19C OSCILLATOR

CONTENTS

1. GENERAL

1.01 This section describes the 19C oscillator and its operation.

1.02 Issue 2 replaces Issue 1 to give additional vacuum tube information and correct Fig. 2.

1.03 The 19C oscillator is a heterodyne type vacuum tube oscillator, developed primarily for use in program transmission testing and in multi-frequency testing on message circuits. It is capable of supplying an output from +6 dbm to -4 dbm over the frequency range. The oscillator has a frequency scale starting at 30 cycles and extending upward to 15 kc. One control dial serves to vary the frequency continuously over the full range, but since for some uses a greater precision as to frequency is desired in the range below 250 cycles, an expanded scale is provided on the same dial and made effective by the operation of a switch. The output impedance is about 600 ohms.

1.04 The 19C oscillator is provided in portable form, equipped with a power supply cord and a removable cover, but can be converted to rack mounting using the sets of parts mentioned in Paragraph 2.01. A set of vacuum tubes as listed in Part 5 is supplied with each oscillator. The 19C oscillator operates from a power source of 105 to 125 volts, which may be either d-c or from 50 to 60 cycles a-c, consuming about 25 watts. The design is not suitable for use on 25-cycle power.

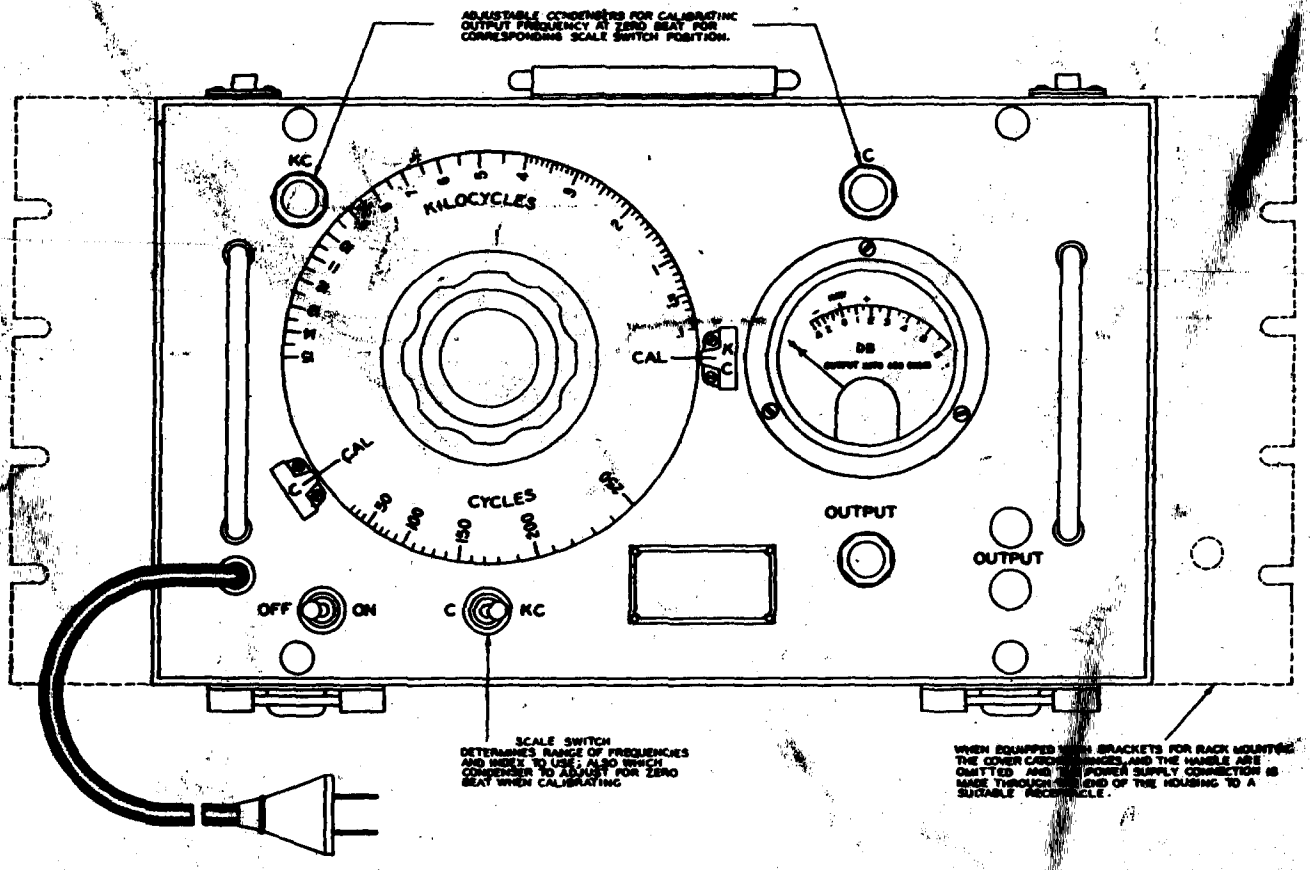

Fig. 1 - Face View of 19C Oscillator

2. DESCRIPTION

2.01 This apparatus is of a panel-chassis type construction and is contained in a perforated steel housing with an aluminum finish. The approximate dimensions of the 19C oscillator are as follows: over-all length 15", height 9-1/2", depth 9-1/4". It weighs about 27 lbs. The 19C oscillator when equipped with the D157288 set of parts can be mounted on 19" racks or, when equipped with D157289 set of parts can be mounted on 23" racks. A face view of the 19C oscillator and a set of brackets 8-3/4" high for 19" rack mounting is shown in Fig. 1. A minor modification affecting principally the power supply cord is required to adapt the 19C oscillator for rack mounting. External circuit arrangements are given on Drawing SD-64913-01 (not attached).

2.02 The main frequency control dial includes a calibrated scale covering the full range of frequencies and also an expanded scale covering the low frequency range. The position of the toggle switch indicates which scale and index to use in reading the output frequency. The two small knobs control air condenser adjustments for zero output at the CAL setting on the frequency dial. A separate adjustment is made for each position of the toggle switch. The meter indicates the output and has been calibrated in db in relation to 1 MW in 600 ohms. The output control serves to vary the oscillator output over a 10 db range from -4 dbm to +6 dbm. The output is supplied from the binding post terminals. When rack mounted, these binding posts can be connected to jacks for convenience in patching to circuits.

2.03 The perforations in the housing assist in dissipating the heat generated and should be exposed to freely circulating air while the oscillator is in operation. This is an important consideration in the use of the oscillator, due to its compactness and the effects of heat on the life of certain parts, particularly the electrolytic condensers. When rack mounted, the panel should be spaced at least 1-3/4" from adjacent panels. The effects of temperature variations on the output power and the output frequency have been minimized in so far as practicable in the selection and arrangement of the apparatus components of the oscillator.

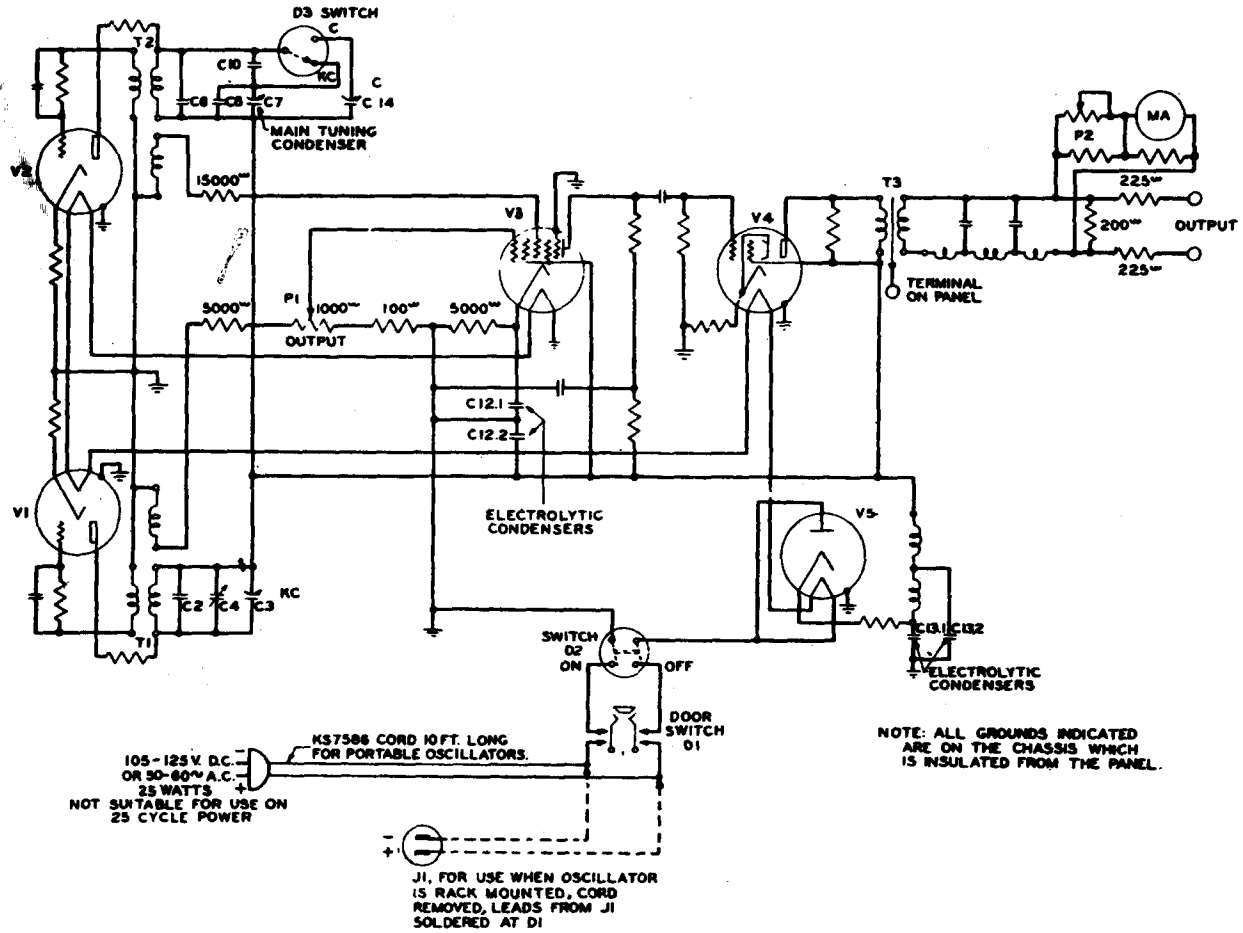

Fig. 2 - Principal Circuit Features

2.04 Detailed information on the circuit of the 19C oscillator is shown in Drawing ESR-629665, a copy of which is attached in the housing of the oscillator. A wiring diagram also is supplied separately. The principal circuit features of the oscillator are shown in Fig. 2.

2.05 The circuit consists of two single tube oscillator circuits, one of which is variable, supplying two frequencies to a vacuum tube modulator circuit in which the difference frequency is produced. This is amplified and separated from the other modulation products to supply the desired output frequency. The power supply circuit for the vacuum tubes is described in Paragraphs 2.11 and 2.12.

2.06 The fixed oscillator circuit, (vacuum tube V1) employs plate circuit tuning and generates a frequency of approximately 115 kilocycles. Most of the tuning capacitance is provided by C2, an 800-mmf condenser. It is supplemented by C3, a 15-mmf variable condenser, which is provided with a knob designated KC, accessible from the front of the panel for calibration purposes. C4 provides a factory adjustment for setting the fixed frequency to within the specified limits.

2.07 The circuit of the variable oscillator (vacuum tube V2) is similar to that of the fixed oscillator except that it includes a switch and condensers of different values of capacitance. C6 provides a large part of the tuning capacitance. The main tuning condenser, C7, provides the output frequency adjustment. This requires a maximum capacitance of about 325 mmf. Condensers C14 and C10 are switched into and out of the tuned circuit by the operation of the scale switch. C14 (15 mmf maximum) is arranged with a knob designated C, accessible from the front of the panel for calibration purposes. C10 (15 mmf) serves only in the CYCLES range of the dial and is connected in series with C7 to produce an expanded scale of the output frequencies for the range below 250 cycles. A 5-mmf fixed condenser, C8, is shunted across C7.

2.08 With the main tuning condenser C7, the variable oscillator frequency can be decreased about 15 kc to supply any output frequency between about 30 cycles and 15 kc. Condenser C10, when connected in series, reduces the range of adjustment and results in the expanded low frequency scale. C14 provides the zero beat calibration adjustment for the CYCLES range of the dial and is operated by a knob designated C.

2.09 The high frequencies produced in the two oscillator circuits are supplied to the modulator (vacuum tube V3) which produces sum and difference frequencies as well as other modulation products. The modulator output is amplified by vacuum tube V4. The low-pass filter between the shielded output transformer T3 and the meter network suppresses modulation products other than the desired difference frequency output. The two 225-ohm resistances connected at the output terminals serve to build the impedance out to about 600 ohms and tend to reduce the effect of vacuum tube impedance on the output impedance of the oscillator. The amplifier includes negative feedback which results in a decrease in harmonic content and an improved frequency response. A rectifier type meter provided in the output circuit serves to indicate the magnitude of the output power. The meter adjusting resistance (P2) has been set to provide a 1 MW reading of the meter scale while supplying 1 MW to a 600-ohm load. This meter indication provides a means for setting the output power to 1 MW when a more accurate device is not available. P1 controls the output over a range of approximately 10 db by varying the fixed oscillator voltage supplied to the modulator.

2.10 The adjustment of the output frequency of the circuit is obtained by using the zero beat principle and employing the output meter as an indicator. When the tuning condenser in the variable oscillator circuit is adjusted to the CAL division on the frequency scale and the small condensers in the oscillator circuits are adjusted in accordance with the switch positions until the frequencies being generated in the two oscillators are the same, the resulting output frequency is zero and the output meter reading drops to the arrow. When the difference frequency is less than about 20 cycles the output meter needle vibrates and readily indicates the difference frequency. This difference or beat frequency can be adjusted to zero, in which case output frequencies will be indicated correctly for other settings of the frequency dial. The control range of the frequency dial is determined by a factory adjustment of a variable condenser C4 in the fixed oscillator circuit.

2.11 The input power is obtained from either d-c or a 50 to 60-cycle supply. When d-c supply is used, it is necessary to select the correct poling of the plug. With the type of power supply circuit suitable for either a-c or d-c, the chassis can be at line potential above ground so the chassis has been insulated from the box. In addition to the OFF switch, there is provided a door switch to automatically disconnect the power supply when the chassis is removed from the box. (See caution note in Part 5.)

2.12 The vacuum tube heaters are connected in series across the power supply. Direct-current for the plate and screen circuits of the vacuum tubes is provided by a vacuum tube rectifier with a coil and condenser filter. The circuit will operate from d-c supply only when poled so that the chassis

is connected to the negative supply lead. On a-c supply best performance will be obtained when poled so that the chassis is connected to a grounded supply lead.

2.13 The shield of the output transformer T3 is connected to the panel instead of to the chassis in order to reduce for certain test conditions the amount of extraneous power content in the output. In the case of portable oscillators this improvement can be obtained when desired by connecting a ground lead under any one of the knurled panel mounting thumb screws.

3. PERFORMANCE DATA

3.01 The performance of the 19C oscillator depends to a large extent upon external conditions such as temperature and supply voltage. The output frequencies are set by the frequency dial and are based upon a single point calibration, referred to as zero beat, which is indicated by the output meter. A calibration adjustment for frequency can be made for the prevailing temperature and voltage. The output power is indicated by a meter of the copper-oxide type in relation to 1 MW into 600-ohm circuits. The over-all performance of the oscillator is normally given in terms of the frequency scale and of a particular reading of the output meter at the time of test. The accuracy in terms of absolute frequency and output power is subject to wide deviation, particularly at below-normal room temperature. The data in Table 1 do not cover extreme conditions.

TABLE 1

PERFORMANCE DATA OF 19C OSCILLATOR SHORTLY AFTER ZERO BEAT CALIBRATION AT TEMPERATURES BETWEEN APPROXIMATELY 60° F AND 100° F

	Frequency	Data (Max.)
Output Range	30 - 15000~	+6* to -4 dbm
Output Meter Accuracy	1000~ (1 MW)	±0.7 db (75° F)
	30 - 15000~	(Note 1)
Output Variation (Note 2)	30 - 15000~	± 1 db
	50 - 10000~	±0.5 db
Frequency Accuracy	30 - 250~	± 5 cycles
	200 ~	± 40 or 20%
	1000~	± 50 or 5%
	2000~	± 60 or 3%
	5000~	±100 or 2%
	15000~	±150 or 1%
Output Impedance	1000~	600 ± 5%
	30 - 15000~	600 ± 10%
Harmonic Content at 1 MW Output	2nd Harmonic	-30 dbm
	3rd Harmonic	-30 dbm
Extraneous Power Content (Note 3)	50-60~ Supply	-40 dbm

*See Paragraph 5.03.

Note 1: For reasons given in Paragraph 3.02 the accuracy of the output power when adjusted in accordance with the readings of the output meter is ± 1 db over the entire frequency range at temperatures between 60° and 100° F if the instrument has been adjusted for the conditions covered in Part 5.

Note 2: The data on output variation with frequency assume a single adjustment to 1 MW at 1000 cycles into an accurate 600-ohm measuring set such as the 7A and the frequency dial varied over the range, without regard to the output meter reading.

Note 3: It is obvious that the extraneous power will not result in indications on the output meter. However, the effect of rapid surges of power supply voltage can be observed on the output meter. Such changes of output are not extraneous power.

3.02 The output meter varies in accuracy and sensitivity, and its scale which is marked in db for indicating the output power is an averaged scale. The meter therefore contributes materially when a deviation of the indicated output power from absolute power in db is suspected or observed. An adjustment of the meter circuit for rectifier aging can be made under favorable conditions as covered in Part 5. The meter accuracy varies less than 0.5 db with frequency, the error being greatest at the highest frequencies. At temperatures below 60° F the errors for any output increase more rapidly so that below 35° F the total error in absolute power may be greater than 1 db.

3.03 From the standpoint of output frequency the 19C is designed to supply any frequency over the full range by means of a single adjustment, but it is desirable for best accuracy in the range below 250 cycles to use the cycles range with the switch operated to the C position. With the calibration adjustment correct, the output frequency is in substantial agreement with the frequency scale divisions throughout the range. Each frequency scale has been determined by actual calibrations at several frequencies and is marked as shown in Fig. 1. Precise settings at scale divisions of the tuning dial with respect to the index are assumed in the performance data given in Table 1. These data assume a room temperature between 60° F and 100° F, and assume that good vacuum tubes are used, that the oscillator is used after a warming-up period of at least 10 minutes, and that the zero beat frequency calibration has just been made.

3.04 Changes in frequency may occur due to temperature, power voltage and other causes, therefore calibration adjustments should be made occasionally so that the output frequency will correspond to the frequency scale indication. After a warming up period of about 10 minutes, the drift of the output frequency over periods of time such as two hours should be less than 50 cycles at any frequency scale setting, provided the power

line voltage has not changed more than 5 volts. This 50-cycle maximum drift includes that due to room temperature variation in the range from 60° to 100° F.

4. OPERATION

4.01 The best performance of the 19C oscillator will be obtained when operated under normal temperature conditions, (60° F to 100° F) and calibrated in accordance with the procedure given in Paragraph 4.04. This procedure assumes that the power supply to the oscillator has been connected as given in Paragraph 4.03. In the case of portable oscillators the conditions given in Paragraphs 4.07 and 4.08 should also be followed.

4.02 When the oscillator is to be used under exacting conditions it may be desired to determine the output characteristic of a particular oscillator in relation to an accurate measuring device, such as the 7A transmission measuring set, and to make allowances for deviations. It should be noted, however, that such a characteristic gives precise corrections only when the circuit being tested provides a uniform 600-ohm impedance to the oscillator terminals.

Note: If the oscillator is used on balanced circuits with a poorly balanced receiving device or with balanced pads such as in amplifier gain measurements, a turnover may be observed, particularly at high frequencies. If changing the poling of the power supply plug (a-c supply only) does not give a satisfactory turnover it can be reduced by connecting a 1:1 ratio repeating coil in the testing circuit at the input to the receiving device or at the output of the oscillator, or both. If a wide range of frequencies is to be used, this coil can be the 111C repeating coil which has a transmission loss of about 0.3 db and is substantially constant over the wide program band.

4.03 Insert the plug of the power supply cord into the receptacle of a 105-125 volt d-c or 50-60 cycle supply. With a-c supply either poling of the plug is normally satisfactory but with d-c supply it is necessary to select the particular poling that results in output power.

(A) Calibration

4.04 Procedure for Frequency Calibration

(1) Operate the ON switch and allow a warming up period of about 10 minutes.

(2) Connect a 600-ohm circuit to the output terminals and adjust the output to indicate approximately 1 MW on the meter scale.

(3) With the KC switch operated, adjust the frequency dial until the CAL line is exactly opposite the KC index line.

(4) Adjust the small knob designated KC until the meter indication falls to the arrow without vibration. With reasonable care this can be done to an accuracy of better than 1 cycle.

(5) Operate the C switch and adjust the small knob designated C until the meter indication falls to the arrow without vibration. This adjustment is dependent on the KC adjustment given above and must be rechecked whenever that is changed if output frequencies in the CYCLES range are to be observed.

(6) Since the C adjustment has a small effect on the KC adjustment, operate the KC switch and check that the meter indication falls to the arrow without vibration. If this is not the case repeat items (3) through (5).

(7) Turn the frequency dial to the desired output frequency indication such as 1 kc and adjust the output control knob to give a meter indication such as 1 MW. With these adjustments the desired frequency is supplied to the circuit.

(8) Change the frequency dial and the OUTPUT knob as desired for other output frequencies and power.

(B) Output Settings

4.05 With the calibration as described in Paragraph 4.04, substantially the same output power will be supplied at any other frequency within either range indicated on the frequency dial.

4.06 The output is increased when the output knob is turned clockwise and may be operated at 1 MW or at any value in the adjustable range from -4 dbm to +6 dbm. The output power of the oscillator is more uniformly accurate at all frequencies when adjusted to the same value on the output meter. For accuracy of output readings see Paragraph 3.02.

(C) Portable Arrangements

4.07 The 19C oscillator should always be operated with the panel in a vertical position. Excessive heating will result if operated otherwise. Sufficient space should be allowed for the air to circulate freely around the oscillator housing during the time the power is turned on. This is important because temperatures above 100° F, will be reached and excessive heat may cause damage to parts in the oscillator circuit.

4.08 A ground lead connected under one of the knurled panel mounting thumb screws will improve the balance-to-ground of the output circuit.

4.09 In transporting the oscillator it is not necessary to remove the vacuum tubes from the sockets when reasonable precautions are taken to prevent vibration or jolts. When handling conditions are not controlled the tubes should be removed and shipped separately.

5. MAINTENANCE

5.01 The periodic maintenance of the 19C oscillator may be confined principally to a check of the vacuum tubes. If the vacuum tubes are good, and yet unsatisfactory operation is noted, it usually will be necessary to return the oscillator to the manufacturer unless the difficulty is some obvious defect such as a defective electrolytic condenser, or a broken wire.

Caution: Always remove the plug from the receptacle before removing the oscillator from the box. With door switch D1 closed and the power turned on, the chassis and all metal parts connected to it, including the shaft of P2 (meter adjustment resistance), may be at line potential depending on which side of the power circuit is grounded. Proper precautions should therefore be taken to avoid electrical shock.

5.02 The vacuum tubes used in the 19C oscillators should be tested periodically and should meet the usual transconductance tests. A full set of tubes is supplied with each oscillator and should be inserted in sockets in accordance with the designations on the circuit label or on the chassis. The following vacuum tubes should be used in the 19C oscillator.

V1* - RCA	12J5GT or 6L5G	Vacuum	Tube
V2* - RCA	12J5GT or 6L5G	"	"
V3 - RCA	12SA7	"	"
V4 - RCA	50L6GT	"	"
V5 - RCA	35Z5GT	"	"

*Either type may be used. See Paragraph 5.03.

5.03 In general, the 6L5G tube should be used in sockets V1 and V2 where it is necessary to obtain +6 dbm from the oscillator (e.g., with the 40B transmission measuring system) if the oscillator is to be used with line voltages less than about 110 volts. For all other cases the 12J5GT tubes should be used. Where line voltages exceed about 115 volts, materially longer tube life should be obtained from the use of the 12J5GT tubes and fewer breakdowns between the heater and cathode should be experienced. The two types of tubes are interchangeable without rearrangement of the oscillator and the effect on the performance other than a reduction in the maximum power output should be small.

5.04 The calibration of the output meter should be checked occasionally to verify that the 1000-cycle output of the oscillator is 1 MW in 600 ohms when the meter indication is 1 MW. This should be done at times when a precise means of measuring 1 MW is available and when the room temperature is about 75° F. When the deviation from 1 MW is greater than ± 0.4 db the output power should be readjusted to 1 MW and the meter adjusting resistance P2 setting should be changed as necessary to indicate 1 MW. This will necessitate removing the chassis from the box and closing switch D1. (See Caution in Paragraph 5.01.)

5.05 The electrolytic condensers can be replaced locally when found defective. This will usually be evidenced by a change in the stability of output, or by an increase in the extraneous power content in the output. Unsatisfactory performance of the oscillator not due to vacuum tubes will probably be an indication of defective condensers.

5.06 A check of the accuracy of the frequency dial can be made by comparison test using a beat method with an oscillator which generates known frequencies in the range of this oscillator. If excessive deviations are noted it should be returned to the manufacturer.