12A TRANSMISSION MEASURING SET

1. GENERAL

1.01 This section describes the 12A transmission measuring set, which is a small, portable receiving instrument for measuring transmission losses from 0 to 20 db over the frequency range of 350 to 10,000 cycles. Losses between 20 and 25 db can be estimated as discussed in Paragraph 3.02. This set does not employ vacuum tubes and therefore external power is not necessary for its operation.

1.02 This issue replaces issue 1. The purpose of the new issue is to include information regarding changes in the set. These changes have been made to facilitate the testing of the new type cord circuits and trunk circuits employing ballast lamps in the voice current path and also P.B.X. and miscellaneous circuits requiring special sleeve conditions.

1.03 All 12A transmission measuring sets with serial numbers higher than No. 350 include the new features, i.e. have the SX binding post, and the "L" designation at one 241 MEAS jack indicating the jack arrangement to permit adding resistance in the holding circuit. The new features modify the transmission characteristics of the set a negligible amount.

2. EQUIPMENT AND CIRCUIT FEATURES

2.01 The 12A transmission measuring set is assembled in an aluminum alloy box which, excluding hardware, measures 8-1/2" x 5" x 5". The total weight of the set including a cover, which is provided for protecting the panel equipment when not in use, is 7 pounds.

2.02 The face view of the measuring set panel is shown in Fig. 1. The equipment as shown consists of a meter, two lever type keys, three (see Paragraph 1.03) binding posts, ten jacks and an adjustable resistance for calibration.

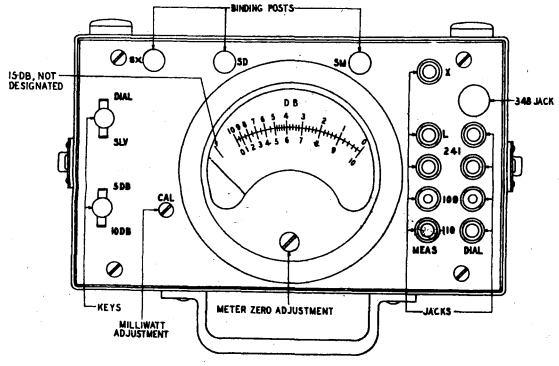

Fig. 1 - Face View of Measuring Set

2.03 The meter used is a Weston Model 643 microammeter employing a copper oxide unit. It has two scales, one black (upper) and the other red (lower) each graduated in db from 0 to 10. The black (upper) scale is used for loss measurements, and the red (lower) scale for gain measurements when calibrating repeaters, lining up circuits etc. The black scale is calibrated in 0.2 db steps between 0 and 5 db and in 0.5 db steps from 5 to 10 db. The line between 10 db on the black scale and the arrow indicating the pointer position for no input current is 5 db below the graduated scale range, thus indicating 15 db.

2.04 The jacks are provided for making the various dialing and measuring connections between the set and the various types of switchboards, test boards, P.B.X.'s etc. Jacks are provided to receive 109-, 110- and 241-type plugs and for connection to a hand test set in a step-by-step office. The MEAS and DIAL jacks are on separate multiples that may be connected together by means of the DIAL key. The group of jacks designated MEAS provides for connecting the set to the circuit being measured. The group designated DIAL provides for connecting a hand set or other testing facilities when required for controlling or establishing connections.

2.05 The X jack is provided for facilitating measurements at a P.B.X. where 1000-cycle testing power is supplied from the central office. Cord circuits can be measured in both the trunk to extension and extension to extension conditions. In addition, the X jack is associated with circuits which provide for holding the central office trunk supplying the testing power while the cord circuits are being changed. The tip and ring of the X jack are reversed with respect to the DIAL and MEAS jacks. Where the P.B.X. trunk circuit does not require the operation of a relay in the sleeve circuit to cut the trunk through to the central office, this arrangement supplies ground to the ring side of the trunk for holding the connection to the testing power when the SLV key is operated.

2.06 The SM and SD binding posts are in the measure and dial sleeve circuits, respectively, and are normally connected together through an auxiliary contact on the X jack. The SX binding post normally is disconnected from the test circuit, but may be connected to the sleeve of the X jack by operating the SLV key.

2.07 The DIAL-SLV key is provided for setting up dialing and holding conditions. When this key is normal the MEAS

jacks are connected to the retardation coil and the meter circuit and the X jack is connected to the dial jacks. In the DIAL position, the measure and dial jacks are connected together and the X jack is connected to the retardation coil for holding purposes. The operation of the SLV key disconnects the DIAL jack sleeve from the X jack sleeve, connects it to the MEAS jack sleeve, and reconnects the X jack sleeve to the SX binding post. To this binding post may be connected either battery or ground to secure the proper sleeve condition to hold relays in the trunk operated, when required in order to cut the trunk through to the central office.

2.08 The 5 DB - 10 DB key is provided for extending the range of the db meter by switching 5 and 10 db pads out of the circuit. When this key is normal, the 10 db pad is in the circuit and the black scale is read directly for loss measurements. When the 5 DB key is operated, the 10 db pad is replaced by a 5 db pad and meter readings made under these conditions should have 5 db added to the readings on the black scale. When the 10 DB key is operated both pads are removed from the circuit and 10 db should be added to all black scale meter readings. With the key in this (10 DB) position, the single line to the left of the scale graduations mentioned in Paragraph 2.03 indicates a loss of 25 db. As described previously, the red scale is for use in making gain measurements with a suitable pad circuit. For such measurements the 5 DB - 10 DB key of the set should remain normal and the gain range will then depend on the size of the external pads (see Paragraph 4.06).

2.09 The circuits of the 12A set for the three positions of the DIAL-SLV key are shown in schematic form in Fig. 2.

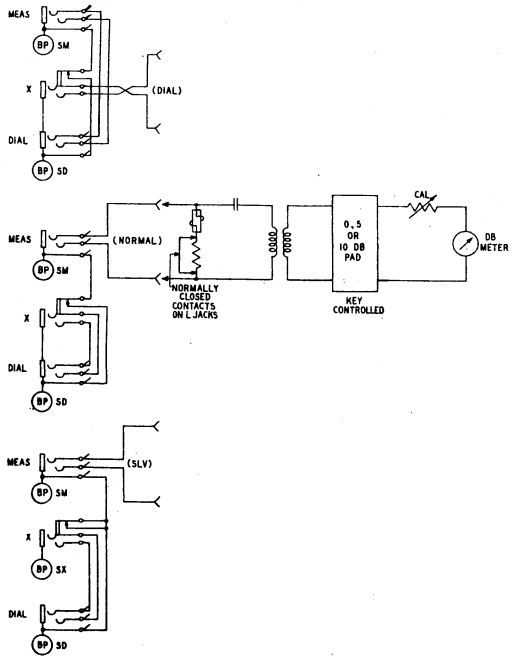

Fig. 2 - Schematic Circuit of 12A Set

2.10 The input connections at the jacks are carried through key contacts to a retardation coil. This coil acts as a bridge to give a d-c path for holding the connection established to the test line when required. The resistance of the holding circuit can be increased by opening the contacts on the 241 MEAS jack designated "L" by means of a single plug, inserted into this jack. The amount of the increase is sufficient to limit the battery supply current from the circuit under test, for tests on the new type cord circuits and trunk circuits employing ballast lamps in the voice current path. The coil and a condenser make up a filter circuit for attenuating the lower frequencies so that low frequency noise will not interfere with transmission measurements at low levels. The transformer serves to match the impedance of the meter circuit to that of a 600-ohm line.

2.11 The circuit label in the cover of the carrying case gives the complete circuit of the set and shows the detailed arrangements of the jacks and keys.

2.12 The apparatus in the 12A set can be made accessible for maintenance purposes by removing the four corner screws from the top panel and lifting the entire assembled unit from the box.

3. TRANSMISSION PERFORMANCE

3.01 The accuracy of the 12A set for 1000-cycle measurements in the 0 to 5 db portion of the black scale, immediately after calibration, is ± 0.2 db at normal room temperatures. Under the same conditions, the accuracy for the 5 to 10 db part of this scale is ± 0.5 db but, as pointed out in Paragraph 4.04, the use of this measuring range can be avoided for losses of 15 db or less by proper use of the pad key. When the set is calibrated at a temperature in the range between 40° and 90° F., and measurements are made in the 0-5 db portion of the black scale at any other temperature in this range without recalibration, additional error due to this cause will result. This additional error will be within the limits of ± 0.2 db. At temperatures beyond this range, the additional error becomes increasingly greater and in extreme cases may amount to more than 1 db. This is beyond the compensating ability of the adjusting dial rheostat resistance. The set, therefore, should not be used under temperature conditions for which it can not be calibrated, and after exposure to very high or low temperatures should be allowed to return to approximately the calibrating temperature before use. The temperature of the copper-oxide rectifier changes slowly, and the time allowed should depend on the temperature differences involved. In extreme cases time allowances up to about an hour may be necessary.

3.02 The accuracy of measurement in the range between 20 db and the mark indicating 25 db is approximate. In this range it is necessary to estimate the scale divisions on the basis of continuing the "taper" of the scale divisions which are calibrated. At 75° F., the temperature at which the meter scale was calibrated, the mark indicating 25 db is accurate to about ± 1 db. At other temperatures it may be less accurate. Where greater precision is desired the set may be checked by measuring known loss pads.

3.03 This measuring set has a practically flat receiving characteristic in the frequency range from 700 to 4000 cycles - the maximum deviation being about 0.2 db. In the range below 700 cycles, due to the action of the low-frequency filter the characteristic falls off, the loss at 350 cycles being about 1 db below the 1000-cycle loss. At 60 cycles, the loss is about 25 db below the 1000-cycle loss. These values are decreased a small amount when the resistance in the holding circuit is increased by opening the contacts of the jack designated "L". In the range above 4000 cycles due to the capacitance of the rectifier the characteristic also falls off so that at 10,000 cycles it is about 1.5 db below the 1000-cycle loss. Where desired the error at these and other frequencies may be determined and a calibration curve plotted for future reference. Fig. 3 gives the average loss frequency characteristic curve for 1 MW input, for several sets. In the range between 350 and 4000 cycles this curve may be considered typical of the performance of any set.

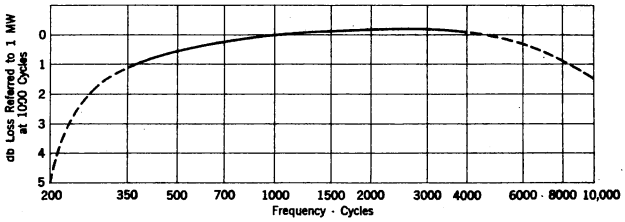

Fig. 3 - 12A Set Loss Frequency Characteristic

3.04 The input impedance of the 12A set at 1000 cycles is close to 600 ohms. While it varies with frequency the deviation is usually unimportant.

4. OPERATING FEATURES

4.01 The 12A set should be in an approximately horizontal position when measurements are made.

4.02 The small arrow at the left of the meter scale indicates the correct position for the pointer of the meter for zero current input. The only time when the meter zero adjustment screw (see Fig. 1) should be adjusted is when, with zero current input, it is necessary to bring the pointer to accurate registry with this arrow.

4.03 As stated in Part 2, connections to external circuits are made by means of the jacks and binding posts in the measuring set. In order to provide for connecting to the various types of switchboards, test boards and P.B.X.'s, etc., four different types of jacks are furnished: those for use with 109, 110 and 241 plugs and a jack for use in step-by-step switch rooms. The binding posts provide means for connecting battery or ground to the sleeve circuit, when required for establishing and holding connections.

4.04 The 5 DB - 10 DB key is provided for increasing the measuring range of the set, and for shifting the meter pointer to the more accurate part of the scale when the measured loss is between 5 db and 15 db. Thus, if the loss in a particular loop or trunk is about 8 db, a more accurate reading can be obtained by operating the 5 DB key and causing the meter to read about 3 db. Or, if an initial reading of about 11 db is obtained, this can be changed to about a 1 db reading by operating the 10 DB key.

4.05 When this set is used for measuring transmission gains on circuits, a series of pads connected to jacks, or inserted by keys should be provided to be inserted in the measuring circuit ahead of the measuring set. If repeater gains are being measured the pads should be connected between the 1 MW source of testing power and the input of the repeaters.

4.06 When the 12A set is used for gain measurements, the 5 DB - 10 DB key should be normal. Under this condition, the received testing power is between 1 MW and 10 db below 1 MW and, therefore, the gain of the circuit or repeater under measurement will be 10 db greater than the sum of the external pad losses in db plus the meter reading on the red (lower) scale. In other words, the gain is equal to this sum (of the external pad losses and the red scale meter reading) less 10 db.

4.07 The 12A set is calibrated by connecting it to a 1000-cycle source of 1 MW testing power and adjusting the CAL resistance with a screwdriver until the meter reads 0 on the black scale. As mentioned previously this should be at approximately the temperature to which the set is to be exposed during measurement.

4.08 In general, transmission loss can be measured by connecting the circuit involved to the MEAS jacks of the 12A set and to a source of testing power in accordance with the procedure given in other sections of the A and K series of Bell System Practices. If hand sets or other testing facilities are required to establish a con-

nection to the testing power they are connected to the DIAL jacks and the DIAL key is operated. After the connection is established 1000-cycle test tone can be heard on the circuit and the DIAL-SLV key should be restored, thus connecting the testing power to the meter circuit. With the 5 DB - 10 DB pad key normal the meter reads directly the loss between the source of testing power and the 12A set. If the measured loss is less than 15 db the meter reading can be kept in the 0-5 db range by means of the 5 DB or 10 DB pad key. When the pad key is operated this loss is obtained by adding the operated pad key designation to the meter reading.

4.09 When testing a P.B.X. cord circuit using 1 MW testing power supplied over a trunk from the central office, the X jack is patched to the trunk jack, the cord circuit patched to the DIAL and MEAS jacks and ground supplied at the SM binding post in accordance with the procedure given in other sections of the B and K series of Bell System Practices. Then, with the DIAL key operated, the measured loss is that of the P.B.X. trunk. With this key restored to normal the measured loss is that of the trunk plus that of the P.B.X. cord circuit in the trunk to extension transmission condition. With the SLV key operated, the measured loss is that of the trunk plus that of the extension to extension transmission condition of the cord circuit. With the DIAL key operated, the trunk connection to the 1 MW testing power is held while changing cords.