15-A OSCILLATOR

1. GENERAL

1.01 This addendum specifies changes in Section K31.26, Issue 1, made necessary principally by modifications of the 15-A oscillator. Certain other minor changes are also covered.

2. PERFORMANCE

2.02 Output:

Change Item (2) to read: The manufacturing testing requirements are such that with a plate battery voltage of 112 volts and using commercial tubes, the full output of individual oscillators will be 13 and 20 db above 1 milliwatt (approximately 5.5 and 13 milliamperes into 600 ohms).

2.03 Change to read: Plate Battery Voltage Range:

(1) 112 volts to 90 volts.

4. DESCRIPTION OF CIRCUIT

4.05 Change to read: The "RECT" key and binding posts "A" and "B" are provided for checking the operation of the rectifier tubes and their effect on the natural frequency of the tuned circuit of the oscillator. In this test, as later described, the voltage of a dry cell battery is impressed on the rectifier tubes in place of the peak value of the a.c. voltage normally supplied by the seven-cycle oscillator. This permits the measurement of the upper and lower frequency limits of the oscillator. Binding post "A" is also used to ground the filament circuits and the shield of the output transformer.

4.06 Change to read: By depressing the button located on the edge of the voltmeter, the voltage of the plate batteries may be measured.

5. DESCRIPTION OF APPARATUS

5.02 Change to read: On Page 103 is a photograph of the under side of the panel and the interior of the box. This shows the location of the 22-1/2 volt dry batteries per KS-6571 and the dry cells per KS-6542 in the box and the vacuum tube sockets on the under side of the panel. In the box with the batteries is also located a compartment for holding the five 231-D vacuum tubes required for operation and for carrying an additional spare tube. The tubes should always be placed in this compartment when the oscillator is to be shipped.

5.03 Change to read: The following tubes and batteries are required for use with the 15-A oscillator. They are not furnished with the oscillator and must be ordered separately.

Five 231-D Vacuum Tubes
Five 22-1/2-Volt Dry Batteries per KS-6571.
Three Dry Cells Per KS-6542.

6. OPERATION

6.01 Change to read: Before using the oscillator, binding post "A" should be connected to ground. To operate the oscillator the "OSC" key should be operated to the "ON" position and the "METER" key to the "IN" position. The "RECT" key should be in the "NORM" position. The rheostat should be adjusted until the meter indicates three volts. This three-volt indication should be checked occasionally during the operation of the oscillator but at all other times the "METER" key should be operated to the "OUT" position.

6.03 Change to read: It is desirable to measure the voltage of the plate batteries occasionally. This is accomplished by depressing the button located on the edge of the meter. As long as this voltage does not fall below 90 volts the oscillator will operate satisfactorily.

7. MAINTENANCE

7.06 Change note to Item (2) to read: The 20-volt battery (± 1 volt) may be obtained from any 22-1/2 volt block plate battery and a sufficient number of dry cells per KS-6542 connected in opposition, if necessary. Grid batteries should not be used as the current drain may be as high as 5 milliamperes.

7.08 Change to read: The dry batteries per KS-6571 should be replaced when their voltage (as measured by depressing the button on the edge of the meter) has dropped to 90 volts. This voltage should be checked while the oscillator is in operation.

7.09 Change to read: The dry cells per KS-6542 should be replaced when the three-volt filament voltage cannot be obtained when the rheostat is turned in a clockwise direction as far as it will go.

Attachment:

Title	Drawing	Page
15-A Oscillator Circuit Diagram	913-619, Issue 6	101

15-A OSCILLATOR

1. GENERAL

1.01 This section consists of Bulletin 501 prepared by the Department of Development and Research to describe the portable vacuum-tube 15-A oscillator which has been developed to serve as a source of testing current for voice frequency crosstalk measurements.

1.02 The information of this section is outlined as follows:

1.03 The 15-A oscillator is a portable, frequency band, vacuum tube oscillator designed primarily as a source of testing power for voice-frequency crosstalk measurements. It delivers a frequency which sweeps continuously back and forth over the range of 830 to 1230 cycles, the period of a complete back and forth sweep being about one seventh of a second. This is accomplished entirely by electrical means, no motors, relays, or other moving parts being involved.

1.04 This oscillator is suitable with respect to output for all crosstalk testing except for measurements of far-end crosstalk on non-repeatered sections of cable circuits for which case the output is not sufficient. Other frequency band oscillators having greater output have been developed and are suitable for this type of measurement although not as readily portable. (See Bell System Practices—Toll Test Room Operation—Section E40.326, 14-A and 16-A oscillators.)

1.05 The oscillator cabinet, which contains all necessary batteries, measures about 18" x 12" x 11". The weight of the oscillator complete with batteries is 65 pounds.

1.06 The suitability of the frequency band and the period of sweep of the oscillator were determined from crosstalk measurements on circuits of various types. In these measurements both the band width and period of sweep were varied until the best results were obtained from the standpoints of checking speech crosstalk measurements. A broader band would have more nearly the same frequency content as the voice, but this is offset by increased difficulty in ear-balance measurements due to greater distortion of the crosstalk current, as compared with the normal oscillator current attenuated through a distortionless crosstalk meter network. The frequency band selected gives good checks against speech measurements, even when using transmitters and receivers having somewhat better frequency characteristics than the present standard instruments.

2. PERFORMANCE

2.01 Frequency Range:

(1) 830 cycles ± 10 per cent. to 1230 cycles ± 10 per cent. with normal variations of tubes and battery voltages.

2.02 Output:

(1) With a battery voltage of 112 volts the full output of an average oscillator with average tubes will be approximately 17.5 db above 1 milliwatt (approximately 9.5 milliamperes into 600 ohms). At 90 volts this output will be reduced to approximately 15.5 db above 1 milliwatt (approximately 7.5 milliamperes into 600 ohms).

(2) The manufacturing testing requirements are such that with a "B" battery voltage of 112 volts and using commercial tubes the full output of individual oscillators will be between 13 and 20 db above 1 milliwatt (approximately 5.5 and 13 milliamperes into 600 ohms).

(3) By means of a key provided on the oscillator, the output may be reduced to approximately 6 db above 1 milliwatt with oscillators delivering the maximum output of +20 db.

2.03 PLATE Battery Voltage Range: see add.

(1) 112 volts to 90 volts.

3. OUTPUT FOR CROSSTALK MEASUREMENTS

(a) The Use of 6 db Above 1 Milliwatt (Key Operated to "REPTR CCTS")

3.01 The standard testing power for transmission measurements is 1 milliwatt. A study indicates that for crosstalk measurements on repeatered circuits the best testing power is about 6 db above 1 milliwatt or about 2.6 milliamperes into 600 ohms. This corresponds roughly to the power delivered to a circuit by a loud talker. A greater testing power would overload repeaters and, therefore, give incorrect crosstalk values, while the use of smaller values of testing power would make it difficult to measure the crosstalk accurately. This testing power is intended for use at the toll circuit terminal of a repeatered circuit or at other points of similar transmission level. Crosstalk measurements at points of lower level should use correspondingly less power in order to avoid overloading repeaters.

(b) The Use of 16 db Above 1 Milliwatt (Key Operated to "OTHER CCTS")

3.02 For use on non-repeatered circuits or parts of repeatered circuits not containing repeaters, a crosstalk testing power of 16 db above 1 milliwatt may be used. This corresponds roughly to the output of a four-wire repeater with a loud talker at the toll circuit terminal. It is desirable, however, to use 6 db above 1 milliwatt on non-repeatered circuits in cases where this is sufficient to make the crosstalk current readily detectable, in order to minimize the possibility of audible cross-induction into working circuits.

3.03 With the above values of output, experience shows that crosstalk of any practical importance stands out above the line noise sufficiently well to make measurements practicable. This assumes that some method of compensating for line noise is used, as is the case with near-end measurements with the 50-B crosstalk set. With far-end crosstalk measurements on non-repeatered sections of cable circuits, such as are made in connection with cable completion tests, there is difficulty in measuring the crosstalk with the 50-B crosstalk set if the above values of testing power are used. This difficulty could be avoided by using means of compensating for the line noise, and by employing terminal receiving amplification to make the crosstalk sufficiently audible above room noise. These means of overcoming the difficulty are not available with the 50-B crosstalk set so that, in general, the combination of 15-A oscillator and 50-B crosstalk set cannot be used for far-end measurements on non-peatered sections of cable circuits.

4. DESCRIPTION OF CIRCUIT

4.01 Drawing 913-637, page 100, shows the general principles of operation of the oscillator and illustrates the method by which the frequency is caused to sweep over the range. As will be noted, the complete 15-A oscillator consists of a seven-cycle vacuum tube oscillator, two rectifier tubes and a conventional push-pull oscillator. The seven-cycle oscillator output is applied to the rectifier tubes, causing their internal resistance to change from a high to a low value and back again to a high value at a seven-cycle rate. The rectifier is in turn connected to one of the condensers in the tuned circuit of the push-pull oscillator. When the resistance of the rectifier tubes is varied by the seven-cycle oscillator, the variable shunt which it forms across this condenser changes the total capacity of the tuned circuit in the push-pull oscillator, thus changing its frequency from maximum to minimum and back to maximum at a seven-cycle rate. Since the filaments of the rectifier tubes are operated from the same battery source as the filaments of the push-pull oscillator tubes, a balanced arrangement using two rectifier tubes is necessary to permit the push-pull operation of the oscillators.

4.02 As may be seen from the circuit diagram of the 15-A oscillator shown on Drawing 913-619, page 101, the push-pull oscillator circuit is the conventional one involving the oscillator tubes V_4 and V_5, the tuned circuit consisting of the condensers C_1 and C_2 in series and the inductance L_1, which is a 155-A retardation coil. The seven-cycle oscillator circuit is made up of vacuum tube V_1, and 249-A input transformer and condensers C_3 and C_9 in parallel. This is a conventional oscillator circuit in which part of the energy from the plate circuit is returned to the grid circuit by means of condenser C_4 and the feed-back resistances R_1 and R_2. The output from this oscillator is impressed upon the rectifier tubes V_2 and V_3 which, as has been explained, vary the total capacity in the tuned circuit of the push-pull oscillator. The frequency is thus caused to vary from 830 cycles to 1230 cycles.

4.03 On the oscillator panel are four keys, a meter, a rheostat, and two binding posts ("A" and "B"). The "OSC" key is for the purpose of turning the oscillator off or on. The meter and "METER" key are provided for use in adjusting the filament voltage by means of the rheostat. For this purpose the "METER" key must be operated to the "IN" position, thus placing the meter in the circuit. In order not to place any greater drain than necessary on the filament battery, it is desirable that this key normally remain in the "OUT" position, thereby removing the meter from the filament circuit.

4.04 The "REPTR CCTS—OTHER CCTS" key controls the output of the oscillator by inserting a 14 db pad between the output transformer and the output terminals. When the key is in the position marked "REPTR CCTS" the pad is included in the circuit, so that a resistance of 600 ohms connected to the output terminals will receive a power not exceeding 6 db above 1 milliwatt. When the key is operated to the position designated "OTHER CCTS," the pad is removed from the circuit, and the full output of the oscillator will be impressed upon a 600-ohm resistance connected to the output terminals.

4.05 The "RECT" key and binding posts "A" and "B" are provided for checking the operation of the rectifier tubes and their effect on the natural frequency of the tuned circuit of the oscillator. In this test, as later described, the voltage of a dry-cell battery is impressed on the rectifier tubes in place of the peak value of the a-c. voltage normally supplied by the seven-cycle oscillator. This permits the measurement of the upper and lower frequency limits of the oscillator.

4.06 By depressing the button located on the edge of the voltmeter, the voltage of the "B" batteries may be measured.

5. DESCRIPTION OF APPARATUS

5.01 On page 102 is a face view of the 15-A oscillator which shows the four keys, meter, rheostat and binding posts, used in operating and testing the oscillator.

5.02 On page 103 is a photograph of the under side of the panel and the interior of the box. This shows the location of the No. 763 Eveready 22½-volt batteries and the No. 6 dry cells in the box, and the vacuum tube sockets on the under side of the panel. In the box with the batteries is also located a compartment for holding the five 231-D vacuum tubes required for operation and for carrying an additional spare tube. The tubes should always be placed in this compartment when the oscillator is to be shipped.

5.03 The following tubes and batteries are required for use in the 15-A oscillator. They are not furnished with the oscillator and must be ordered separately:

Five 231-D Vacuum Tubes
Five No. 763 Eveready Batteries
Three No. 6 Dry Cells

5.04 A padded shipping case per KS-6840 has been made available for use in shipping the 15-A oscillator. This is not furnished with the oscillator and should be ordered separately if needed.

6. OPERATION

6.01 To operate the oscillator, the "OSC" key should be operated to the "ON" position and the "METER" key to the "IN" position. The "RECT" key should be in the "NORM" position. The rheostat should be adjusted until the meter indicates three volts. This three-volt indication should be checked occasionally during the operation of the oscillator, but at all other times the "METER" key should be operated to the "OUT" position.

6.02 If possible, after turning the oscillator on, a warming up period of about 10 minutes should be allowed, before using the oscillator, to permit the output to become stabilized.

6.03 It is desirable to measure the voltage of the "B" batteries occasionally. This is accomplished by depressing the button located on the edge of the meter. As long as this voltage does not fall below 90 volts, the oscillator will operate satisfactorily.

7. MAINTENANCE

(c) Vacuum Tubes

7.01 In general, 231-D vacuum tubes which have not seen previous service should function satisfactorily in the 15-A oscillator.

7.02 To maintain satisfactory operation, the tests outlined in the following paragraphs should be made at intervals during the life of the tubes and whenever new tubes are placed in the oscillator. These tests should be made with a battery potential of 90 volts.

7.03 Tubes which have been tested and found to be satisfactory should be tagged or labeled to facilitate replacing them in the same sockets in which they were tested, after shipment of the oscillator.

7.04 The output should be checked occasionally by means of a 6-A, 7-A or 8-A transmission measuring set. Care should be taken when making this check that the "REPTR CCTS" key in the oscillator is in the posi-

tion designated "REPTR CCTS." The transmission measuring set should be calibrated at a frequency of 1000 cycles. The power measured by the transmission measuring set should be between 1 db below 1 milliwatt and 6 db above 1 milliwatt. If the measured output power is lower than 1 db below 1 milliwatt, one or both of the tubes V_4 and V_5 should be replaced until the measuring set indication is between the above limits.

7.05 If the frequency of the output ceases to vary periodically between 830 and 1230 cycles and remains constant at some single frequency between these limits, it is an indication that the seven-cycle oscillator is not operating. Should this occur, tube V_1 should be replaced.

7.06 The effect of poor or outworn rectifier tubes (V_2 and V_3) will be evidenced by an irregularity in the sweep of frequencies between 830 and 1230 cycles, and by a shift upward in the frequency scale of the entire frequency band. To guard against this condition, an occasional check should be made of the operation of these tubes. This is accomplished as follows:

(1) Place the oscillator in operation, as described under "6. Operation."

(2) Connect a dry-cell battery with a voltage of 20 volts ± 1 volt* between binding post "A" and binding post "B" on the face of the panel. The + terminal of the battery should be connected to binding post "A."

(3) Operate the key to "REPTR CCTS."

(4) Operate the "RECT" key to "CHECK FREQ."

(5) The frequency of the power obtained from the "Output" binding posts should be 1230 cycles ± 123 cycles.

(6) Reverse the polarity of the dry-cell battery so that the + terminal is connected to binding post "B."

(7) The frequency of the power obtained from the "Output" binding posts should be 830 cycles ± 83 cycles. (These frequencies may be checked against any available standard multifrequency oscillator.)

(8) If the frequencies obtained in items 5 and 7 are within the limits assigned, tubes V_2 and V_3 are operating satisfactorily. If either of the frequencies is outside of the limit, one or both of these tubes should be replaced until the limits are met.

(9) Restore the "RECT" key to "NORM."

(10) Disconnect the dry-cell battery from binding posts "A" and "B."

(d) Frequency Calibration

7.07 If, after trying several tubes to replace V_2 and V_3, the oscillator continues to operate with a frequency sweep which is other than 830 cycles ± 10 per cent. to 1230 cycles ± 10 per cent, it is possible that the calibration of the tuned circuit may have changed. In this case arrangements should be made to return the oscillator to the manufacturer, as a recalibration cannot be readily accomplished in the field. The chances of such a change in calibration, however, are quite remote.

(e) Batteries

7.08 The No. 763 Eveready "B" batteries should be replaced when their voltage (as measured by depressing the button on the edge of the meter) has dropped to 20 volts. This voltage should be checked while the oscillator is in operation.

7.09 The No. 6 dry cells should be replaced when the three-volt filament voltage cannot be obtained when the rheostat is turned in a clockwise direction as far as it will go.

(f) Rheostat and Keys

7.10 The oscillator should be gone over annually and the key contacts cleaned and adjusted in the usual manner. The rheostat should be wiped with a clean cloth which has been slightly moistened with unmedicated vaseline, and after cleaning should be wiped dry.

* The 20-volt battery (± 1 volt) may be obtained from any 22½-volt block "B" battery and a sufficient number of No. 6 dry cells connected in opposition if necessary. "C" batteries should not be used, as the current drain may be as high as 5 milliamperes.

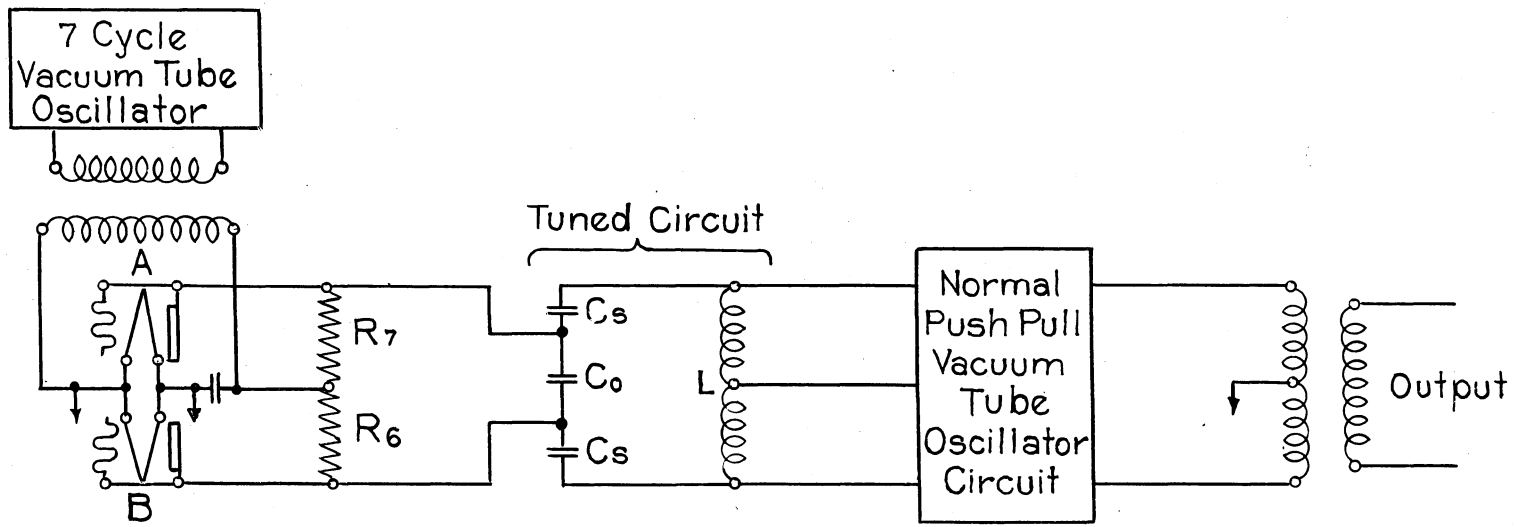
Attachments

* This drawing is not attached but is listed for reference.

A. T. & T. Co.
Dept. of
Dev. & Res.

FREQUENCY BAND OSCILLATOR
Schematic

913-637
1-28-30
F.E.F.



Internal Resistances of Rectifier Tubes Controlled by Output Voltage of 7-Cycle Oscillator

Total Capacity in Tuned Circuit Controlled by Internal Resistances of Rectifier Tubes A and B

Frequency of Oscillator Controlled by Total Capacity in Tuned Circuit

A. T. & T. CO.
Dept. of
Dev. & Res.

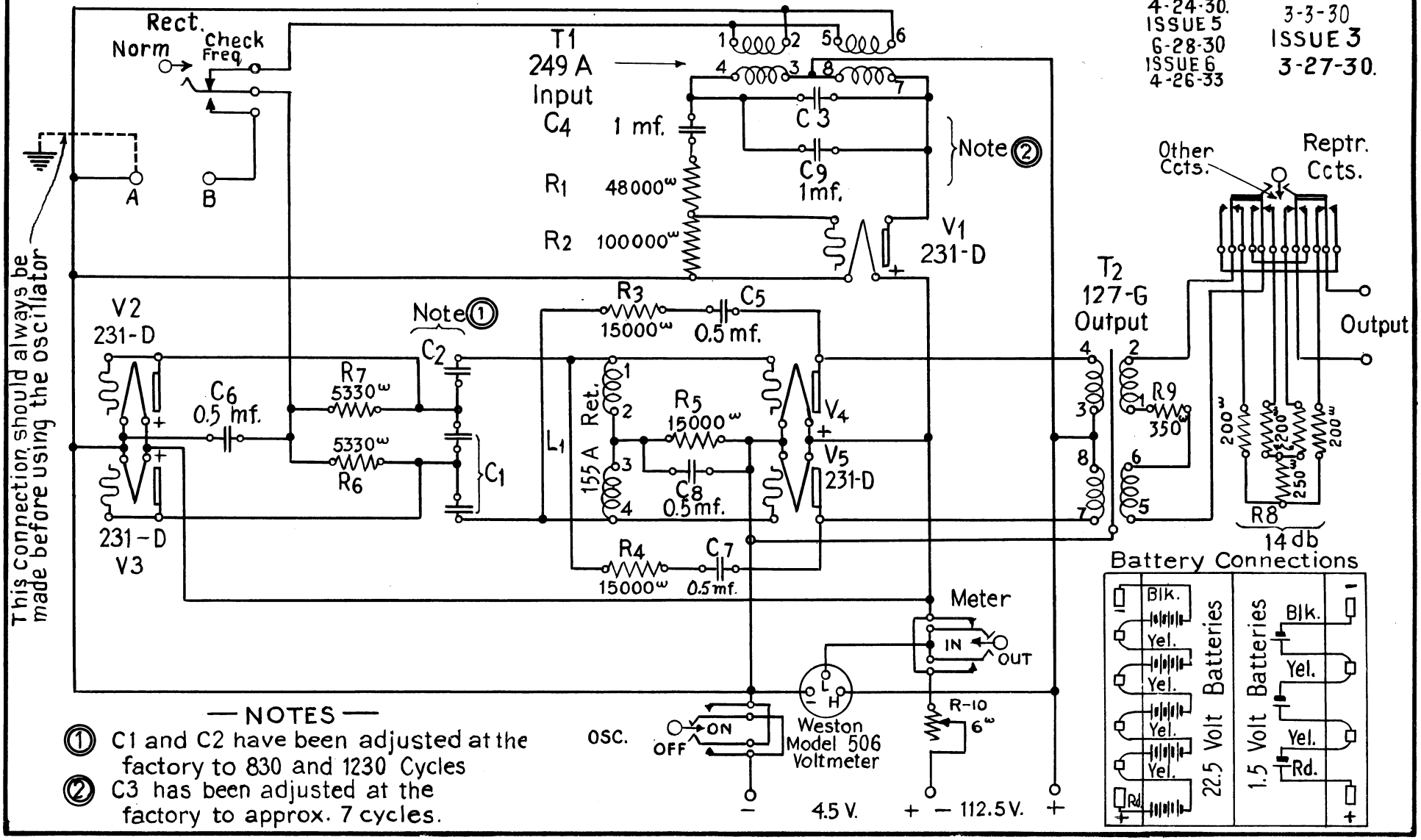
15-A OSCILLATOR

CIRCUIT DIAGRAM

913-619
11-25-29

ISSUE 4
4-24-30.
ISSUE 5
6-28-30
ISSUE 6
4-26-33

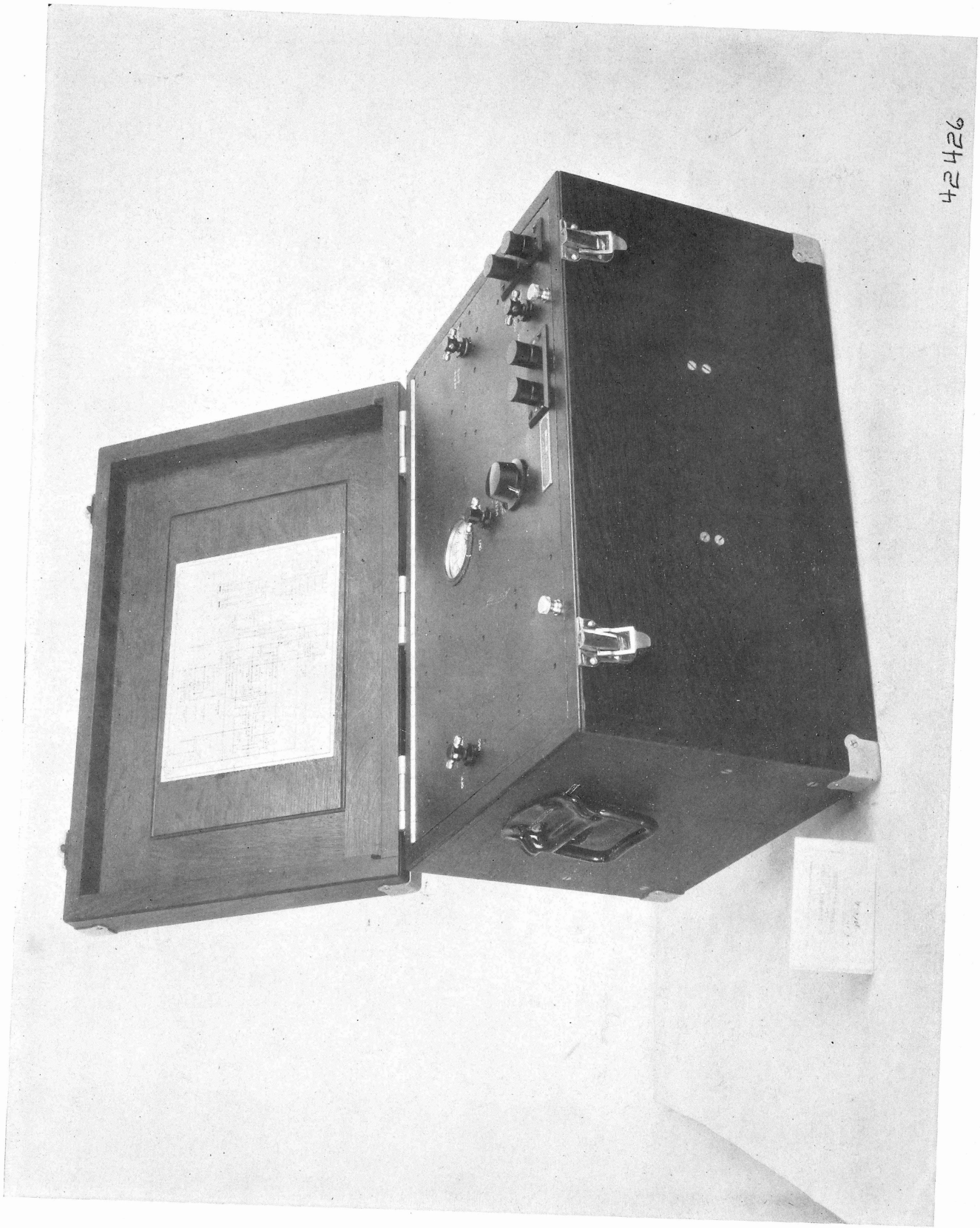
Issue 2 F.E.T.
3-3-30
ISSUE 3
3-27-30.



— NOTES —

① C1 and C2 have been adjusted at the factory to 830 and 1230 Cycles

② C3 has been adjusted at the factory to approx. 7 cycles.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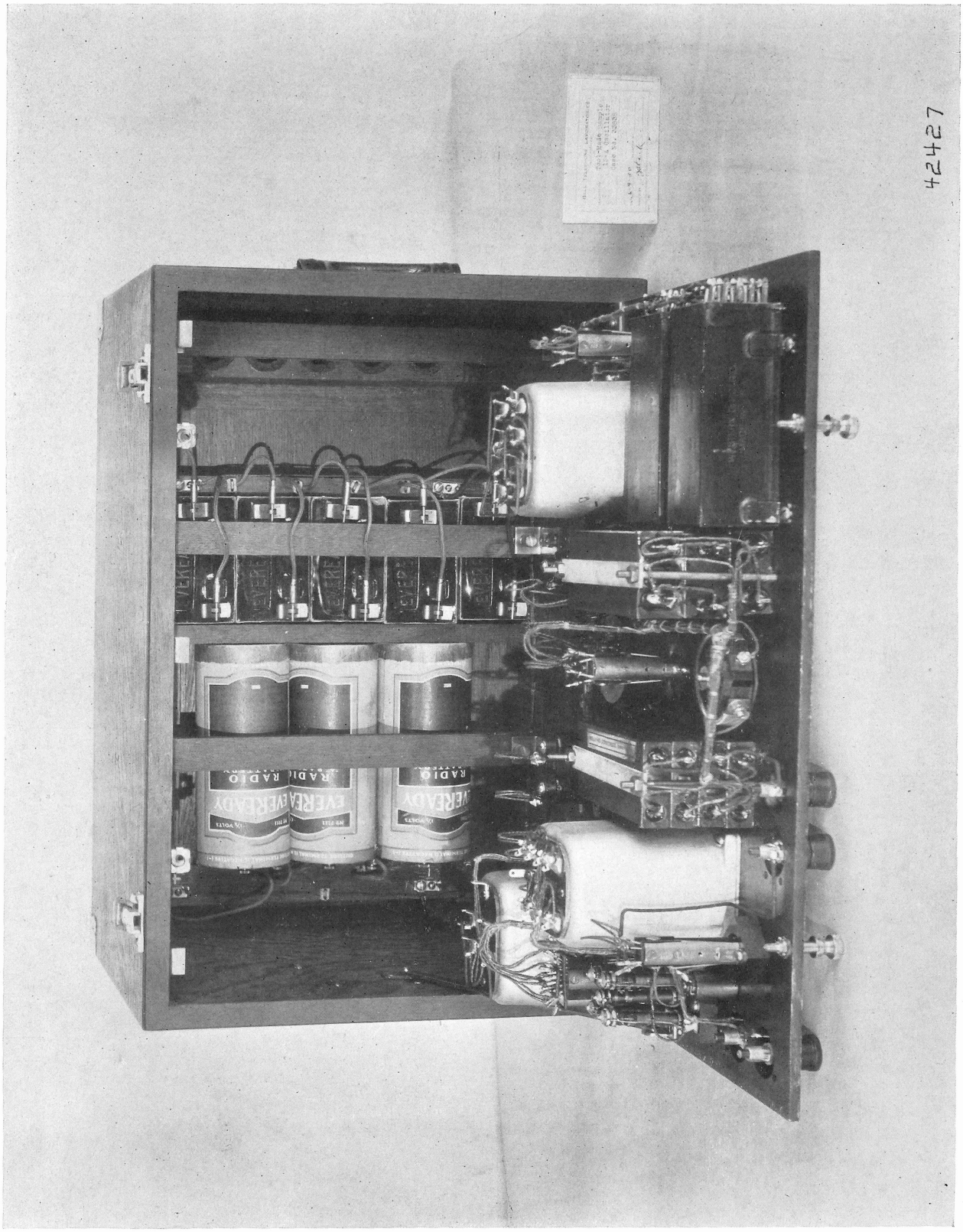
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