13 March 1939

NRL Report No. R-1521
BuEng.Prob. F3-13

NAVY DEPARTMENT

BUREAU OF ENGINEERING

FR-1521

Report

on

Test of Weston Oscillator, Model 776

(Weston Electrical Instrument Corporation)

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

Number of Pages: Text - 10 Tables - 11 Plates - 4

Authorization: BuEng let.S67/80(4-22-W8) of 25 April 1938.

Date of Test: 17 - 26 October 1938, 23 - 31 January 1939.

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Distribution: BuEng (10)

LP

S67/S0 (4-22-WS) D-J-Z-8-5-m

FR-1521

25 APR 1938

From: Bureau of Engineering.
To: Director, Naval Research Laboratory, Anacostia, D.C.

Subject: Radio - Commercial Radio Frequency Oscillator - Weston Model 776 - Test of - Bureau of Engineering Problem F3-13.

1. The Weston Electrical Instrument Corporation has submitted to the Bureau a sample of their recently developed Model 776 Test Oscillator (Standard Signal Generator). The interest in this instrument lies primarily in its possible application as an issue to such small vessels as are not allowed Model LM Signal generators. Essentially it is a low priced commercial product not intended to parallel or compete with the Standard LM instrument, nor does it cover the same frequency range as this instrument.

2. The subject oscillator was forwarded to the Laboratory by messenger on 21 April, 1938, and the Bureau desires that it be inspected to determine its suitability for Naval issue and subjected to sufficient tests to determine the performance to be expected from it.

3. In general the following tests are suggested:

(a) Test for accuracy of output vs calibration.

(b) Test for accuracy of frequency calibration.

(c) Test for leakage.

(d) Test for percentage of modulation.

4. Tests (a) and (d) would be additionally valuable if conducted with vacuum tubes possessing high and low transconductances. This is of particular interest with respect to test (a) due to the claims made by the exhibitor for the self-compensating oscillatory circuit, the efficacy of which would appear to be a subject for scrutiny.

5. Bureau of Engineering Problem F3-13 is hereby assigned with Priority "B" to cover the subject tests.

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REPLY IN DUPLICATE
AND REFERENCE TO
S67/74
WILL BE APPRECIATED

NAVAL RESEARCH LABORATORY

ANACOSTIA STATION

SAG:LP

WASHINGTON, D. C.

15 March 1939

From: Director.
To: The Chief of the Bureau of Engineering.

Subject: Radio - Report on Test of Weston Oscillator, Model 776, manufactured by the Weston Electrical Instrument Corporation. (BuEng.Prob.F3-13)

Reference: (a) BuEng let.S67/80(4-22-W8) of 25 Apr.1938.

Enclosure: (A) 10 copies of NRL Report No. R-1521.

1. There are being forwarded 10 copies of NRL Report No. R-1521, Test of Weston Oscillator Model 776, conducted in accordance with reference (a).

2. Information is requested as to what disposition shall be made of this instrument.

H. M. Cooley

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Appendices

AUTHORIZATION FOR TEST

1. The tests herein reported were authorized by reference (a). Other pertinent data are listed as reference (b).

Reference: (a) BuEng let.S67/80(4-22-W8) of 25 April 1938.
(b) Instructions for the Weston Model 776 Oscillator.

OBJECT OF TEST

2. The object of this test was to determine the suitability of subject oscillator for Naval use, and to determine the performance to be expected from it.

ABSTRACT OF TEST

3. The Weston Model 776 oscillator was given an inspection to determine the general character of its mechanical features, also to ascertain the type of circuits employed, no diagram having been furnished by the manufacturers or shown in reference (b). The following electrical tests were made:

(a) Accuracy of output vs calibration.
(b) Accuracy of frequency calibration.
(c) Leakage.
(d) Percentage of modulation.
(e) Frequency of modulation.
(f) Frequency range and overlap.
(g) External audio frequency fields.
(h) Output impedance.
(i) Frequency drift.
(j) Frequency stability with change in line volts.
(k) Frequency stability with change in output.
(l) Value of harmonics of radio frequencies.
(m) Variation in output with change of oscillator tube.

Conclusions

(a) Realizing that the subject oscillator is built primarily to meet the needs of service men, and to come within comparatively low cost limitations, it is considered to be a very satisfactory instrument for use where accuracy of output, and durability over long periods of operation are not of paramount consideration.

(b) While the subject oscillator is a compact, readily portable unit, which can be quickly made ready for use in any location, its construction is considered to be frail and non-rigid, and many of the materials used are of a type that would not meet Navy standard specifications. The parts are not sufficiently protected to withstand sea atmospheres over any considerable period of time without serious effect upon the proper functioning of the parts.

(c) In performance, tests show the accuracy of frequency and operation in general to be such that the equipment may be considered valuable for use in locating trouble, making comparative tests and other adjustments where accuracy of output is not necessarily required. The outputs are much below the rated values in the three highest frequency bands, and on account of the comparatively high output impedance, would be still further affected when operating into a low impedance circuit.

Recommendations

(a) It is recommended that this instrument not be considered sufficiently rugged or reliable for general service use. It may, however, in view of its relatively low cost, be considered as a desirable and useful instrument in servicing receivers where accuracy is not essential and where it is not subjected to high humidity, saline atmosphere, or physical abuse.

DESCRIPTION OF MATERIAL UNDER TEST

4. One Weston Model 776 oscillator, a commercial product manufactured by the Weston Electrical Instrument Corporation, Newark, New Jersey, frequency range 50 to 30,000 kilocycles.

METHOD OF TEST

5. Accuracy of the CW output was checked by applying the output of the subject oscillator to the input terminals of Model RAA and RAB receivers, through standard antennae, General Radio Types 418 and 418G, with gain adjustment for a standard output, then substituting the output from a Model LC No. 8 standard signal generator and recording the equivalent microvolts necessary to produce the same receiver output without change of receiver adjustments. Type 418 has a series combination of L, 20µh, C, 200 µµf, and R,25 ohms. Type 418G has a series parallel arrangement of L 20 µh, C_1 200 µµf, C_2 400 µµf and R 400 ohms, being the standard antenna adopted in I R E Standards for 1938. A second method of checking used the Model RAG receiver for low frequencies, and the Model RAL receiver for frequencies above 600 kilocycles applying the oscillator output directly to the grid of the first r-f tube to assure a high impedance which would not result in oscillator output loading.

6. The audio frequency output was measured by the use of a Balantine Model 300 electronic voltmeter for direct reading of the oscillator output.

7. Accuracy of the frequency calibration was checked against the Model LN signal generator, using Model RAA and RAB receivers with the heterodyne oscillator off, and zero beating the subject oscillator with the Model LN. Leakage was measured both by setting the slide wire of subject oscillator on zero with the output connected to the receiver, and by disconnecting the output of subject oscillator from the receiver, and using an insulated feeler wire connected to the receiver input, four inches of which was laid along the cracks between the panel and subject oscillator case. The equivalent microvolts from the Model LN signal generator to produce the same receiver output were recorded in each case.

8. Percentage of modulation was measured by the use of a DuMont oscillograph Type 168, Serial 927, by measuring the vertical deflection of the modulated signal, and the unmodulated carrier and applying the formula in which the modulation percentage equals $\frac{H_2 - H_1}{H_1} \times 100$. The modulating frequency was determined by beating the audio output of the subject oscillator with a General Radio audio frequency oscillator, Type 713A, the frequency of this audio oscillator first having been checked with the reed adjustment incorporated therein.

9. External audio frequency fields were measured using the secondary winding of a Type SE 4342B audio transformer as a pick up, the voltage being fed through a General Radio Type 714A, Serial 160A,

voltage amplifier. The amplifier was adjusted to give a 50 decibel gain and its output was connected to a General Radio 20,000 ohm output meter to provide a standard output level for several positions of the pick-up transformer with respect to the oscillator under test.

10. The output impedance was measured as the d-c resistance across the output terminals, with a Leeds and Northrup Type S Wheatstone bridge (Serial No. 143465).

11. Frequency drift and frequency stability were measured by reference to a Model LD_{2X} heterodyne calibrator, Serial 1.

12. The harmonic output of the oscillator was determined by adjusting a radio receiver to the oscillator fundamental for the test frequencies of 1200 and 6000 kilocycles, noting the microvolts required for a standard output, then adjusting the oscillator for other frequencies which have harmonics at 1200 or 6000 kilocycles and for sufficient oscillator output to give the standard receiver output. The percentage of harmonic output was then considered to be the microvolts at receiver resonant frequency required for standard output times 100, divided by the microvolts at the frequency which produces a harmonic at receiver resonant frequency.

13. Variation in output voltage and frequency with replacement of the Type 6L7 oscillator tube was measured using the Model RAB receiver and output meter combination as a voltage indicator, observing the variation in radio frequency in terms of beat note, audio output of the receiver.

DATA RECORDED DURING TEST

14. Complete data were recorded for all tests conducted, which are contained in appropriate paragraphs in the following section on results of test, and Tables 1 to 11 inclusive, appended hereto.

PROBABLE ERRORS IN RESULTS

15. The estimated percentage of overall accuracy of the various measurements is given in the following list:

Accuracy of output vs calibration under 7500 kilocycles	± 10%
Accuracy of output vs calibration above 7500 kilocycles	± 25%
Accuracy of frequency calibration	± 1.5%
Leakage	± 10%
Percentage of modulation	± 5%
Frequency of modulation	± 1%
Frequency range and overlap	± 1%
External audio frequency fields	± 10%
Output d-c resistance	± 1%
Frequency drift	± .1%
Frequency stability	± .1%
Value of harmonics of radio frequencies	± 10%
Variation in output with change of oscillator tube	± 10%

16. The Model LN signal generator, which was used for checking frequencies, is itself subject to an error of ± 1%, but was considered suitable for use in these measurements inasmuch as the construction of the pointer on the subject oscillator is such that it is difficult to determine the exact setting within 1-1/2% at the higher frequencies.

RESULTS OF TEST

17. A description is given below of the fundamental elements of the subject oscillator, which consists of

(a) Carrier oscillator
(b) Buffer tube
(c) Modulator tube
(d) Attenuator system
(e) Rectifier tube
(f) Filter
(g) Power transformer
(h) Line filter

(a) The carrier oscillator tube is a commercial Type 6L7 pentagrid mixer amplifier. The first grid serves as the control grid to which a tuned circuit is coupled. The second and fourth are the screen grids. The third grid, by virtue of the induced d.c. from the screen grid, serves as the anode for the oscillatory circuit. This grid is r-f coupled to ground through a condenser, and has a d-c path to ground through a choke and resistor. The impedance of a section of the tuning inductance is between ground and the cathode, and the mutual inductance of this section with the remaining section couples the anode circuit to the control grid. The fifth grid is tied to the cathode. The plate acts mainly as an accelerator anode; the modulation frequency voltage, however, being applied to this plate circuit. A band change switch cuts in six separate coils for the tuning inductance to cover the range of 50 kilocycles to 30,000 kilocycles. The wobbler jack is connected directly across the terminals of the main tuning condenser, thus permitting variation of the frequency from an external source.

(b) The buffer tube is a commercial Type 76 triode, grid excitation being supplied directly from the cathode of the oscillator tube. There is a fixed cathode resistor and in series with this resistor to ground is a potentiometer. The arm of this potentiometer regulates the output level and is coupled through a condenser to the attenuator network or output divider. A switch connects the output leads either across the entire network and ground, or across taps in the network to ground.

(c) The modulator tube is also a commercial Type 76 triode, grid bias being obtained by means of a cathode resistor. In the grid circuit of this tube is the primary of the modulation transformer, shunted by a fixed condenser. The secondary of this transformer is in the plate circuit of the modulator tube, and by reason of the audio impedance of the filter in the common plate supply lead, modulation voltage is supplied to the plate of the oscillator tube. A modulation switch has three positions as follows: "RF Mod," "RF unmod," and "Audio." This is a double arm rotary switch and in the first position one arm connects the voltage supply to the screen grid of the oscillator tube, while the second arm is on a blank contact. In the second position, one arm connects the voltage supply to the screen grid of the oscillator tube as before, while the second arm places a ground on a tap in the primary of the modulation transformer, thus shorting out a section of the primary and stopping oscillations in the modulator tube. In the third position, one arm disconnects the voltage supply to the screen grid of the oscillator tube and the other connects the tap on the primary of the modulation transformer to the output level control potentiometer, thus supplying audio voltage direct to the attenuator system.

(d) The attenuator system consists of the potentiometer mentioned in (b) describing the buffer tube, and also a resistor network with taps to attenuate the output. A multiplier switch is provided which provides attenuation in steps so that the final output can be read either directly from the continuously variable dial or the value thus indicated may be multiplied by 10, 100, or 1,000 depending upon switch position.

(e) The rectifier tube is a commercial Type 84 full wave rectifier.

(f) The filter consists of an iron cored choke, shunted by an electrolytic condenser, and with a .25 mfd condenser from the side away from the rectifier to ground.

(g) The power transformer has separate secondary windings for the filament supply and high voltage supply.

(h) The line filter consists of a universal wound coil on a 1/2 inch form in each side of the line, each coil shunted by a tubular paper shell condenser. These are connected to the line plug through a shielded lead, and a block containing a 1 ampere automobile type fuse in each side of the line.

A schematic diagram of the oscillator circuits, as traced out by the Laboratory, is shown on Plate 1.

18. The following is a description of the mechanical features of the subject oscillator:

Case. The case is of iron or steel of 1/16 inch thickness, made of one piece with overlapped and welded corners. It has a black wrinkle finish, and measures 9-7/8 inches high, 15-7/8 inches long, and 4-7/8 inches deep, the controls projecting 3/4 inch from the front of panel. There are four rubber feet bolted to the bottom of the case, and there are holes in the end of the case with rubber grommets for the power line and output cables. It has a leather carrying handle on the top.

Chassis. The chassis is also of magnetic material .052" thick, cadmium plated, and consists of a sheet of metal bent at right angles at the front and back for 2-5/8 inches. This is fastened to the back of panel, the sole means of securing being the nuts which secure three of the switches mounted on the panel.

Panel. The panel is of aluminum .046 inch thick, with all edges bent at right angles for approximately 1/2 inch. These edges fit over the case, and the panel is secured to the case with slotted screws, the holes in the case being threaded. The frequency range switch, modulation control switch, output multiplier switch, output level potentiometer and power on-off switch are all mounted on the back of the panel, as well as the main tuning condenser assembly. The frequency range switch also supports the entire tuning inductance system of six coils. All other parts are mounted on the chassis, mostly on the under side. The controls on the front of panel consist of four oblong molded plastic knobs for the frequency range, modulation control, and output multiplier switches, and the output level potentiometer. There is also one round molded knob for the control of the main tuning condenser. This tuning control is coupled through a so-called "free wheeling" drive, which operates the pointer shaft through a belt, the pointer shaft being geared to the main condenser shaft, with a split gear on the condenser shaft, having a spring to prevent back lash. The final controlled effect on the main condenser from the vernier knob is approximately a 20 to 1 ratio over one-tenth of the range, and approximately a 4 to 1 ratio over the balance of the range. The sector where the 20 to 1 ratio is effective may be changed at will in either direction by rotating the dial past the point where it is desired to use it, and then backing off. The low gear ratio picks up after rotation through one-tenth of the range in either direction. The dial has six scales, calibrated for direct frequency reading and is of paper stamped with black and red ink. The pointer is attached to an auxiliary shaft, which as stated above is geared to the main condenser shaft, so that the pointer covers approximately 340° for 180° of condenser rotation. The dial and pointer are enclosed by a glass window supported by a molded plastic frame, having the appearance of bakelite, secured to the front of the panel. The balance of the front of the panel is reversed photo-etched, with all controls plainly marked except the control for the tuning condenser. There is also a wobbler jack on the front of the panel, which has a screw cap.

Main Tuning Condenser. The main tuning condenser has a steel frame and shaft, cadmium plated while the plates are of aluminum. The shaft is slotted, and the rotary plates are swedged in these slots. The stationary plates are also swedged in steel brackets, which are supported on bakelite strips. The condenser shaft has a spring brass forked arm for a sliding contact. The belt from the drive control to the dial shaft is of treated canvas 3/16 inch wide, and the slack is taken up by an idler pulley mounted on an arm positioned by the tension of a coil spring.

Fixed Condensers. The fixed condensers are of the molded mica type except for one electrolytic and one .25 mfd molded condenser in the plate supply filter, two tubular paper condensers in the line filter and one wax coated paper condenser in the lead from the output level control to the attenuator network.

Fixed Resistors. The fixed resistors appear to be of the "Centralab" type except for two which appear to be wire wound and enamel dipped. The resistors in the attenuator network appear to be wire wound on bakelite strips, but are made up in a small compact unit, and are so enclosed that inspection is not practicable.

Tube Sockets. The tube sockets are of plastic composition, having the appearance of bakelite.

Coils. The tuning coils are wound on 3/4 inch bakelite forms. Two of the coils have bare wire and are single layer space wound; two have enameled wire and are single layer close wound; while two have silk covered wire, and are universal wound. The choke coils in the No. 3 grid and the screen grid leads from the oscillator tube are three section coils of silk covered wire, universal wound on 3/8 inch forms. None of these coils has more than a very thin application of varnish or other coating material. The choke coils in the filament leads, and in the line filter are universal wound and have a heavy wax coating. These are on 1/2 inch forms.

Transformers. The transformers and iron cored choke are not enclosed and appear to have only a very light coating of varnish, with the paper between the winding layers and the fine wire terminal leads exposed.

Switches. The multiple switches are of an unknown wafer type and have single bearings and punched bakelite insulation approximately 1/16 inch thick. The arms make sliding contact with spring fingers, which appear to have a silver plating. Positioning clicks are definite, resulting from the operation of two rollers on the outer ends of a heavy spring, the rollers dropping into slots in a metal disc. The toggle on-off switch has fiber insulation and is not enclosed.

Wiring. The hook-up wire has a thread wrapping over which is a composition which does not appear to be rubber, and a fabric outside covering, apparently wax treated. This wire also appears to have "push-back" qualities. The power and output cables are metal shielded and rubber covered, and are permanently secured to the chassis. The output leads from the buffer tube to the output control, and from this control to the attenuator system, are metal shielded.

Shielding. Shielding is accomplished by use of four aluminum cans, one for each of the following assemblies, the tuning coil and frequency range switch assembly, the output level potentiometer, the output multiplier switch including the attenuator network, and the power line filter. The can enclosing the tuning coils is supported by two bolts which are a part of the switch assembly, and the two cans enclosing the output level potentiometer and the output multiplier switch and attenuator network are held in place by the nuts securing the potentiometer and switch to the panel. The soldering and workmanship is generally very good and all parts are readily accessible. The total weight of the oscillator is 17-1/2 pounds. The results of the electrical tests are shown below.

Accuracy of Output vs Calibration. Table 1 shows the accuracy of voltage calibration when applying the oscillator output through a standard antenna to the receiver terminals, and Table 2 shows the accuracy of voltage calibration when applying the oscillator output directly to the grid of the first r-f tube, thus placing no appreciable load across the output terminals, and giving a measure of the actual voltage delivered by the oscillator under no load condition. Table 3 shows the output resulting from the operation of the output level control, for every 10 divisions on the control dial, from 0 to 100, at various frequencies. From Table 2 it will be noted that the outputs are generally in excess of the voltage calibration in bands 1 and 2, and at the lower end of band 3, the maximum being 36% in excess of the calibration at 550 kilocycles using the 1,000 multiplier; 98% in excess at 160 kilocycles using the 100 multiplier, 182% in excess at 50 kilocycles using the 10 multiplier, and 75% in excess at 550 kilocycles using the 1 multiplier. At the upper end of band 3, and in bands 4, 5, and 6, the outputs are generally less than the voltage calibration, the minimum being 9.1% of the voltage calibration at 12,000 kilocycles using the 1,000 multiplier, 11% at 16,000 kilocycles using the 100 multiplier, 12.5% at 16,000 kilocycles using the 10 multiplier, and 26.5% at 16,000 kilocycles using the 1 multiplier. It will also be noted that the output voltage varies considerably in each band, from the lower end of the band to the upper end. Table 4 shows a measure of the audio output of the oscillator for various attenuator settings, the maximum output being 0.92 volt.

Accuracy of Frequency vs Calibration. The degree of accuracy of calibration is shown in Table 6, which table also shows the minimum and maximum frequency coverage of each band. Accurate setting of the pointer to the dial calibration is difficult from the fact that the outer edge of the pointer is much thicker than the inner edge and the graduations on the dial, so that the graduation line is obscured when looking at the pointer from directly in front. The maximum error found as compared with the Model LN is 1.6%, which occurs at 20,000 kilocycles. Inasmuch as the Model LN is subject to a calibration error of from 0.5% to 1%, the error in calibration of the subject oscillator is considered to be within 1.5%.

Leakage. The leakage as measured with a 4 inch pick up wire placed along the cracks of the oscillator case is shown in Table 6, the maximum of 180 equivalent microvolts occurring at 20,000 kilocycles. The leakage from the output leads, when the output level control is on zero and the multiplier on 1,000, is shown in Table 3, the maximum occurring at 1,000 kilocycles. These leakage values are excessive as compared with specification requirements for equipments such as the Model LN.

Percentage of Modulation. The percentage of modulation, measured in accordance with the procedure outlined under METHOD OF TEST, is 20. The modulation frequency is 320 cycles.

Frequency Range and Overlap. The frequency range is shown in Table 5 to be from 46.2 to 30,000 kilocycles, the overlap between bands also being shown in this table.

External Audio Frequency Fields. External audio frequency fields were measured in accordance with the procedure outlined under METHOD OF TEST, and the results are shown in Table 7.

Output Impedance. The output being fed from a resistance attenuator network, its impedance can be described as being chiefly resistive except possibly at the higher frequencies. The d-c resistance as measured across the output leads is shown in Table 8.

Frequency Drift. The frequency drift, as measured at 5,000 kilocycles over a period of 2 hours was found to be 2.85 kilocycles, or .057%.

Frequency Stability with Change in Line Voltage. Frequency stability with change in line voltage is shown in Table 9 and was measured at 1,000 kilocycles and 6,000 kilocycles; the maximum change with a voltage increase of 5%, at 6,000 kilocycles, was .01365%.

Frequency Stability with Change in Output. No shift in frequency with change in output was noted. It was noted, however, that a change from cw to mcw output at 6,000 kilocycles caused a shift of 1.6 kilocycles, or .0267%.

Harmonic Output of Radio Frequencies. The harmonics from frequencies of 200, 240, 300, 400, and 600 kilocycles which produce 1200 kilocycles and the second harmonic of 3,000 kilocycles were determined by the method described under paragraph 12. The results in terms of percentage of the fundamental are given in Table 10. The maximum found is the second harmonic of 600 kilocycles which equals 7.7%.

Variation in Output Voltage and Frequency Resulting from Replacement of the Oscillator Tube. The oscillator was adjusted for a 1,000 kilocycle output of sufficient voltage to produce a standard 1,000 cycle receiver output when fed through a Model RAB receiver. The 6L7 oscillator tube was replaced with other tubes having various mutual conductances and the receiver output voltages and audio frequencies were noted. These data are given in Table 11. The variation in mutual conductances of the tubes available was not great, ranging from 1100 to 1300 micromhos. The variation in oscillator output voltage was as great as 31% and the frequency about .3%. This change in output does not appear to be governed by the mutual conductance as this maximum change resulted when a tube having the same mutual conductance as the original was substituted. It also appears that the frequency change is not a direct function of the mutual conductance. This may be the result of the unusual method of obtaining anode voltage in which the effective anode potential would appear to depend greatly upon the spacing of the tube elements rather than mutual conductance. In Table 2, a change of 2 to 1 in output is noted over the range of a coil, which indicates that the manufacturer's claims of controlling the mutual conductance of the oscillator tube, to keep the oscillator signal at a flat voltage level over each range, are not fully realized.

CONCLUSIONS

19. Realizing that the subject oscillator is built primarily to meet the needs of service men and to come within comparatively low cost limitations, it is considered to be a very satisfactory instrument for use where accuracy of output and durability over long periods of operation are not of paramount consideration.

20. While the subject oscillator is a compact, readily portable unit, which can be quickly made ready for use in any location, its construction is considered to be frail and non-rigid, and many of the materials used are of a type that would not meet Navy standard specifications. The parts are not sufficiently protected to withstand sea atmospheres over any considerable period of time without serious effect upon the proper functioning of the parts.

21. In performance, tests show the accuracy of frequency and operation in general to be such that the equipment may be considered valuable for use in locating trouble, making comparative tests and other adjustments where accuracy of output is not necessarily required. The outputs are much below the rated values in the three highest frequency bands, and on account of the comparatively high output impedance, would be still further affected when operating into a low impedance circuit.

Table 1

Accuracy of Output vs Calibration
Equivalent Output in Microvolts Checked with Model LC Standard Signal Generator using RAA-RAB Receivers
Standard 418 Antenna used with RAA
Standard 418G Antenna used with RAB
Weston 776 Oscillator

		RAA					RAB							
Multi-plier	Scale	50 kc µv	160 kc µv	160 kc µv	550 kc µv	550 kc µv	1800 kc µv	1800kc µv	5500kc µv	5500kc µv	16000kc µv	12000 kc µv	16000 kc µv	30000 kc µv
x 1000	100	98,000	130,000	120,000	109,000	127,000	73,000	55,000	36,000	22,000	10,500	7,300	12,500	10,500
x 100	100	9,600	12,900	12,200	13,000	14,200	20,000	13,500	8,400	4,650	1,100	1,210	1,270	173
x 10	100	1,060	1,400	1,330	1,400	1,540	1,960	1,360	940	497	128	120	148	300
x 1	100	110	160	150	153	177	189	140	132	58	28	26	50	254

Table 2

Accuracy of Output as indicated by Step Attenuator Switch Position
Equivalent Output in Microvolts Checked with Model LC Standard Signal Generator
Using Model RAG - RAL receivers - Output of Oscillator applied directly to grid of first r-f tube in each receiver.
Weston 776 Oscillator
(Refer to headings above)

		RAG					RAL							
x 1000	100	95,000	134,000	123,000	112,000	136,000	63,000	78,000	38,800	21,200	10,400	9,100	16,000	#
x 100	100	10,900	19,800	13,500	14,600	15,900	10,000	16,700	10,000	5,000	1,100	1,700	1,480	#
x 10	100	2,820	2,180	1,500	1,530	1,720	2,500	1,920	1,080	800	125	155	158	#
x 1	100	122	160	148	154	175	210	160	159	72	31	27	26.5	#

Model RAL receiver range does not cover 30,000 kilocycles.

Table 3

Accuracy of Output
as indicated by
Variable Attenuator Calibrations
using Model RAA-RAB Receivers

Equivalent output in microvolts checked with Model LC Standard Signal Generator.

Standard 418 Antenna used 100 - 1,000 kilocycles
Standard 418G Antenna used 1,000 - 5,000 - 25,000 kilocycles

			(418 Ant)	(418G Ant)		
Multiplier	Scale	100 kc	1000 kc	1000 kc	5000 kc	25000 kc
x 1,000	100	107,000	115,000	109,000	42,200	13,200
	90	100,000	110,000	104,000	38,000	8,800
	80	92,500	107,500	100,000	35,100	3,470
	70	84,500	98,000	95,000	31,700	2,340
	60	73,000	89,000	88,000	28,100	1,770
	50	62,000	80,000	77,000	24,100	1,400
	40	53,000	70,000	67,000	20,700	1,180
	30	43,400	58,000	53,000	18,300	1,000
	20	27,600	42,200	43,200	13,400	700
	10	7,200	12,200	15,500	5,700	352
	0	244	400	400	194	128

Table 4

Measure of Audio Output
for Various Attenuator Settings
Weston Oscillator 776

Frequency	Output Level Setting	Multiplier	Output in Volts
320 cycles	10	x 1,000	.037
	20		.135
	30		.235
	40		.335
	50		.445
	60		.525
	70		.67
	80		.77
	90		.86
	100		.92
	100	x 100	.097
	100	x 10	.01

Table 9

Frequency Stability with Change ± 5% in Line Volts
Weston Oscillator 776

Frequency	Line Volts	Output Frequency Cycles	% Change of R.F.
6000 kc	110 to 115.5	1000 to 1820	.01365
	110 to 104.5	1000 to 250	.0125
1000 kc	110 to 115.5	1000 to 1060	.006
	110 to 104.5	1000 to 900	.01

Table 10

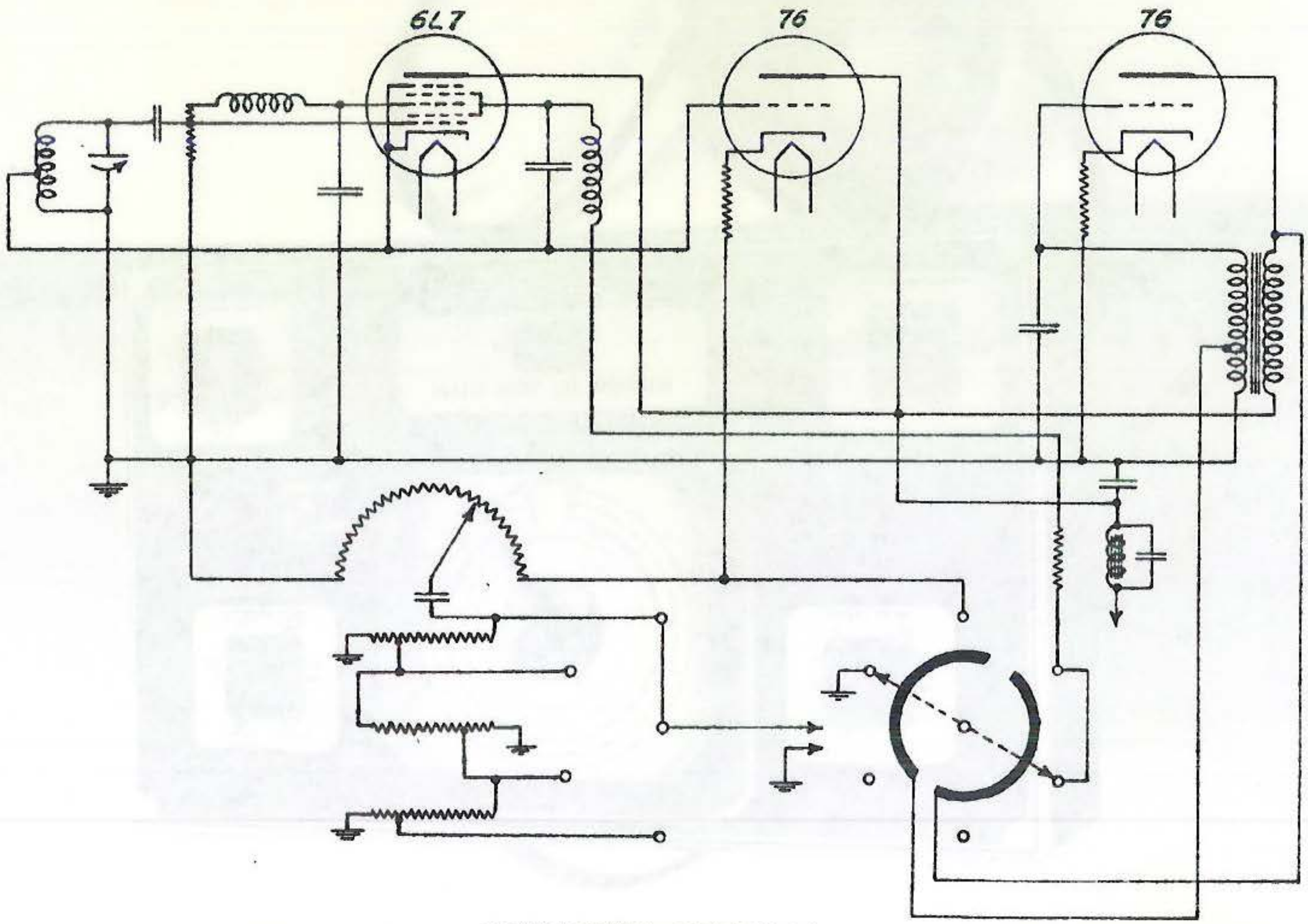
Value of Harmonics of Radio Frequencies
Weston Oscillator 776

Frequency Oscillator Fundamental	µv Input for a Standard Output	Harmonic Value in % of Fundamental
1200 kc - resonant freq. of recr.	10	0
600 kc - 2nd sub.har. of recr.freq.	130	7.7
400 kc - 3rd " " " " "	240	4.17
300 kc - 4th " " " " "	216	4.63
240 kc - 5th " " " " "	588	1.7
200 kc - 6th " " " " "	1560	.64
6000 kc - resonant freq. of recr.	990	-
3000 kc - 2nd sub.har.of recr. freq.	68880	1.44

Table 11

Variation of Output Voltage
with Replacement of Oscillator Tube

Frequency	Tube	Gm	Per Cent of Initial Output Voltage	Variation of Output Freq.Cycles	% Change in R.F.
1000 kc	6L7 No. 1	1100	100	1000	0
	2	1300	86	2953	0.19
	3	1260	89	1512	0.0512
	4	1120	84	2432	0.1437
	5	1270	69	884	0.0116
	6	1100	69	2448	0.1448
	7	1230	95	1229	0.0229



SCHEMATIC DIAGRAM
WESTON OSCILLATOR 776
AS TRACED FOR PROBLEM F3-13

PLATE 1

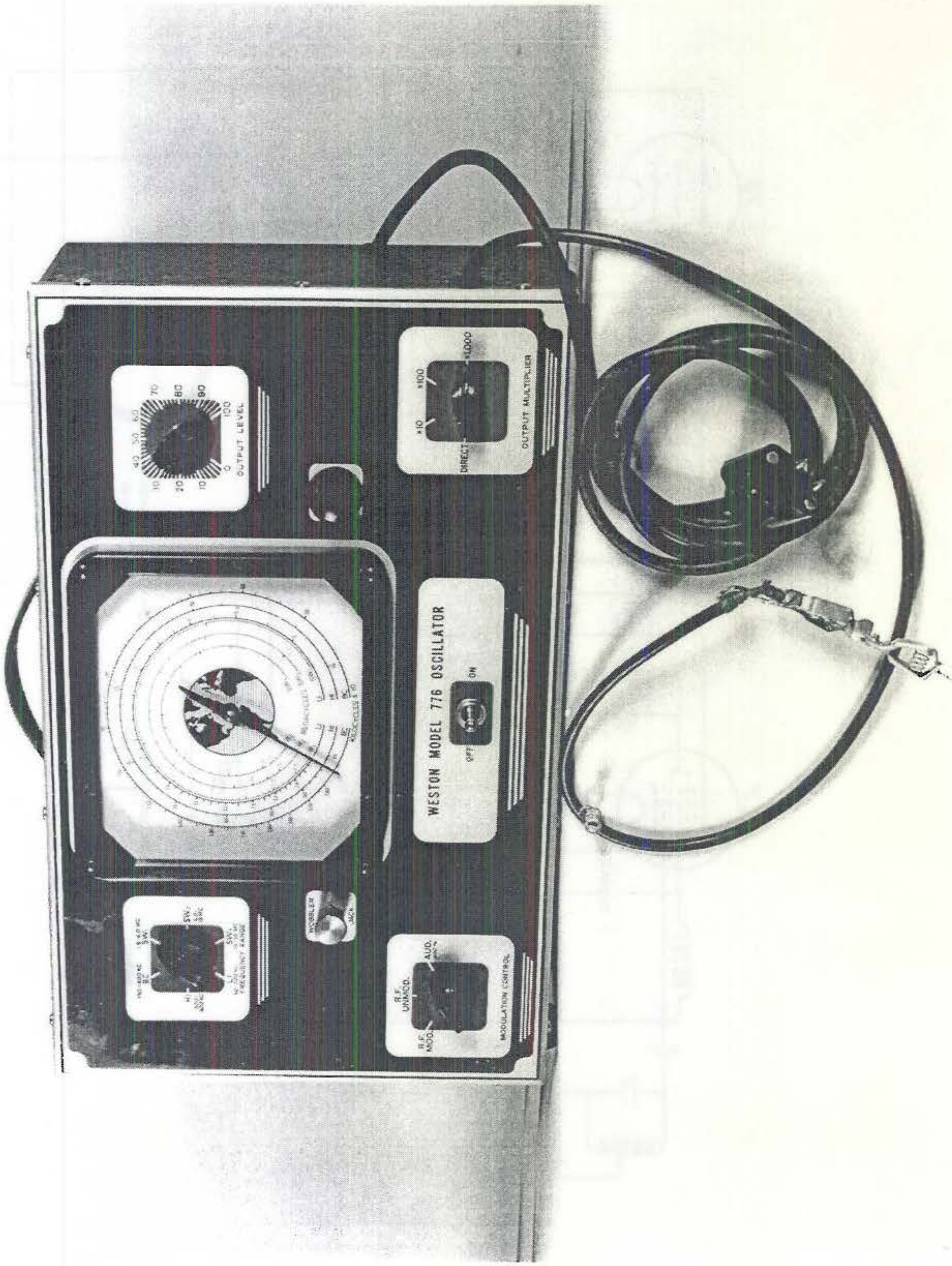

WESTON MODEL 776 OSCILLATOR
OFF
ON
OUTPUT LEVEL
OUTPUT MULTIPLIER
DIRECT
x10
x100
x1000
WOBBLER
JACK
FREQUENCY RANGE
MODULATION CONTROL
R.F. MOD.
R.F. UNMOD.
AUD.

PLATE 2

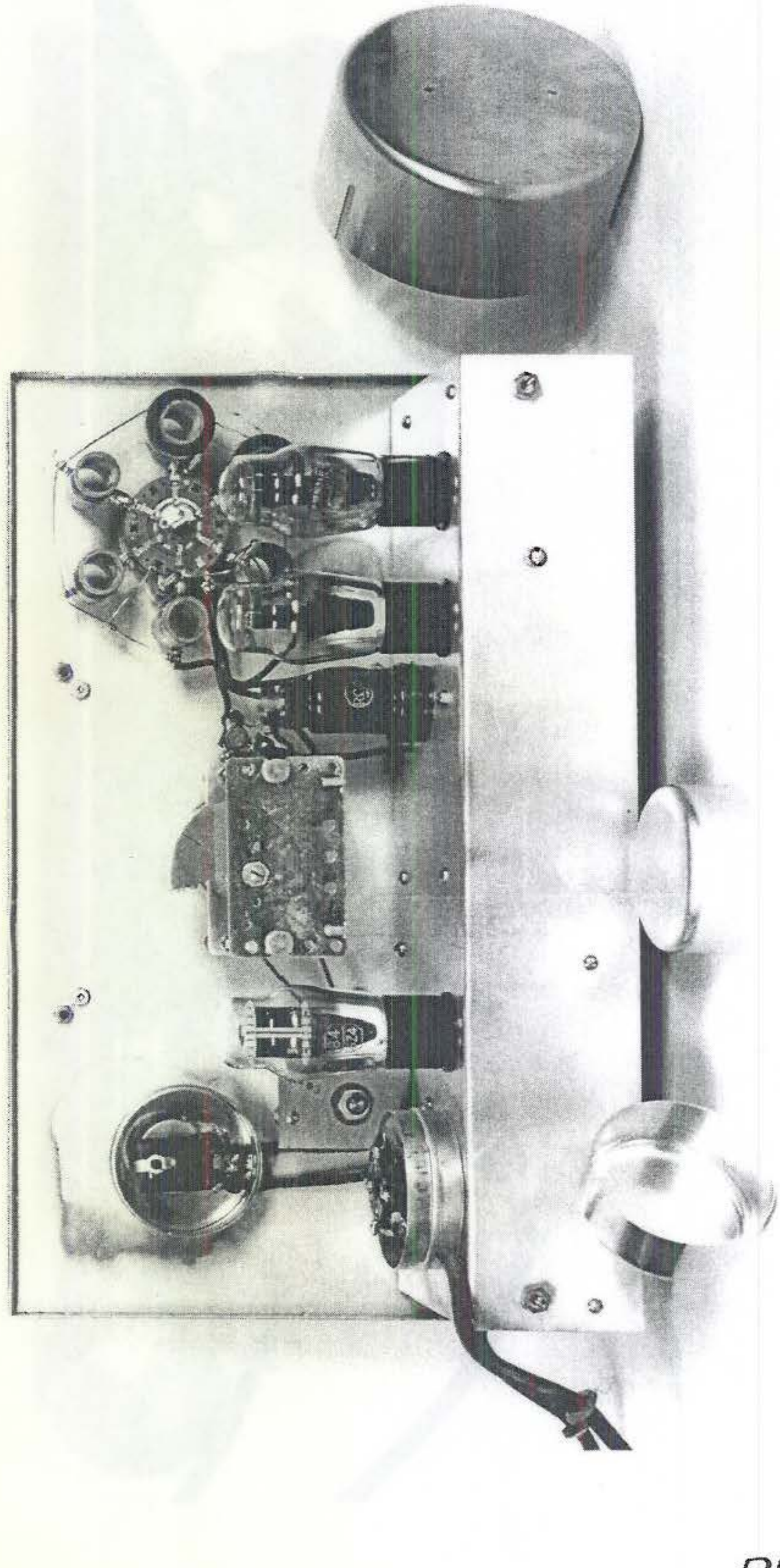


PLATE 3

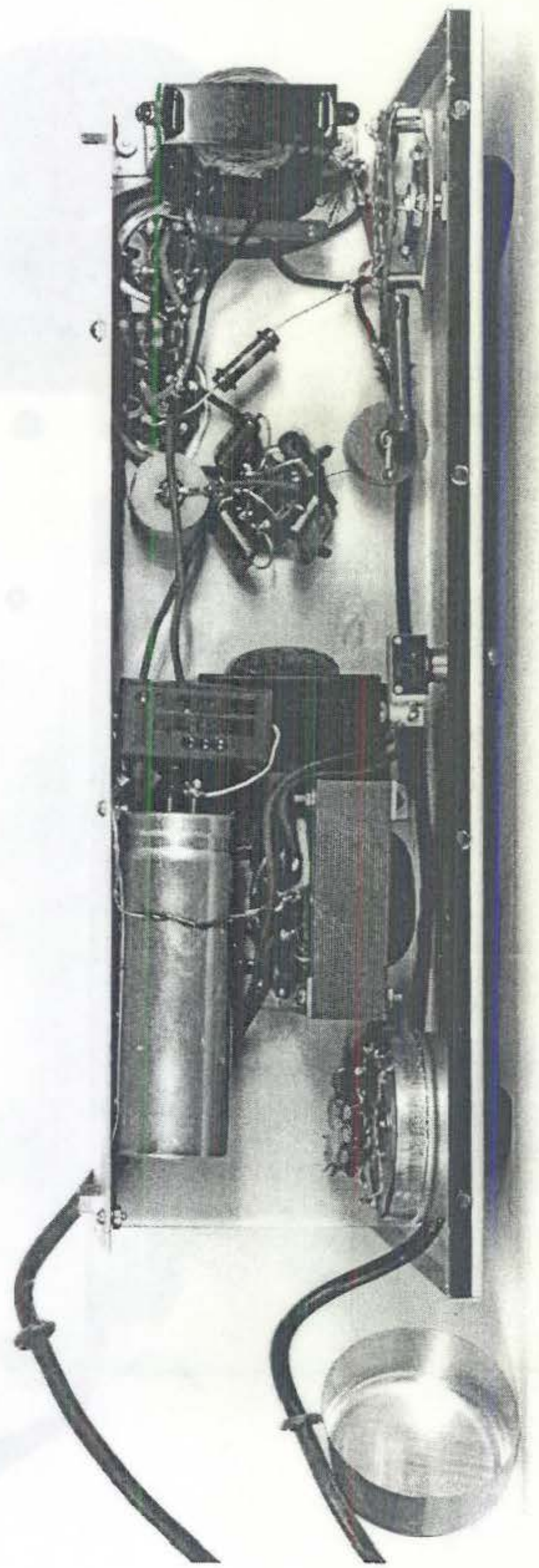


PLATE 4