simple and only the volume control and on-off switch need be manipulated externally, facilitating its operation by inexperienced personnel.

(f) Safe operation is assured by the inaccessibility of line potential circuits when the case is closed. Controls operate at ground potential. Satisfactory electrical performance has been demonstrated.

(g) Transformers and condensers are sealed in metal containers; hence, no information on softening or flow of compound has been obtained, no extra components having been furnished for test.

(h) Flexible stranded leads are used throughout and all conductors in the unit are firmly and neatly supported. Color coding is employed on all leads.

(i) Wiring is insulated by double varnished cambric covering with an outer layer of glass fabric.

(j) The pilot lamp is rated at 125 volts, 6 watts and has a candelabra screw-type base. The requirement of paragraph 2-1 that pilot lamps shall use a bayonet-type base is not met, presumably because of non-availability of commercial lamps of the required type. The desirability of a bayonet-type base was emphasized by the fact that the screw-type pilot lamp worked loose during vibration tests. The pilot lamp is fitted with a suitable bezel which projects 3/4" beyond the front panel.

(k) A single pole single throw toggle switch of Navy type CIEI 24000 is provided for power on-off switching. A double-pole double-throw toggle switch is provided for selecting conditions for a-c or d-c power source. Both of these switches are of the laminated phenolic sheet construction and their functioning after many cycles of operation in high saline humidities has not been investigated during the present tests.

(l) By opening the cover of the unit, which is regarded as an access door, all vacuum tubes, resistors and fuses become readily accessible for replacement. The indicating lamp is accessible for replacement from the front of panel by removal of the bezel. Resistors of one watt or smaller size are mounted on terminal strips and are very convenient for replacement. The 20 watt 230 ohm resistor which is substituted for the rectifier tube heater during operation from d-c power lines does not carry a complete

Navy type number. The enamel on this resistor is chipped and blow holes were noted in the enamel surface near one of the ferrules. A portion of the lead wire to this ferrule is exposed and a sharp tag from this conductor protrudes through the surface of the enamel. This resistor is mounted in sturdy spring clips on a strong laminated phenolic base.

(m) All joints are properly secured before soldering. Soldering is neat and secure.

(n) Tubes of type 35L6 GT and 35Z5 GT are used in the Unit. These tubes are not included in a list of Navy-approved tubes issued March 21, 1941. Use of 35 volt heater tubes is conditioned by the a-c, d-c universal feature of the unit. The electrical design of the Unit is so liberal that the specifications would be met with wide variation of vacuum tube characteristics.

(o) The unit is very strongly constructed of excellent materials. Good workmanship is evident throughout.

(p) The metallic parts, with the exception of the brass brackets supporting the chassis, are protected against corrosion by plating or paint. The aluminum case, cover and chassis appear to be protected by zinc chromate primer before application of aluminum paint. The brass chassis support brackets appear to be finished in aluminum lacquer.

(q) Iron or steel is employed for all condenser and transformer cases, for the potentiometer covers, for toggle switch frames, and for the eye bolt and wing nut used to hold the cover closed. It is not felt that the use of iron or steel is held to a practicable minimum in the model unit. It is proposed, in production units, to furnish a brass eye-bolt and wing nut for holding the cover closed. Reference (j), page 8.

(r) The liberal use of aluminum for case, cover and chassis results in a very rugged structure of comparatively light weight.

(s) The unit was subjected to combined vibration and rocking tests along with the XRAQ receiver. The vibration frequency varied from 0 to 26 cycles per second while the rocking extended over an angle of plus or minus 45 degrees from the normal mounting position. During these tests electrical operation was satisfactorily maintained and the only casualty was the loosening of the pilot lamp.

(t) All nuts are provided with shakeproof lockwashers with the exception of the wing nut used to hold the cover closed and the nuts holding the toggle switches in place. It is understood that the shakeproof lockwashers are to be replaced in production units by split-ring type bronze lockwashers. Reference (j), page 8. All wires are well secured to the terminals before soldering, in such a way that the solder is not depended on for mechanical support.

[redacted]

(u) The chassis which supports the tubes, transformers and condensers is supported on shock mounts to increase tube life and reduce microphonic modulation effects caused by vibrating vacuum tube elements. These shock mounts are of the rubber washer type and are readily replaceable.

(v) Besides the on-off switch, only one control is provided for adjusting the volume. The control shaft and bushing is grounded so as to present no shock hazard. Clockwise rotation of this control increases the volume. The control operates two potentiometers in tandem by direct drive. No locking device is provided for the volume control. A plate labeled "Volume" and marked in uniform divisions from 0 to 10 is provided with the volume control. In production units it is understood that this volume control name plate will be reverse etched and will match the Unit name plate. Reference (j) page 8.

(w) The arrangement of parts permits ready replacement of any component and no rivets are used in securing any of the parts likely to require replacement with the exception of the voice-coil terminal strip as noted in paragraph 52(a). The tube sockets are secured by spring rings; these sockets are of a commercial type not on the Navy approved list, however, it is indicated on page 8 of reference (j) that the tube sockets used in the production units will be of Navy standard design, type CFH-49351.

(x) The unit nameplate is of Navy standard design conforming with specification RE 13A 51GB.

(y) Controls are located on the panel front with the exception of the switch for selecting a-c or d-c power source which is mounted on the chassis within the unit.

(z) All bolts and nuts conform to the National Screw Thread Commission coarse or fine thread series with the exception of a number of 4-40 screws and nuts used in lieu of the standard 4-36 screws in securing the fuse block sub-panel and the cable clamps to the cover of the case.

(aa) The exterior of the case is finished in light gray paint. The interior metal parts are finished in aluminum paint or lacquer.

(bb) A hole for leads passing through the chassis is provided with a grommet.

21. Par. 3-1 Universal AC or DC operation is provided for these units. A 35Z5-GT rectifier tube with an associated filter system is used when operating from 115 volts, single phase AC. When using DC a D.P.D.T. toggle switch is used to short out the rectifier tube and disconnect its heater. Power amplification is provided by two 35L6-GT tubes in a single push-pull stage. The loud speaker is of the permanent magnet dynamic type. This unit is housed within a sprayproof cast aluminum cabinet suitable for bulkhead mounting. The loud speaker and all necessary controls for positive operation of the unit are mounted on the front panel. However, the a-c, d-c switch is mounted on the chassis within the case.

[redacted]

22. Par. 3-2. The cabinet is provided with a reinforced cast aluminum cover which is hinged at the bottom and which may be opened through an arc of 180 degrees. The case cover is held closed by a swiveled bolt and wing-nut assembly in a slotted boss located at the top center of the mounting case.

23. Par. 3-3. The cabinet is substantially of the construction shown by sheet 9A of reference (e) and does not exceed the dimensions shown thereon. The actual cabinet dimensions are shown in Plate 5.

24. Par. 3-4. Cast bosses with circular faces 2 inches in diameter are provided on one side and on the bottom of the cabinet to permit drilling and tapping for stuffing tubes for the power and input circuit wiring. These bosses extend the thickness of the case by about 1/4 inch.

25. Par. 3-5. Watertightness of the seal between the cabinet and the cover is provided for by a soft rubber gasket between the edges of the cabinet and the cover. The unit is not submergence-proof because of the opening at the volume control. The speaker diaphragm appears to be non-hygroscopic and to seal the aperture which it covers.

26. Par. 3-6. Four mounting lugs of sturdy design are provided on the sides of the case. These lugs have holes suitable for a 5/16 inch diameter bolt. The lugs are 7/8 inch thick in the direction perpendicular to the bulkhead and the center of the bolt hole is about 5/8 inch from the side of the case.

27. Par. 3-7. The exterior of the cabinet is finished with gray lacquer. This finish is very smooth and the aluminum case was primed with zinc chromate before applying the lacquer.

28. Par. 3-8. The interior of the cabinet is finished with aluminum lacquer applied over a zinc chromate primer. The quality of this finish is excellent.

29. Par. 3-9. The chassis and the major parts of the amplifier rectifier unit are of aluminum with steel blast and lacquer finish. The surface of this finish is uniform and its quality very good.

30. Par. 3-10. The cover of the unit carries the following parts: loud speaker, ON-OFF switch for controlling the power, pilot light to indicate when the power is on, volume control, and name plate.

31. Par. 3-11. The chassis carries all the necessary amplifier and rectifier equipment and is secured by shockproof mountings to the mounting brackets carried by the cover. The shockproof mounts consist of rubber washers around the supporting screws at the four corners of the chassis. These mounts are not very large in volume and hence would be expected to absorb only relatively small amounts of vibrational energy. However, they would be an effective aid in protection against small amplitude vibrations.

[redacted]

32. Par. 3-12. The terminal board for the connection of the input and power wiring is mounted on the rear and inside the cabinet. The terminal strip is of heavy phenolic material and has deeply recessed slots for the terminals; this design provides long leakage paths and a strong, rugged structure. The terminals are legibly marked. The power terminals are marked "a-c"; it would appear preferable to mark them in a manner indicating that the unit may be operated on either a-c or d-c supply and to indicate the proper polarity of connection when d-c supply is to be used. A flexible, multi-conductor cable connects the terminal board to the chassis with sufficient slack to permit the cover to be opened through an arc of 180 degrees.

33. Par. 3-13. The power line fuse block is of sturdy, sub-panel construction consisting of a phenolic panel mounted on screws with bushings to space it from the cover of the case. The fuse block is designed for GT type fuses and is in a position on the inside of the cover which permits ready replacement of fuses after the door of the case has been opened. The fuse block is not marked to indicate the type of fuses to use for replacement. However, it is understood that the production equipments will be so marked. Reference (j), page 8.

34. Par. 3-14. A nameplate is secured to the front of the cover. This nameplate is of Navy standard design, in conformity with specification RE 13A 516-B.

35. Par. 3-15. A blast plate similar in design to that shown by sheet 11A of reference (e) is used to protect the diaphragm of the loud speaker from both mechanical and acoustical damage resulting from the blast of gunfire. The thickness of this blast shield is 3/64 inch. Six holes for mounting the blast shield are provided on a radius of 2 11/16 inches and spaced 60 degrees apart.

36. Par. 3-16. The loudspeaker is of the permanent magnet dynamic type. The diameter of its cone type diaphragm is 4-1/2 inches. This diaphragm is made of a non-hygroscopic fabric base phenolic material. The voice coil is cemented to a cylinder which in turn, is cemented into a recess in the speaker diaphragm. The voice coil terminals are mounted on a fishpaper strip which would not be satisfactory in stability when subjected to high-humidity atmospheres. One of these terminals was loose in the fish paper strip. This strip was not securely mounted because one of the supporting rivets had partly ruptured one end of the strip. In most other respects this loud speaker is a very good unit. The speaker handles 1.75 watts without appreciable change in fidelity or the development of "rattle" or any damage to the unit. The voice coil impedance is rated at 15 ohms.

37. Par. 3-17. The basic components of the power unit and amplifier unit are as follows:

[redacted]

(1) An input transformer.

(2) A push-pull power amplifier.

(3) An output transformer for matching the impedance of the loud speaker voice coil.

(4) A rectifier with the required filter capacitors and reactors.

(5) A switch for shifting from a-c to d-c supply lines.

(6) Required capacitors, resistors, etc., comments on the compliance of these units with Navy specifications are made earlier in this report. Reference Par. 20.

38. Par. 3-18. The vacuum tubes used are one type 3525-GT half-wave high vacuum rectifier and two type 3516-GT beam power amplifiers, and are in accordance with the governing specifications, Reference (e).

39. Par. 3-19. The circuit diagram is given on plate 4, and is essentially that required by the governing specifications, reference (e).

40. Par. 3-20. A D.P.D.T. toggle type switch is provided on the amplifier chassis to eliminate the rectifier tube when the equipment is to be operated from a d-c power supply source. When the switch is in the D.C. position the rectifier tube plate-cathode circuit is shorted and at the same time the heater is opened and a suitable resistor is inserted to permit the maintenance of the proper operating current for the amplifier tube heaters, as is shown in reference plate 4. It may be assumed that the governing specifications, reference (e), meet compliance except where definitely noted in Par. 52.

41. Par. 4-1. The input impedance was 620 ohms at 1000 cycles. It does not depend on volume control setting or input level up to 6 milliwatts.

42. Par. 4-2. The primary of the input transformer has a center tap brought out to a terminal which may be grounded.

43. Par. 4-3. With the volume control set at maximum and an input of 1.8 mw. at 1000 cycles, the output was 1.75 watts to the loud-speaker voice coil, which exceeds the specification requirements by a liberal margin.

44. Par. 4-4. The total distortion for any condition was less than 4% with a sinusoidal input and an output of 5 volts into 15 ohms, corresponding to 1.66 watts. Reference Table 1.

[redacted]

45. Par. 4-5. The frequency characteristic of the amplifier is flat within ± 2 decibels between the limits of 300 and 5000 cycles with reference to the 1000 cycle response. Reference Plate 2.

46. Par. 4-6. The overall frequency characteristic measured as acoustical output with respect to an input of 3.7 milliwatts was flat within + 5 db. and -7 db with respect to the average response over a frequency range of 300 to 5000 cycles. Reference Plate 1. This result agrees qualitatively with the continuously recorded curve obtained by the manufacturer, although the latter shows several peaks which make the total response variation greater than 12 db within the frequency range of 300 to 5000 cycles. See curve MI-8816 of reference (j).

47. Par. 4-7. The acoustical pressure averaged 12 dynes/cm^2 over a frequency range of 750 to 1300 cycles with an input of 1.75 watts to the voice coil. Reference table 2.

48. Par. 4-8. All sound pressure measurements of the speaker were made in a large sound proof room at a distance of six feet and on a line from the cone perpendicular to the front of the Unit.

49. Par. 4-9. The manual volume control attenuation versus angular dial rotation was linear in decibels within ± 12 db. The available variation of output (for constant input) was over 40 db. This control had no effect on the fidelity characteristics of the amplifier. There was no noticeable introduction of distortion or change of input impedance on variation of the manual volume control. Reference Plate 3. The volume control consists of a double potentiometer which varies simultaneously the signal voltages applied to the control grids of the 35L6-GT push-pull amplifier tubes in such a way as to keep these voltages equal in magnitude but in phase opposition.

50. Par. 4-10. No direct tests were made to determine the ability of the speaker with its blast shield to withstand the effects of local gunfire. However, the diaphragm of laminated phenolic material appears to be the sturdiest in structure with which this Laboratory is familiar. The blast shield should afford good protection as it permits only about 6% of the speaker face area to be exposed to the blast. Damping to the back of the diaphragm is obtained through felt-covered apertures at the rear of the diaphragm. These felt covers should be more securely fastened in place. One end of one of these felts had become loose; during gunfire or other shock, it might be forced behind the diaphragm in such a position as to interfere with its motion.

51. Par. 4-11. The total hum and noise level, measured across a 15 ohm load, with no signal impressed on the input was 3.4 millivolts or 63 db. below 1.75 watts. This level is 13 db lower than that required by the governing specification and represents excellent performance in this respect.

[redacted]

52. Summary of Defects which may adversely affect satisfactory operation in shipboard service.

(a) The voice coil terminal strip on the loudspeaker frame is made of fish paper or similar material. One of the terminals is loose in this strip and one of the supporting rivets has ruptured the strip noticeably at one end. This material is not well suited to use in atmospheres of high humidity. Reference Par. 20.

(b) The pilot lamp has a screw-type base which may become loosened by vibration. Reference Par. 20(j).

(c) The main terminal board power terminals are marked "a-c" and do not indicate that the unit may also be operated on d-c supply. Reference Par. 32.

(d) Only two cable bushing bosses are provided on the case. Three are required by the governing specifications. Reference Par. 24.

(e) The brass brackets for supporting the chassis are not nickel-plated. They appear to be finished in aluminum lacquer. Reference Par. 20(p).

(f) The tube sockets are not of Navy standard design. Reference Par. 20(w).

(g) The felt strips covering the apertures behind the loudspeaker diaphragm are not all well secured in place. Reference Par. 20.

(h) The 20 watt 230 ohm ferrule-type resistor does not conform to specifications RS 13A 372J for wire wound fixed resistors. The enamel surface of this resistor does not afford satisfactory protection. Reference Par. 20(l).

CONCLUSIONS

53. The model XT8T Speaker-Amplifier Unit meets the requirements of the governing specifications, with some qualifications which are mentioned in the preceding recommendations. It is strongly constructed, reliable and not adversely affected by mechanical vibrations, with a minor exception. It is better equipped for protection against gunfire than similar equipment known to the Laboratory.

54. Excellent materials and good design are evident throughout the Unit with very minor exceptions. However, the use of corrosive materials has not been kept to an absolute minimum.

55. It is concluded that the Unit with suggested modifications is suitable for use in the Naval Service.

[redacted]

TABLE 1

OUTPUT DISTORTION

(1.65 watts output to a 15 ohm resistor replacing and corresponding to the loudspeaker voice coil)

Line Voltage	Total Output Distortion Percent
103.5 (a.c. 60 cycle)	3.7
115.0 (a.c. 60 cycle)	3.2
126.5 (a.c. 60 cycle)	2.7
125.0 (d.c.)	2.7

TABLE 2

ACOUSTIC OUTPUT FROM LOUDSPEAKER

Frequency	Acoustic Output at Six Feet
750 cycles	13 dynes per square centimeter
1000	11
1300	11

[redacted]

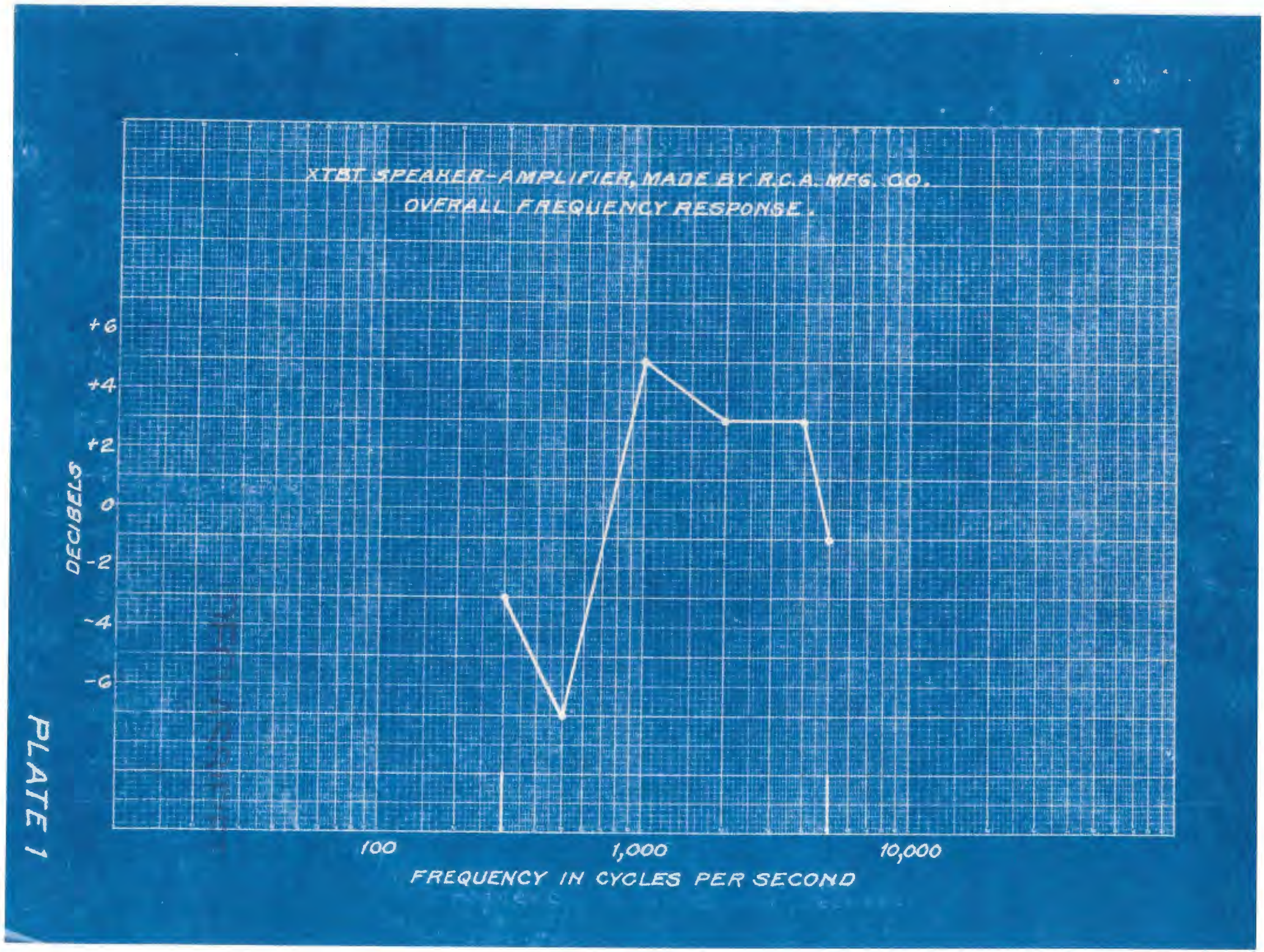

XTBT SPEAKER-AMPLIFIER, MADE BY R.C.A. MFG. CO.
OVERALL FREQUENCY RESPONSE.
+6
+4
+2
0
-2
-4
-6
DECIBELS
100
1,000
10,000
FREQUENCY IN CYCLES PER SECOND

PLATE 1

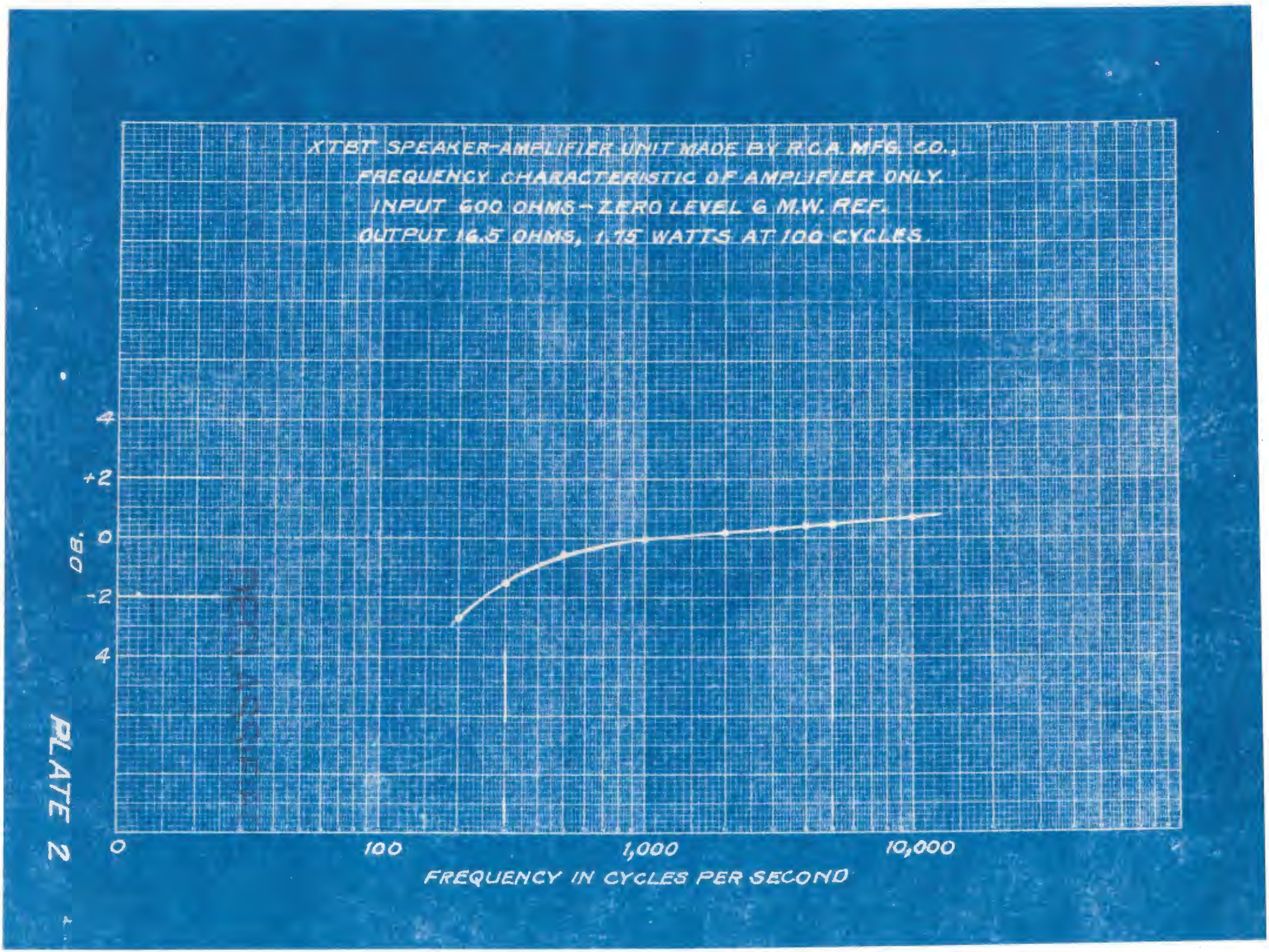

XTBT SPEAKER-AMPLIFIER UNIT MADE BY R.C.A. MFG. CO.,
FREQUENCY CHARACTERISTIC OF AMPLIFIER ONLY.
INPUT 600 OHMS - ZERO LEVEL 6 M.W. REF.
OUTPUT 16.5 OHMS, 1.75 WATTS AT 100 CYCLES.
DB.
4
+2
0
-2
4
0
100
1,000
10,000
FREQUENCY IN CYCLES PER SECOND

PLATE 2

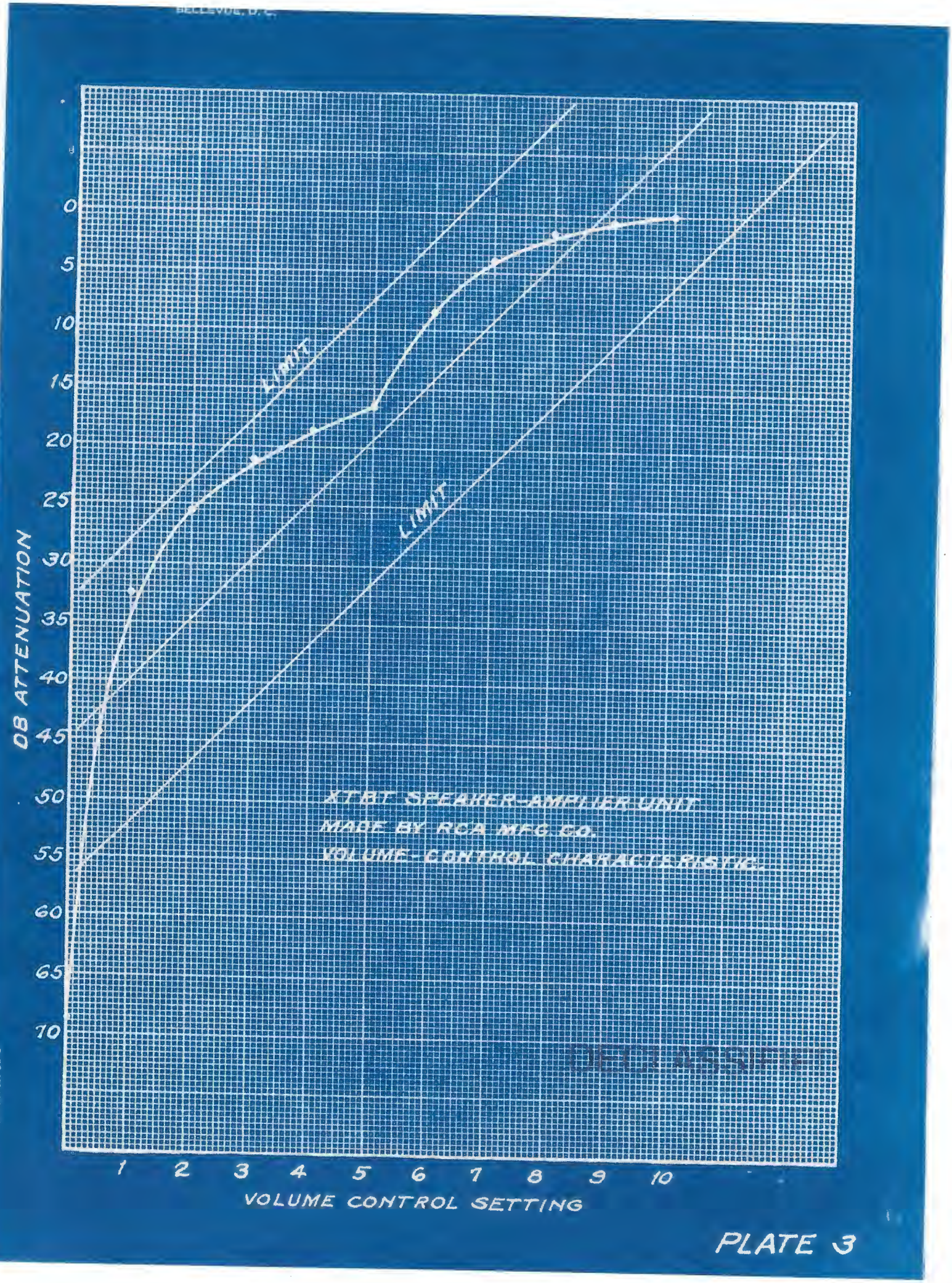
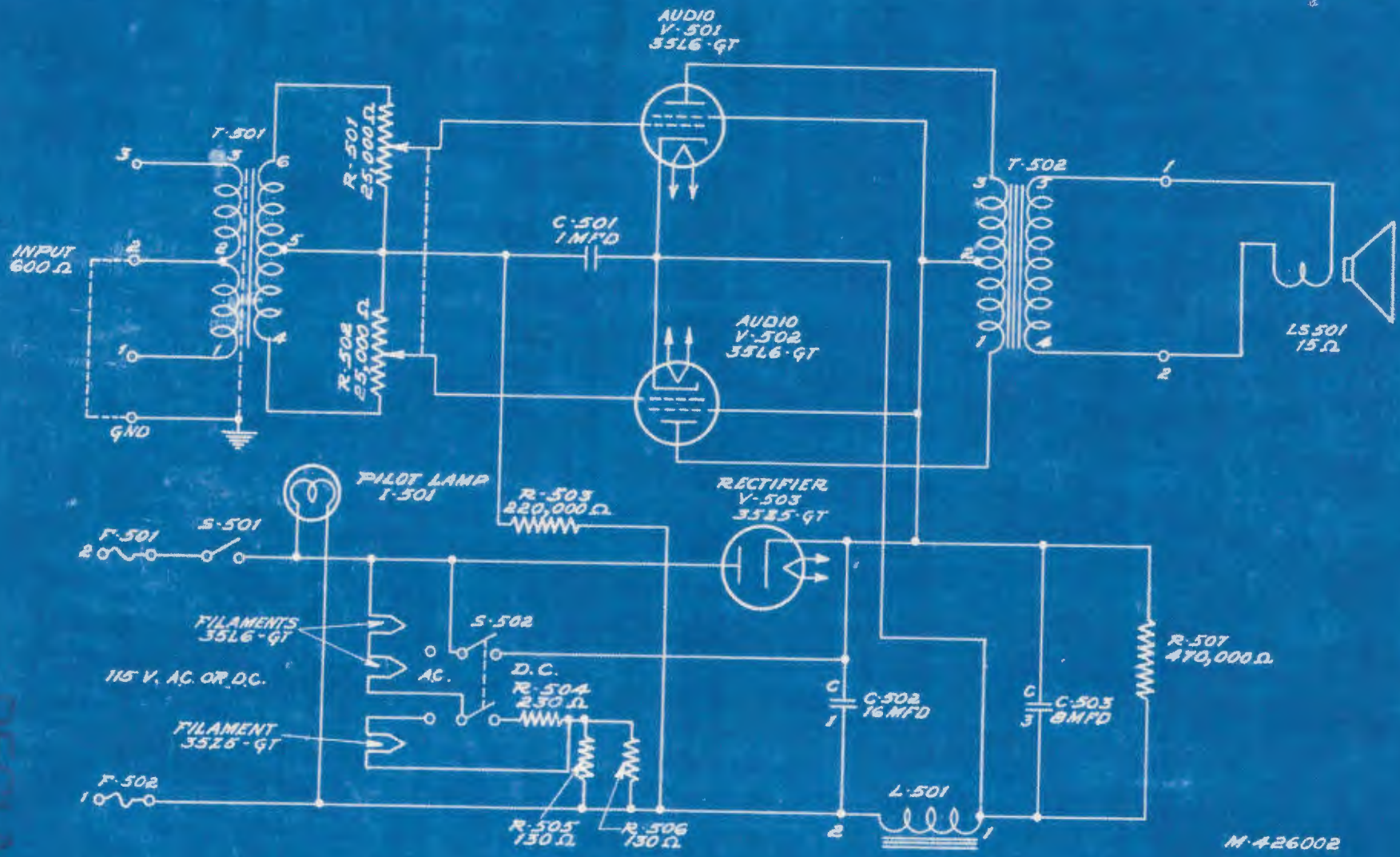
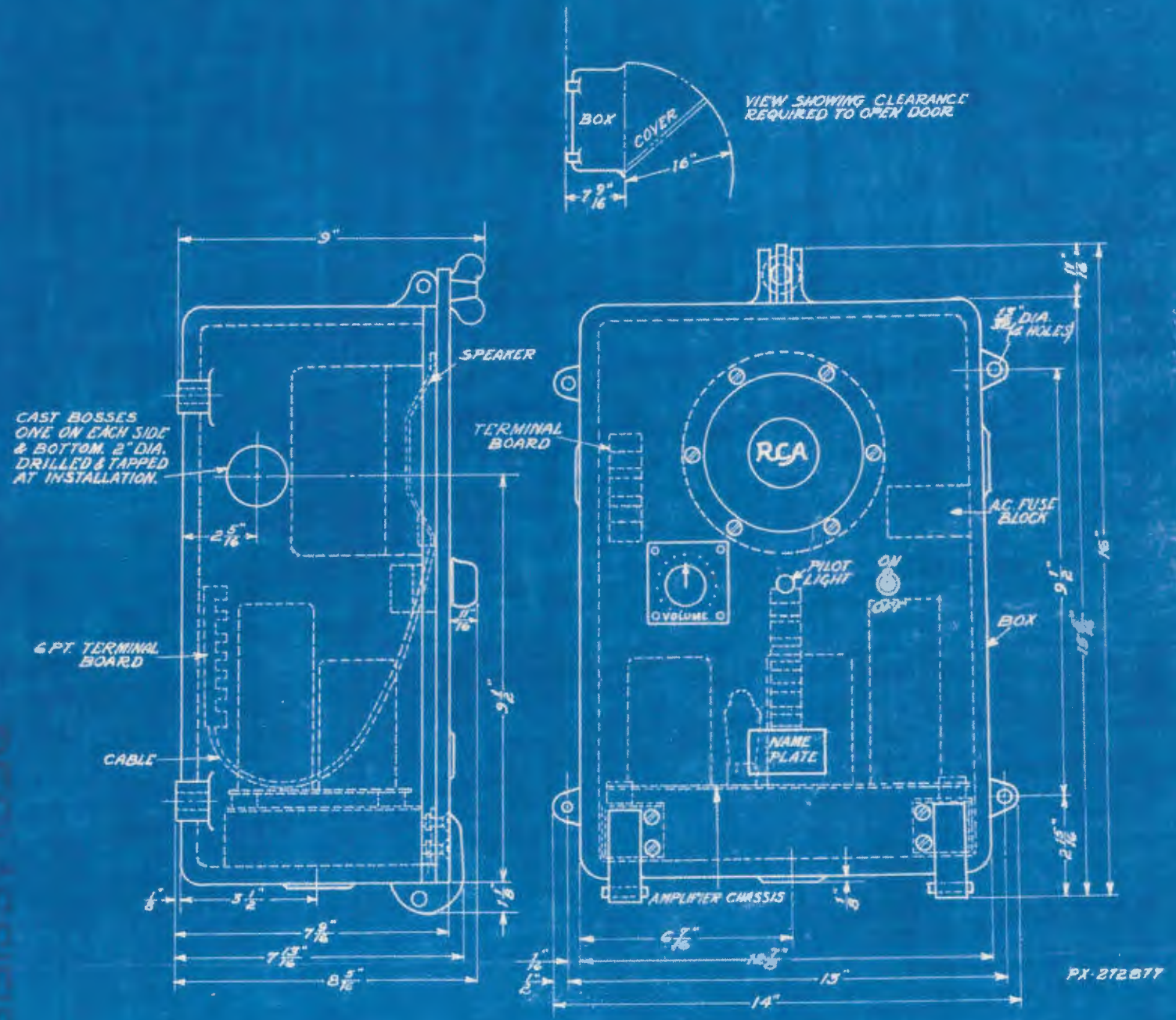

0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
DB ATTENUATION
LIMIT
LIMIT
1
2
3
4
5
6
7
8
9
10
VOLUME CONTROL SETTING
XTBT SPEAKER-AMPLIFIER UNIT
MADE BY RCA MFG CO.
VOLUME-CONTROL CHARACTERISTIC
N.R.I. 314

PLATE 3



MODEL XTBT
SPEAKER-AMPLIFIER UNIT
RCA MFG. CO.

PLATE 4.



MODEL XTBT

SPEAKER-AMPLIFIER UNIT

RCA MFG. CO.

PLATE 5

PLATE 6

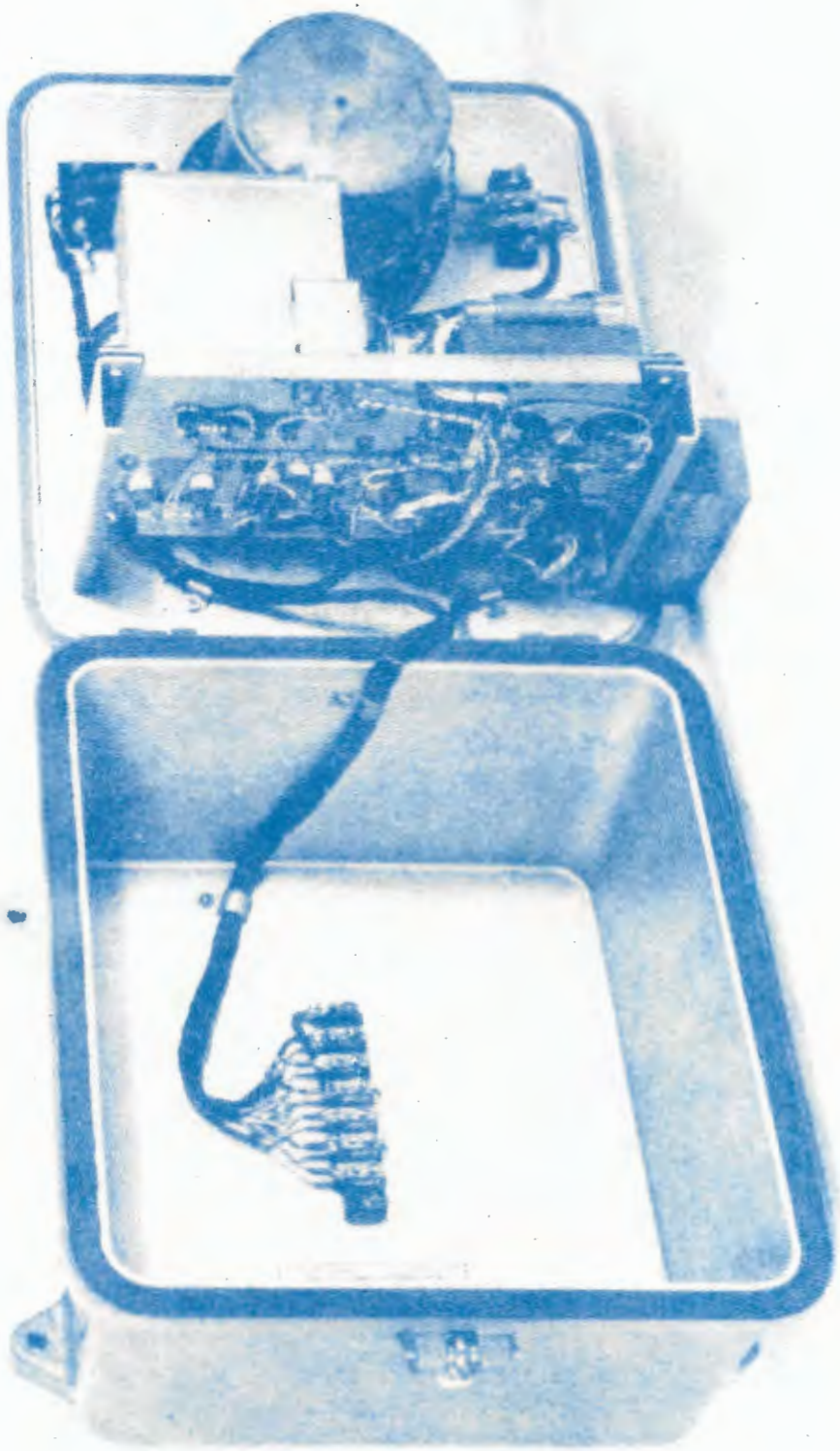


PLATE 7

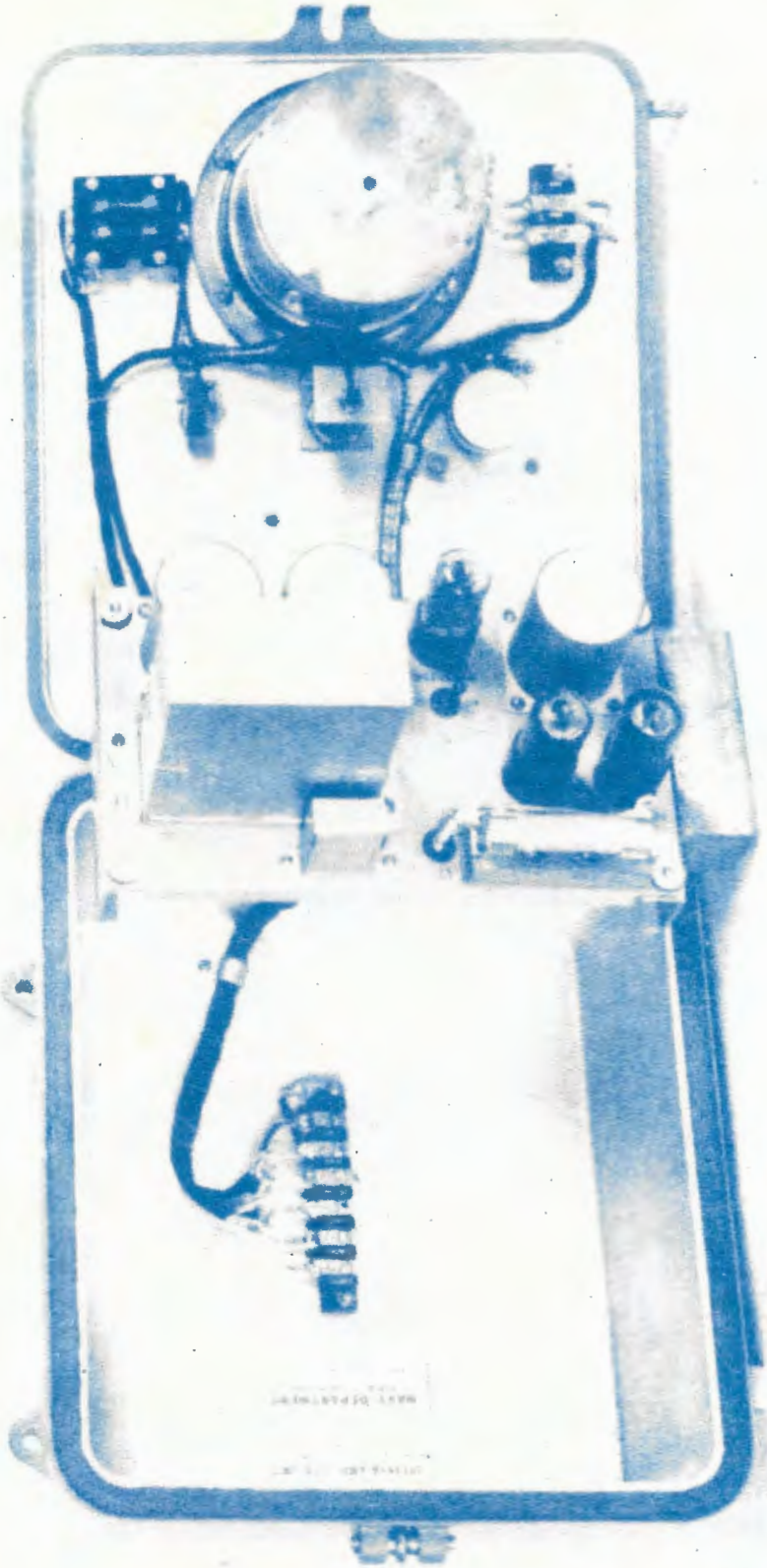


PLATE 8