J64030A (30A) TRANSMISSION MEASURING SET
(RANGE: UP TO 150 KILOCYCLES)
DESCRIPTION

CONTENTS

1. GENERAL

1.01 This section describes the 30A Transmission Measuring Set (J64030A), which is used primarily with types J, K and C carrier telephone systems. The set consists essentially of a thermocouple, meter, attenuators, keys and jacks arranged to facilitate the various types of tests which are required, and means for calibration. It is assembled in a portable case which may be mounted on a table, a tea wagon or a shelf at a testboard. A separate source of testing power such as the 17A or 17B oscillator is required.

1.02 This issue replaces Issue 1, dated January 1938 which was rated Provisional and given limited distribution.

1.03 The 30A Transmission Measuring Set was designed primarily for use at frequencies up to 150 kilocycles. With the attenuators in the set it can be used to measure gains up to about 90 db. With limitations described later, gains up to 120 db can be measured. The maximum loss that can be measured without a supplementary amplifier will depend on the maximum testing power which can be used at the input to the circuit under test. The over-all accuracy varies somewhat with the type of measurement, but, in general, an accuracy of ±0.2 db or better may be expected.

1.04 The impedance of the set is 135 ohms, including attenuators, pads and thermocouple circuit. Two coils having an impedance ratio of 600:135 ohms are included to permit measurements of 600-ohm circuits. These coils affect the accuracy and frequency range as discussed later. Because of the low impedance, level measurements on a bridging basis cannot be made.

1.05 A simplified schematic of the 30A Transmission Measuring Set is shown in Fig. 1. Two comparison paths, which are controlled by a switching key, are provided between the input to the set and the thermocouple and meter. One path contains an adjustable attenuator and both paths contain suitable jacks for measuring losses, gains, and incoming power. A potentiometer is provided in the input to the set for accurately adjusting the testing power, and three key-controlled pads are provided ahead of the meter for protection purposes. An additional 10 db pad is provided on jacks. A set of multiple jacks is also included.

1.06 The thermocouple and meter are arranged to read with reference to a test power of 1 milliwatt. The set is calibrated on direct current from a dry-cell battery contained in the set, and means are provided for building out the thermocouple resistance to 135 ohms and adjusting the sensitivity of the thermocouple circuit.

1.07 All of the equipment is mounted in a portable assembly with the operating dials, keys, jack strip and meter being mounted on a panel approximately 19-1/4" x 11-11/16". A face view of the set with the cover removed is shown in Fig. 2. The complete assembly weighs 36 pounds. The set is designed to be used with the panel in a horizontal position.

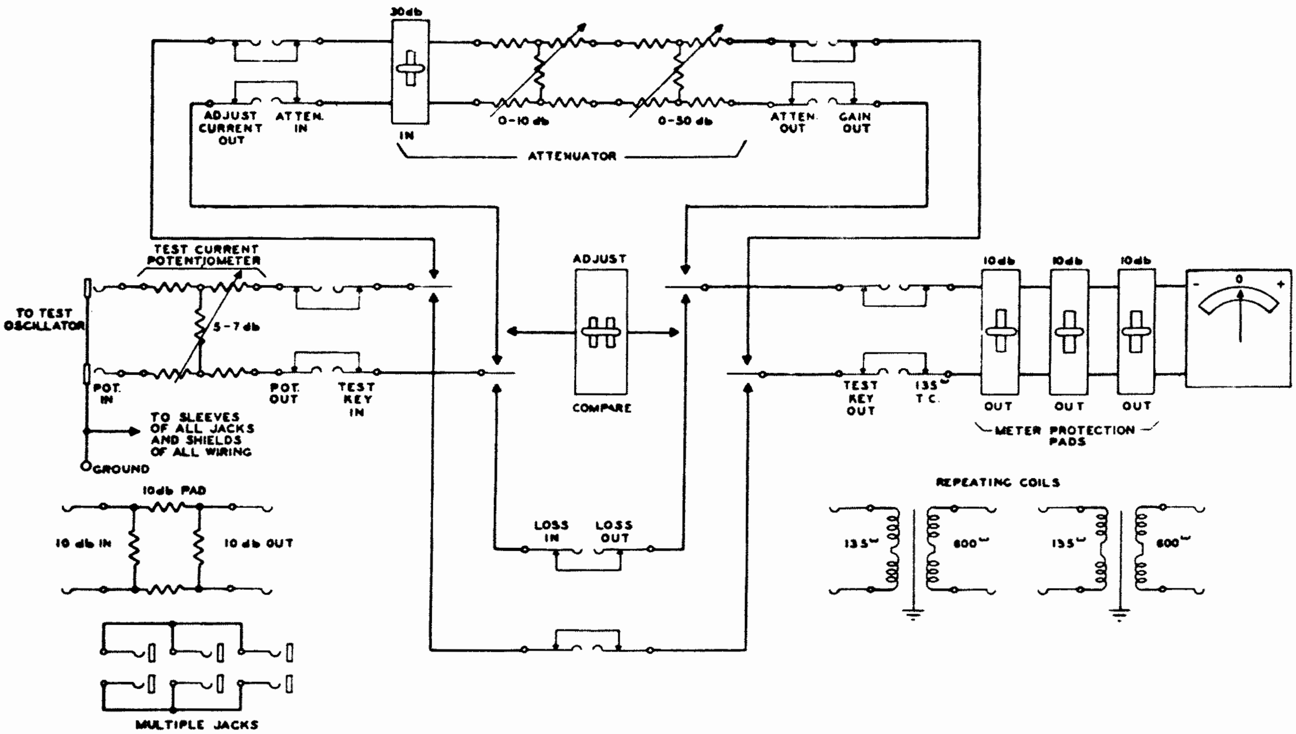

Fig. 1 – Simplified Schematic

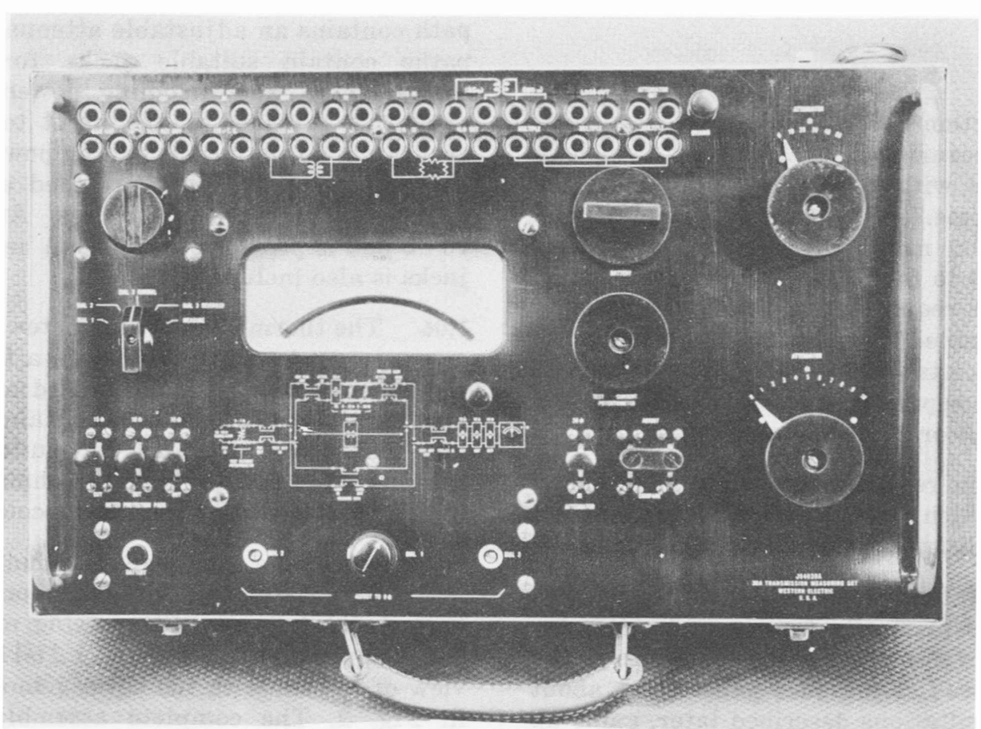

Fig. 2 – Face View of Set

2. DESCRIPTION OF CIRCUITS AND EQUIPMENT

(A) Current Measuring Circuit

2.01 The current measuring circuit is composed of the meter, thermocouple and the associated calibrating circuit. The meter used is a milliammeter per KS-7897 which has a resistance of about 10 ohms and gives a full scale deflection at about 200 microamperes direct current. The meter scale, as shown in Fig. 3, is calibrated in decibels referred to 1 milliwatt and extends from −10 db to +3.4 db with the 0 db index near mid-scale. A "no current" index line is provided below the "−10 db" division mark for the "zero correction" of the pointer. Because of the variation of the temperature-resistance characteristic with different thermocouples, the accuracy at the extreme portions of the scale will not be as good as that near the zero mark where the thermocouple is calibrated. For this reason the meter scale has been made prominent between the limits of ±1 db so as to emphasize the fact that reading should be kept between these limits whenever possible, unless a special scale calibration is made.

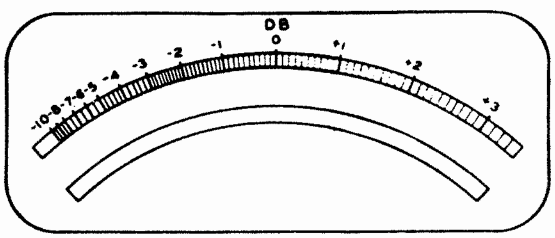

Fig. 3 — Meter Scale

2.02 The 22AM thermocouple used in this set has a heater resistance between 80 and 100 ohms. The 50-ohm rheostat, designated DIAL 2, and a 20-ohm fixed resistor are in series with the heater element and permit the input resistance of the thermocouple to be built out to 135 ohms when the heater current is 2.722 milliamperes at any particular room temperature. The thermocouple is provided with bayonet base contacts to permit mounting in an electron tube socket. (Some of the first models of the 30A set used the D-89322 thermocouple, having a heater resistance between 100 and 125 ohms, and did not require the fixed 20-ohm resistance. In order to make these earlier sets suitable for use with the 22AM thermocouple, a 20-ohm resistor must be added as shown in Drawings SD-64049-01 and ED-64049-01. In sets which are provided with this 20-ohm resistor, it will probably be necessary to strap the resistance out when a D-89322 thermocouple is used.)

2.03 The calibration in general consists of four steps, the switching operations being accomplished by turning the switch located just to the left of the meter scale to the proper positions. (See Fig. 2.) A direct current of 2.722 milliamperes is first passed through a 135-ohm standard resistor in series with the meter shunt of the meter and produces a mid-scale, 0 db, meter deflection. Then the thermocouple heater circuit is substituted for the 135-ohm standard resistor and the same meter deflection is obtained by adjusting the variable resistance in series with the thermocouple heater. The thermocouple heater circuit then has 135 ohms resistance and 2.722 milliamperes flowing through it. Next, the meter is connected to the thermocouple. The resistance in series with the thermocouple and meter is adjusted both direct and reversed, to give the same meter reading as before. When an alternating current of 2.722 milliamperes is passed through the thermocouple the meter should register 0 db. Thereafter as the current is increased or decreased within certain limits, the meter will register the corresponding db change from 1 milliwatt.

2.04 The circuit for adjusting the calibrating current is shown in Fig. 4 and is set up by turning the switch to the DIAL 1 position. A nonlocking key designated BATTERY connects a 1.5-volt dry battery to a 135-ohm standard resistor which is in series with a rheostat designated DIAL 1 and the meter shunt. This shunt

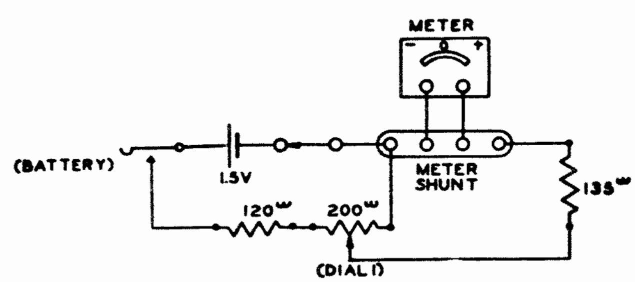

Fig. 4 — Battery Voltage Adjustment — Switch in DIAL 1 Position

is of such a value that when 2.722 milliamperes is flowing through it the meter registers at the 0 db mark on the scale. The rheostat marked DIAL 1 compensates for variations in battery voltage and should be adjusted to give the proper current so that the meter reads 0 db.

2.05 The second step consists of adjusting the thermocouple heater circuit resistance to 135 ohms. For this adjustment the switch is turned to the position designated DIAL 2. This replaces the 135-ohm standard resistance in the circuit described above by the heater circuit of the thermocouple and the rheostat DIAL 2, as shown in Fig. 5, the meter remaining connected to the shunt. If the resistance of the heater circuit and the rheostat in series is 135 ohms, the same current as before (2.722 milliamperes) will be flowing in the circuit and the meter reading will again be 0 db. If the reading is less than 0 db it indicates that the resistance of the thermocouple heater circuit and the rheostat is greater than 135 ohms. If the reading is more than 0 db, it indicates a combined resistance of less than 135 ohms. The rheostat should be adjusted so as to produce a meter reading of 0 db which corresponds to a circuit resistance of 135 ohms.

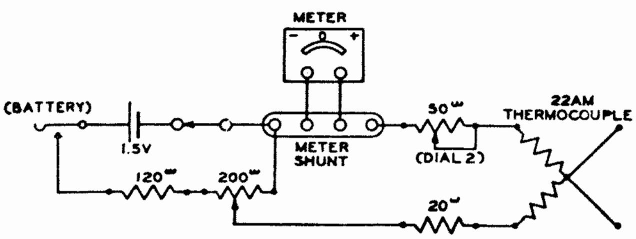

Fig. 5 – Heater Circuit Resistance Adjustment — Switch in DIAL 2 Position

2.06 By operating the switch to position DIAL 3 NORMAL, the meter which has been connected to the meter shunt for the preceding adjustments is removed from the shunt and then connected to the galvanometer terminals of the thermocouple in series with the rheostat DIAL 3. This is shown in Fig. 6. This rheostat, which is adjusted until the meter reads 0 db, is provided to compensate for the difference in efficiencies of thermocouples so that the meter may always be made to read 0 db when a current corresponding to 1 milliwatt (2.722 milliamperes) is flowing through the 135-ohm heater circuit. Some thermocouples may produce a different meter reading when the current through the heater element is reversed. The dial must, therefore, be set so that the mean of the two readings is 0. This is checked by operating the switch to the DIAL 3 REVERSED position which reverses the current through the heater. If the meter does not read 0 db, the DIAL 3 rheostat is readjusted so that with the heater current in one direction the meter reads low by the same amount that it reads high when the current is reversed. This completes the calibration of the thermocouple circuit.

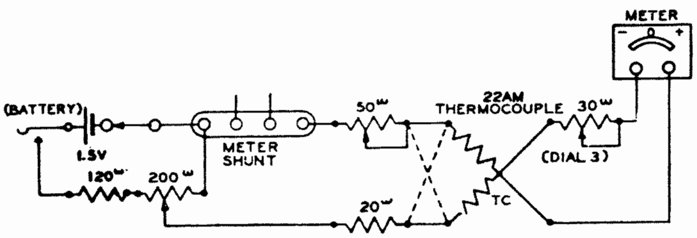

Fig. 6 – Sensitivity Adjustment — Switch in DIAL 3 Position

2.07 To connect the thermocouple meter for measuring, the switch is thrown to the position designated MEASURE. This connects the thermocouple to the 135-ohm TC jacks through three 10 db pads as shown in Fig. 7. The pads are controlled by nonlocking keys in order to afford some protection to the thermocouple from high currents which may accidentally be transmitted to the thermocouple. These keys should be operated one at a time while watching the meter. If the meter reads higher than −7 db, then additional keys should not be operated. These units may also be used to extend the range of gain measurement as much as 30 db, in 10 db steps, by leaving one or more of the keys nonoperated. However, when this is done, care should be exercised that the circuit under test is not overloaded. All key contacts for the networks are paralleled to improve the reliability of contact. The 10 db networks are "square type" pads. An additional 10 db network is provided on jacks.

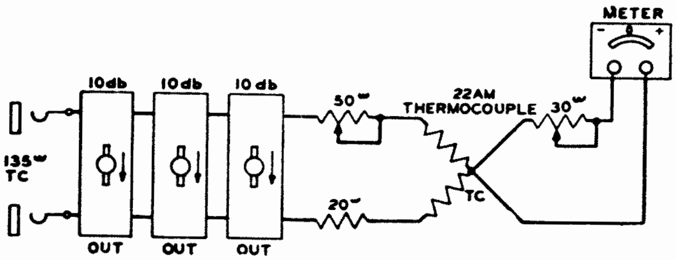

Fig. 7 – Measuring Circuit — Switch in MEASURE Position

(B) Comparison Circuit

2.08 The test key (ADJUST-COMPARE) provides control of the comparison circuit, as shown in Fig. 1. This key is composed of two units equivalent to a four-pole double-throw switch. The test power is connected to one pair of transfer contacts and the other pair of transfer contacts is connected to the current measuring circuit. The two pairs of transfer contacts thus provide a means for setting up two circuit paths for comparison purposes, one of which contains the variable attenuator. Jacks have been provided at various points in the circuit in order to afford the flexibility desired for various types of measurements.

2.09 The attenuator in the comparison circuit consists of three units connected in tandem. Two of the ATTENUATOR units are controlled by dial switches with wiping contacts, one dial having a 0 to 50 db range in steps of 10 db and the other dial a 0 to 10 db range in steps of 1 db. The third unit provides 30 db attenuation which is controlled by a locking key designated "30 db" and is normally out of the circuit. The input and output terminals of the attenuator are connected to jacks designated as ATTENUATOR IN and ATTENUATOR OUT so that when desired the attenuator can be patched to an external circuit. The pads in the 10 db attenuator unit are of the bridged "H" type, and the 30 db and 50 db pad units are of the "square" type. The impedance of all units is 135 ohms.

(C) Test Current Supply

2.10 When making local measurements, test current must be obtained from an external source such as a 17A or 17B oscillator or a standard 1 milliwatt 1000-cycle supply. Where sources of test current which have an output impedance of 600 ohms are employed, it will be necessary to provide a 600:135-ohm impedance matching coil between the supply and the measuring set. Two such coils, which are shielded and grounded to the set case, are provided in the set and may be picked up at the 135-ohm and 600-ohm jacks. However, when making measurements on equipment having 600-ohm impedances, the coils provided in the set will be used with the equipment under measurement, and an additional coil associated with the source of supply will be required.

2.11 The sleeves of the test current supply jacks on the carrier bay should be grounded so that ground for the set may be picked up automatically by employing a three-conductor cord in patching from the test current jack to the measuring set jacks. Otherwise it will be necessary to supply a ground lead to the GROUND terminal in the set. The set ground is wired to the sleeves of all jacks, the shields of the paired wiring, etc.

2.12 A slide wire potentiometer having a 2 db range (5 to 7 db loss) is provided to permit a precise adjustment of the input test power. The coarse adjustment is of course made with the output control for the oscillator. Where a standard 1 milliwatt 1000-cycle supply is used as the source of test power it is connected to the TEST KEY IN jacks, which omits the test current potentiometer from the circuit.

(D) Assembly

2.13 The measuring set is arranged in portable form in a housing consisting of two parts, a panel assembly and a casing assembly. The panel is made of aluminum with its face finished in aluminite, dyed black. The designations for the jacks, keys, dials, etc, and a circuit schematic of the set are etched on the aluminum panel. The casing assembly is made of sheet aluminum and is provided with a leather carrying handle. The panel is 19-1/4" x 11-11/16" and the over-all height of the case is 6-7/16". The panel assembly is secured to the casing by screws through the sides of the casing. To remove the panel assembly from the casing, the set should be turned on its face, the screws removed, and the casing lifted off. A cover is provided to protect the top panel of the set when the set is not in use and during shipment.

3. TRANSMISSION PERFORMANCE

3.01 The performance of the set is substantially independent of frequency up to 150 kc when measuring balanced circuits having an impedance of 135 ohms. Measurements of 600-ohm circuits require the use of 135:600-ohm impedance matching coils, the characteristics of which vary somewhat with frequency, particularly at the lower and higher frequencies, as discussed below. In measuring unbalanced 135-ohm circuits, it will generally be necessary to provide shielded coils ahead of the equipment under measurement; the two 135:600-ohm coils may be connected in tandem to provide a 1:1 arrangement.

3.02 The loss-frequency characteristics of the 135:600-ohm repeating coils (146A) are shown in Fig. 8. A correction should be applied for each coil used. This will be about 0.15 db for frequencies between 700 cycles and 35 kc; the losses at other frequencies are indicated in Fig. 8. The balance to ground of the 146A coils is sufficiently good to use. Accordingly, these coils may be used in connection with the 5A impedance bridge which contains no coils.

3.03 In addition to the coil losses, allowance must be made for the losses introduced by connecting cords or trunks. These losses will vary depending on the type and length of the cord or trunk, the impedance of the circuit, and the frequency. It is desirable to arrange the measuring setup to keep these losses low but in some cases losses ranging up to 1 db or more may be difficult to avoid. In 135-ohm circuits, these losses are due mainly to cord resistance and are largely independent of frequency. In a 600-ohm circuit, the effect of the cord capacity is more important and the loss will vary considerably with frequency. In general, the losses of the connecting cords or of the connecting cords and coils to be used in a particular test should be determined by measurement with the 30A set and applied as a correction to the test measurements. Where long leads must be used in a test, attention must be given to the type of lead used in order to eliminate reflection effects. In such cases, rubber covered shielded pair per D-96232 should be used for 135-ohm circuits, and spaced wires used for 600-ohm circuits carrying the high frequencies of the type "J" carrier system.

3.04 The loss of the attenuator, which includes the 30 db pad, will be within 0.1 db of the indicated value throughout the frequency range of the set. The three 10 db key controlled pads and the additional 10 db pad appearing on jacks have an accuracy of better than ±0.05 db of their nominal value. The test current potentiometer provides an attenuation range between 5 db and 7 db, although different potentiometers may vary from this by as much as 0.5 db. This is not important since it is used only to supplement the output adjustment of the source of test current.

3.05 The impedances of the test current potentiometer, the attenuator, and the 10 db pads are within 3% of 135 ohms resistance with a negligible reactance component for frequencies up to 150 kc. The impedance characteristics of the 135:600-ohm repeating coils (146A) are given

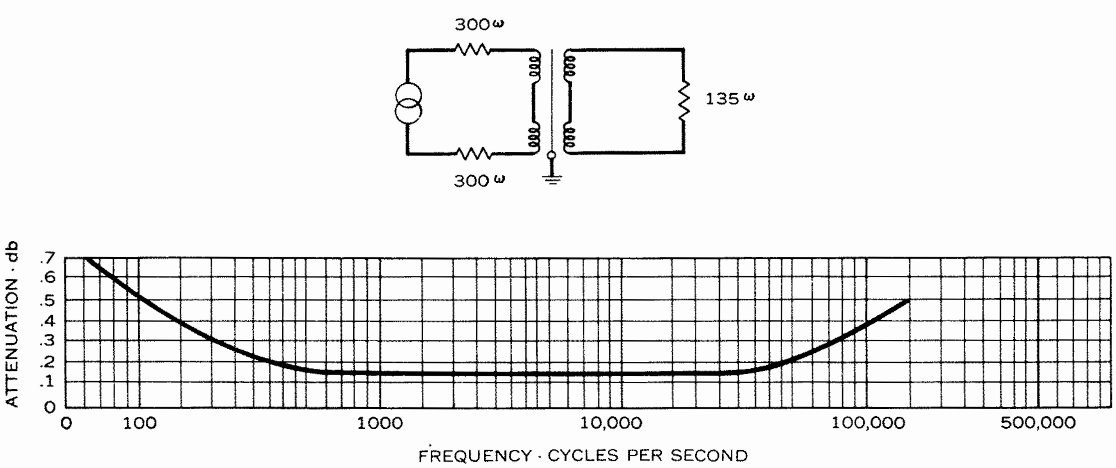

Fig. 8 — Loss-Frequency Characteristic of No. 146A Repeating Coil

in Fig. 9, which show the variation in impedance of each side of the coil when the other side is terminated in the required impedance.

3.06 With 1 milliwatt, 0 db on the meter scale, the accuracy of the thermocouple circuit and meter after calibration is within limits of ±0.1 db. Because of variations in the characteristics of thermocouples the accuracy at the extreme portions of the meter scale will not be as good as this. It is expected, however, that for a scale reading of −10 db the accuracy will always be within limits of ±0.7 db of that at the 0 db reading. At the +3.4 point the limits will be within ±0.5 db. A typical curve of scale reading accuracy is shown in Fig. 10. This accuracy may be improved for a particular set by selecting thermocouples, or a special scale calibration may be made.

3.07 The heater of the thermocouple should not ordinarily be subjected to more than 6 db above 1 milliwatt because of the danger of changing its characteristics. Greater overload may permanently affect the thermocouple and if allowed to continue may burn out the thermocouple. If overloads occur, the calibration should be rechecked before making further measurements.

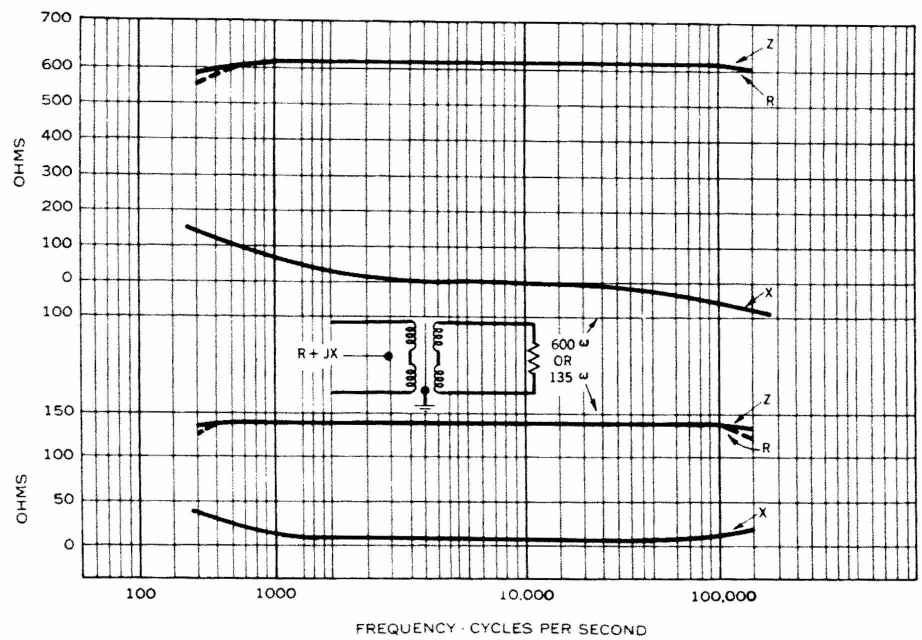

Fig. 9 – Impedance Characteristics of 146A Repeating Coil

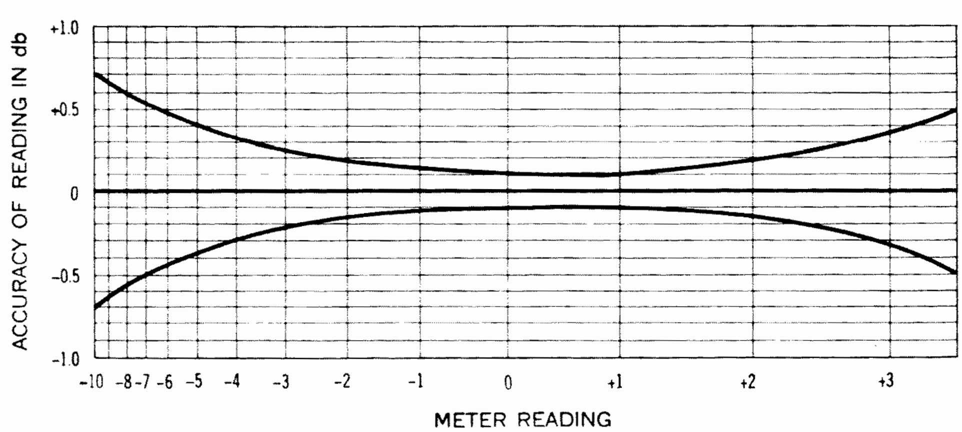

Fig. 10 – Variation in Accuracy with Scale Reading

3.08 The attenuator and pad resistors have been designed to accept power on the input side up to about six watts (which can be obtained from type J system line amplifiers) without danger of damage.

3.09 The life of the dry-cell battery used for calibration purposes is conserved by employing a nonlocking push-type key for connecting it to the circuit during calibration. It is expected that its life ordinarily will be approximately six months. When it is found that the setting on DIAL 1 cannot be increased sufficiently to obtain the normal reading during the first step of calibration, it will be necessary to replace the battery.

4. OPERATION

4.01 The method of using the set for measuring gain, loss, received power, and line attenuation, as described below, represents typical uses of the set, which is quite flexible and may be used in a variety of ways, so long as care is exercised in its use regarding load capacity, etc, described herein. Uses of the set in making tests on any system, in addition to those described below, will ordinarily be described in tests on such a system.

4.02 In using the measuring set, the readings on the meter should be kept within 1 db of the 0 db point in order to obtain maximum accuracy. A test is given below for checking and improving the accuracy at other points on the meter scale. Care should also be taken to insure that the set is properly grounded either by using a three-conductor patch cord and jacks having their sleeves grounded, or by supplying a separate ground to the GROUND post. When measuring unbalanced circuits, balanced and shielded coils should be used in the circuit ahead of the equipment under measurement.

4.03 Measurements of filter losses greater than about 20 db may be inaccurate unless precautions are taken to suppress harmonics of the test frequency. For example, if it is desired to measure the attenuation of a high-pass filter or a band filter at frequencies which are in the attenuation region and which have harmonics which fall into the transmission region, the fundamental may be attenuated by the filter to an amount equal to or less than the harmonics which are transmitted through the filter. It follows that low-pass filter characteristics are the only ones which can be measured without filtering the test power. This filtering may be accomplished by patching a filter which sufficiently suppresses harmonics in the transmitting region of the filter under test between the test current supply and the test potentiometer.

(A) Calibration

4.04 In order to insure maximum accuracy, the set should be checked for correct zero adjustment before calibration. Accordingly, with no input to the meter, check that the meter pointer lines up with the line at the left of the −10 db scale marking. If it does not, adjust the meter zero adjust screw for correct alignment.

4.05 Calibrate the set before each group of measurements to obtain maximum accuracy. The set may be calibrated as follows:

(1) Turn dial switch to position DIAL 1.

(2) Depress the nonlocking key BATTERY.

(3) Adjust DIAL 1 until the meter reads exactly "0 db." (See Fig. 4.)

(4) Turn dial switch to the DIAL 2 position.

(5) Adjust DIAL 2 until the meter reads exactly "0 db." (See Fig. 5.)

(6) Turn dial switch to the DIAL 3 NORMAL position.

(7) Adjust DIAL 3 until meter reads exactly "0 db." (See Fig. 6.)

(8) Turn dial switch to the DIAL 3 REVERSED position. (See Fig. 6.)

(9) Note the reading of the meter.

(10) If the meter does not read "0 db" change DIAL 3 until the average for (7) and (9) is exactly 0 db.

(11) Release the battery key.

(12) Turn the dial switch to the MEASURE position. The set is now in the measuring condition.

4.06 If it is desired to check the accuracy of the meter scale with the given thermocouple, the following procedure may be used. If desired, thermocouples may be so chosen as to provide a higher degree of accuracy than could be obtained by random selection of thermocouples.

(1) Calibrate the set as described under 4.05.←

(2) Patch a test oscillator to the POTENTIOMETER IN jacks. The frequency chosen is not important but 1 kilocycle is suggested.

(3) Set the attenuator dials for a loss of 3 db.

(4) Operate the test key to the ADJUST position.

(5) Adjust the oscillator output and the TEST CURRENT POTENTIOMETER until the meter reads 0 db with all of the 10 db meter protection pads out of the circuit.

(6) Increase the attenuator setting to 10 db and note the meter reading. The departure from the −7 db mark indicates the combined error of the thermocouple and the meter at this point.

(7) Reset the attenuator to 3 db and readjust the potentiometer for a 0 db reading of the meter if necessary.

(8) Set the attenuator for a 0 db loss and note the meter reading. The departure from the +3 db mark indicates the combined error of the thermocouple and the meter at this point. If the errors are greater than are permitted for the type of test involved, the thermocouple should be replaced and the check repeated.

(9) To make a complete calibration of the scale the attenuator may be varied in 1 db steps and the true db readings recorded and plotted for subsequent reference.

(B) Gain Measurement

4.07 Gain measurements are made by patching the circuit to be tested in the attenuator side of the circuit, as indicated in Fig. 11. The attenuator is then adjusted until the meter reading is the same for both positions of the test key. The gain of the circuit is the setting of the attenuator plus the algebraic value of the meter reading. The circuit under test should preferably be placed after the attenuator in order to prevent overloading of the equipment. When measuring a 600-ohm circuit the impedance matching coils should be patched into the circuit at the input and output of the circuit under test and corrections must be made for the loss introduced by the coils and connecting leads.

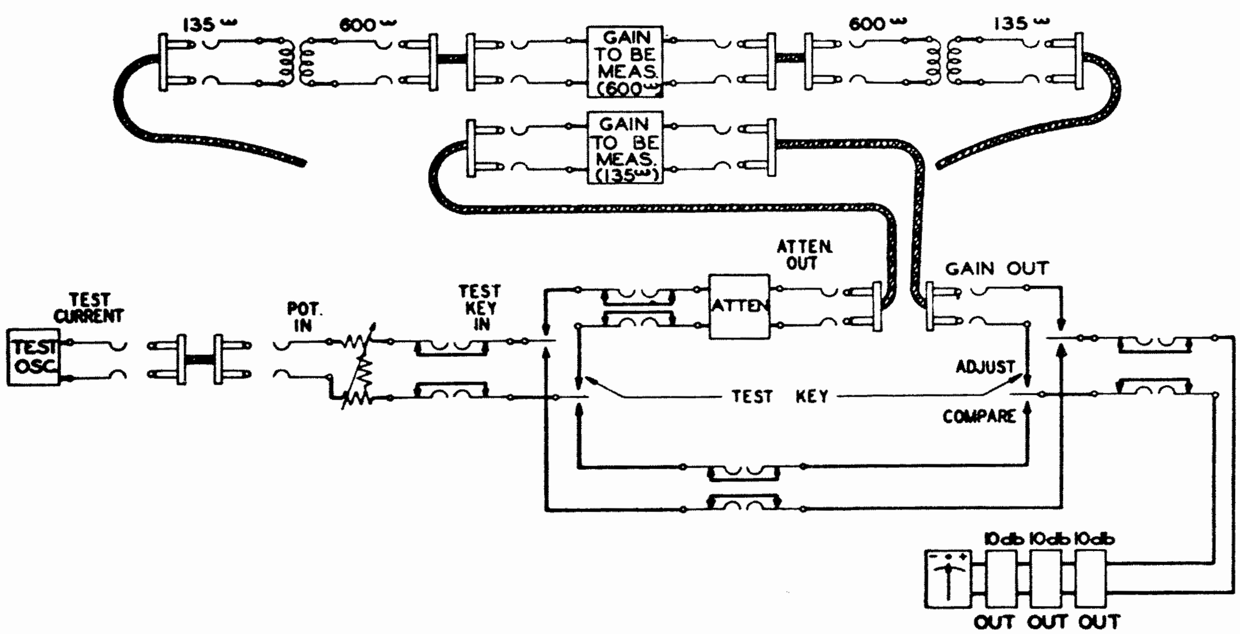

Fig. 11 – Gain Measurement

4.08 A typical measurement is given below.

→ (1) Calibrate the measuring set as described in 4.05.

(2) Patch the test current to the POTENTIOMETER IN or the TEST KEY IN jacks.

(3A) For a 135-ohm circuit patch the input of the circuit to the ATTENUATOR OUT jacks, and the output of the circuit to the GAIN OUT jacks.

(3B) For a 600-ohm circuit proceed as follows: Patch the ATTENUATOR OUT to 135-ohm jacks of one coil and the 600-ohm jacks of the same coil to the input of circuit under test. Patch the output of circuit under test to the 600-ohm jacks of the second coil and the 135-ohm jacks of the second coil to the GAIN OUT jacks.

(4) Operate the test key to the COMPARE position and adjust the oscillator output control and the TEST CURRENT POTENTIOMETER until the meter reading is 0 db with all 10 db pad keys in the OUT position.

(5) Set attenuator for a loss equal to the approximate gain of circuit under test, or for maximum loss.

(6) Operate the test key to the ADJUST position and change the attenuator settings until the meter reads as close as possible to 0 db with all 10 db pad keys in the OUT position.

(7) The gain of the circuit is the setting of the attenuator plus the algebraic value of the meter reading, i.e., meter readings below 0 db are subtracted from the attenuator setting while meter readings above 0 db are added to the attenuator setting. In addition, the loss of connecting cords and 135:600-ohm coils which are used to patch the circuit being measured to the set should be added to the attenuator and meter readings. The corrections to be made are → discussed in Paragraphs 3.02 and 3.03.

(C) Loss Measurement

4.09 The measurement of the loss of a circuit is made by patching the circuit under test in the side of the comparison circuit containing the LOSS jacks as indicated in Fig. 12. The attenuator is then adjusted until the meter reading is the same for both positions of the test key. The loss of the equipment is the setting of the attenuator when corrected by the reading of the meter. The maximum loss which can be measured without the use of added amplification will depend on the maximum testing power which may be used at the input of the circuit under test. This will be determined by either the characteristics of the circuit under test or the maximum output obtainable from the test oscillator. Best accuracy is obtained when the testing power is such as to give a meter reading in the vicinity of 0 db. When added amplification is necessary to obtain this condition, a spare amplifier should be used between the output of the test key and the thermocouple. The 10 db pad should be used with the spare amplifier if no amplifier gain control is provided in order to prevent a possible overloading of the thermocouple. If the frequencies are different in the two positions of the test key the difference in the gain of the spare amplifier at the two frequencies will have to be taken into account. A frequency difference may exist if the circuit under test includes modulators or demodulators. Also, if an amplifier having a 600-ohm impedance is used when measuring the loss of a 135-ohm circuit a 135:600-ohm coil should be used at the amplifier input. No correction for this coil loss is necessary since it is in a common portion of the test circuit.

4.10 When measuring a 600-ohm circuit the 600:135-ohm coils should be used as indicated in Fig. 12 to reduce the impedances of the circuit under test to that of the measuring set. With this setup, if a spare amplifier is required, one having an input impedance of 135 ohms should be used since the two coils supplied in the set are in use. If an amplifier having 600-ohm impedance is to be used one 135:600-ohm coil should be patched to the ATTEN OUT and the GAIN OUT jacks, and the second 135:600-ohm coil between the LOSS IN jack and the input of the loss to be measured. In this case, the loss due to the mismatch in impedance between the output of the amplifier and the 135-ohm TC circuit need not be corrected for, since it is in a common portion of the test circuit.

4.11 The following test illustrates the method of measuring the loss of a 135-ohm circuit.

→ (1) Calibrate the measuring set as described under 4.05.

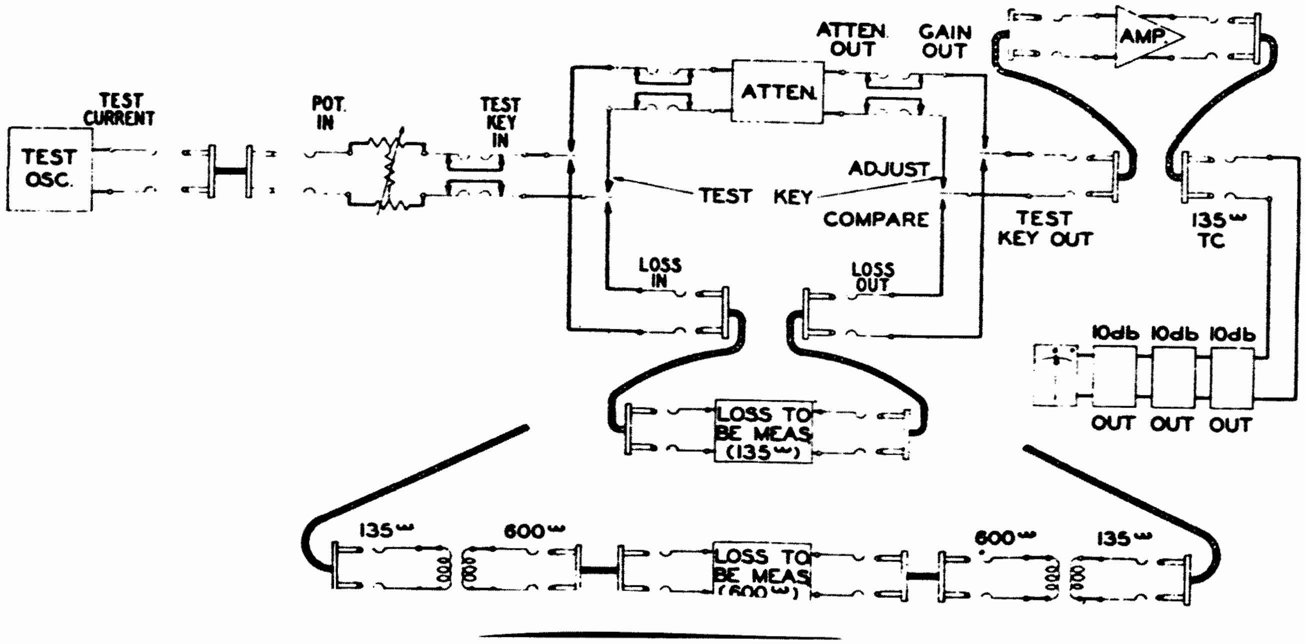

Fig. 12 — Loss Measurement

(2) Patch the test current to the POTENTIOMETER IN or TEST KEY IN jacks.

(3) Patch the input of the circuit under test to the LOSS IN jacks.

(4) Patch the output of the circuit under test to the LOSS OUT jacks.

(5) If the loss to be measured does not require added amplification, proceed to (9).

(6) If added amplification is required, patch from TEST KEY OUT to 10 db IN jacks.

(7) Patch from 10 db OUT jacks to the input of the spare amplifier, using a 135:600-ohm coil, if necessary.

(8) Patch from the output of the spare amplifier to the 135-ohm TC jacks.

(9) Operate the test key to the COMPARE position and adjust the 10 db pad keys until a reading as near as possible to 0 db is read on the meter. When the above patches (6), (7), and (8) are made, remove 10 db pad by patching from TEST KEY OUT to the input of spare amplifier if the reading of the meter is below −7 with all pad keys in the OUT position. Note meter reading and setting of pad keys.

(10) Set the attenuator for maximum loss.

(11) Operate the test key to the ADJUST position and with the pad keys set for the condition used in (9) adjust the attenuator until a reading as close as possible to the meter reading in (9) is obtained. Note the reading of the meter and the attenuator setting.

(12) The loss of the circuit under test is computed as follows: Compute the difference between the meter reading in (9) and (11). If the reading in (9) was the higher, subtract the difference from the attenuator setting. If the reading in (9) was the lower, add the difference to the attenuator setting.

(13) When measuring a 600-ohm loss, the result obtained in (12) should be corrected for the loss of 135:600-ohm coils and connecting cords; the losses in the adjust circuit should be added and those in the compare circuit subtracted from the attenuator setting. The corrected attenuator setting is the loss of the circuit under measurement. The corrections to be made are discussed in Paragraphs 3.02 and 3.03.

(14) An alternative method of measuring losses when an amplifier is required, especially when the gain of the amplifier is not

readily adjustable, is to patch the loss to be measured ahead of the amplifier and then patch these between the ATTENUATOR OUT jacks and the GAIN OUT jacks. With the test key operated to the ADJUST position, the attenuator and test potentiometer are adjusted to give a reading of 0 db on the meter, and the setting of the attenuator noted. The loss to be measured is then removed from the circuit, and the attenuator is again set to give a reading as close as possible to 0 db. This setting of the attenuator, plus or minus the meter reading, is subtracted from the above setting to obtain the loss of the circuit under measurement.

(D) Measurement of Incoming Power

4.12 Measurements of received power are made by patching the circuit under test to the input of the variable attenuator, as indicated in Fig. 13, and adjusting the attenuator until a satisfactory reading is obtained on the meter. Power levels down to 10 db below 1 milliwatt may be measured by this method. When measuring power from a 600-ohm circuit it is necessary to use a 600:135-ohm coil between the circuit under measurement and the set. Correction should be made for the losses introduced by the patching cords and the impedance matching coil if used.

4.13 A typical measurement of incoming power is outlined below:

(1) Calibrate the set as previously outlined.

(2) Set the attenuators for maximum loss.

(3) Operate the test key to the ADJUST position.

(4) Patch the ATTENUATOR IN jacks to the circuit under test, with precautions with respect to test cords and trunks as indicated in Paragraph 3.03. A 600:135-ohm coil should be used if the line impedance is 600 ohms.

(5) Reduce the attenuator setting in 10 db steps until a small reading on the scale is observed, then by 1 db steps until a reading as near as possible to 0 db is obtained on the meter with all the 10 db pad keys operated to OUT.

(6) The power from the circuit under measurement, as compared to 1 milliwatt, is equal to the attenuator setting plus or minus the reading of the meter. The result should be increased by the loss in the patching cords and in the impedance matching coil if used.

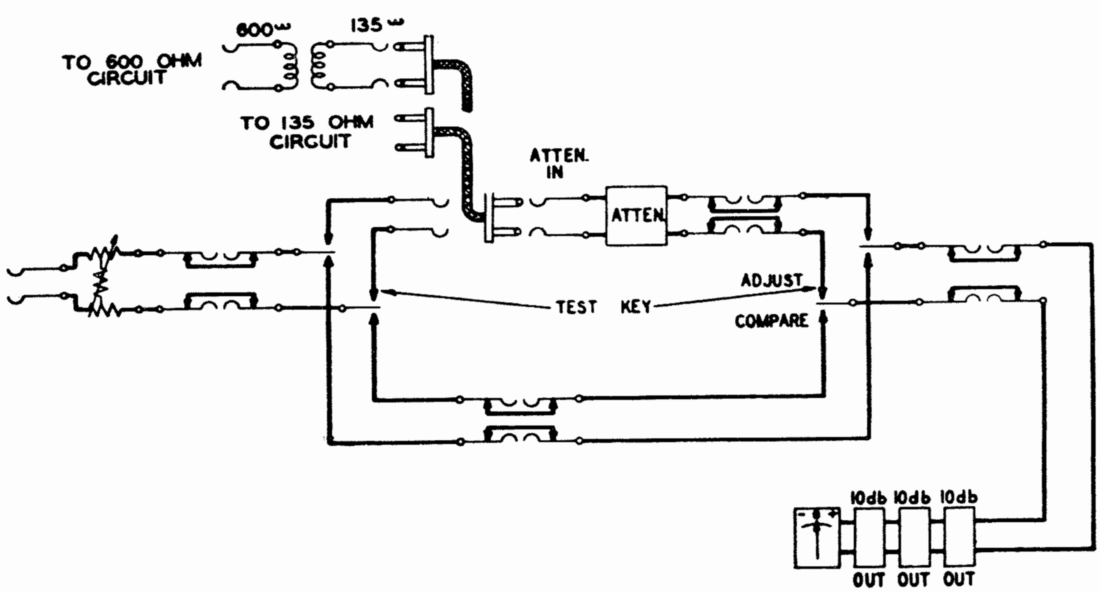

Fig. 13 – Incoming Power Measurement

(E) Line Loss Measurement

4.14 One of the uses to which the measuring set will be put is the measurement of the line loss between offices, using a set at each end of the line. The test is made by transmitting test power at a certain level from one office, measuring the received power at the receiving office, and measuring the gain of any amplifiers in the circuit. A 135:600-ohm coil should be used between the measuring set and the circuit under test if it is a 600-ohm circuit. The general setup for this type of test is illustrated in Fig. 14.

4.15 The procedure at the sending terminal is as follows:

(1) Calibrate the set as previously outlined.

(2) Set the attenuator for a loss equal to the desired sending level.

(3) Patch the LOSS IN jacks to the circuit under test, with precautions with respect to test cords and trunks as indicated in Paragraph 3.03. A 135:600-ohm coil should be used if the line impedance is 600 ohms.

(4) Patch the test current to the POTENTIOMETER IN jacks. A 17B oscillator or its equivalent should be used, if required, to obtain sufficient output.

(5) Operate the test key to the ADJUST position and adjust the oscillator output control and the test potentiometer until 0 db is read on the meter with the 10 db pad keys in the OUT position.

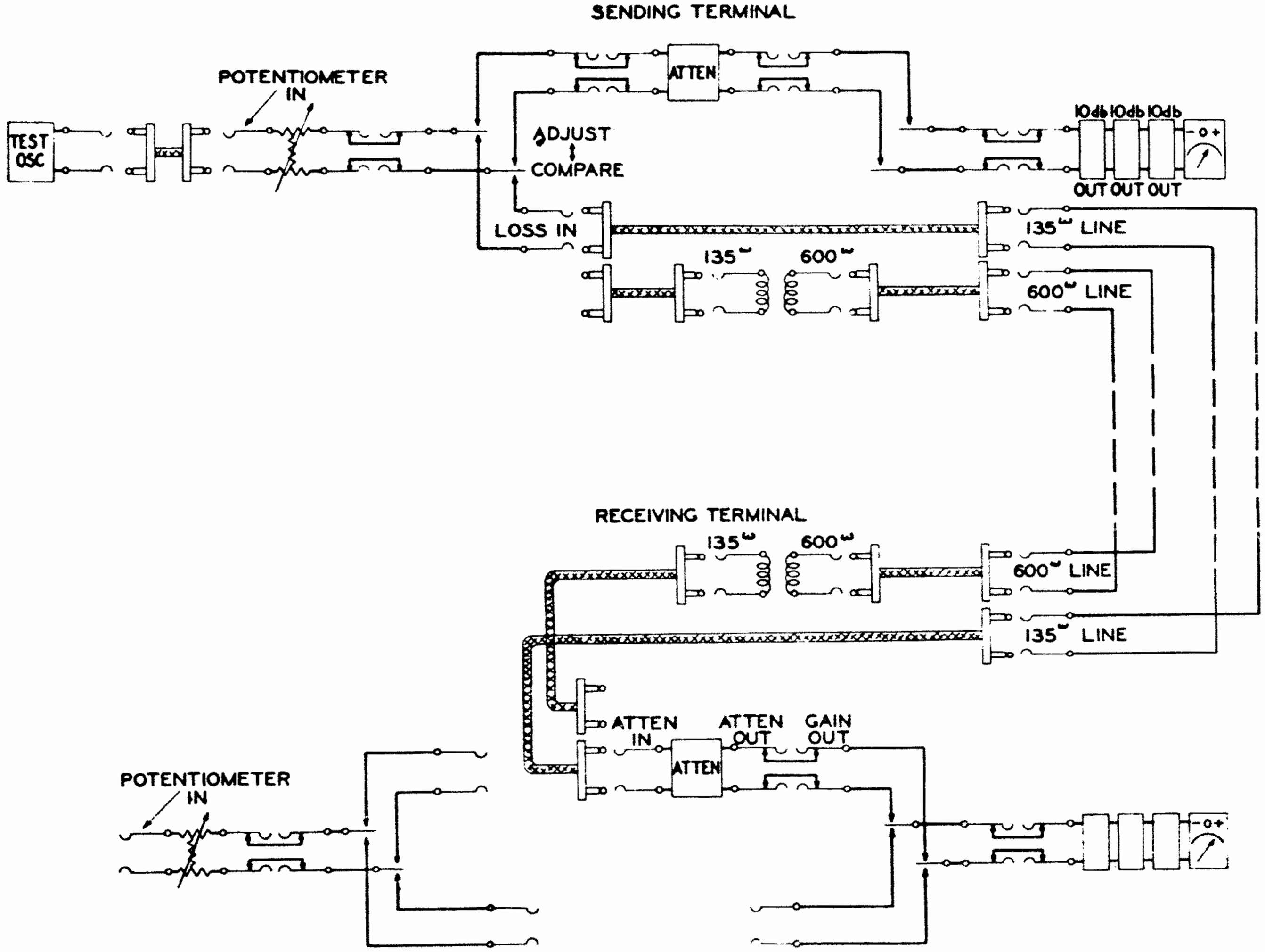

Fig. 14 — Line Loss Measurement

(6) Operate the test key to the COMPARE position to transmit the test power to the circuit under test.

4.16 The procedure at the receiving terminal is as follows:

(1) Calibrate the set as previously outlined.

(2) Set the attenuator for maximum loss.

(3) Patch from the ATTENUATOR IN jacks to the circuit under test, using 600:135-ohm coils, if necessary. Ordinarily there will be an amplifier in the line at the receiving office so that the level out of this amplifier will be approximately the same as the output level at the sending office.

(4) Operate the test key to the ADJUST position and adjust the attenuator until a reading as close as possible to 0 db is obtained.

(5) The difference between the setting of the attenuator at the sending end, and the setting of the attenuator plus or minus the meter reading at the receiving end is the **net** loss or gain of the line. It is a loss if the setting of the attenuator at the receiving end is smaller than the setting at the transmitting end, and vice versa. The attenuation of the line can be determined by adding the net loss to, or subtracting the net gain from, the gain of any amplifiers in the line. The measured loss should be reduced by the amount of the loss in such patching cords and impedance modifying coils as are used.

5. DRAWINGS AND SPECIFICATION

(A) Drawings, Not Attached

SD-64049-01	Circuit Schematic
ED-64049-01	Assembly and Equipment

(B) Specification

J64030 (Section AA268.512)	30A Portable Transmission Measuring Set for Use on Carrier Telephone Systems

ADDENDUM 103-408-100
Issue 1, October 1967
AT&TCo Standard

J64030A (30A) TRANSMISSION MEASURING SET
(RANGE: UP TO 150 KILOCYCLES)
DESCRIPTION

1. GENERAL

1.001 This addendum supplements Section 103-408-100, Issue 2.

1.002 This addendum is issued to add a new paragraph concerning the use of the J94002AA milliwatt reference set.

The following change applies to Part 4 of the section:

(a) 4.07.1—added paragraph

4.07.1 After the 30A transmission measuring set has been carefully calibrated, the deviation from a true reading should be measured by using a J94002AA (2AA) milliwatt reference set (if available) to check the transmission measuring set. The complete method of making this check is specified in Section 103-429-100.