BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G86.064.1
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AT&T Co Standard

KS-14959 TEST SET
(PORTABLE WHEATSTONE BRIDGE)

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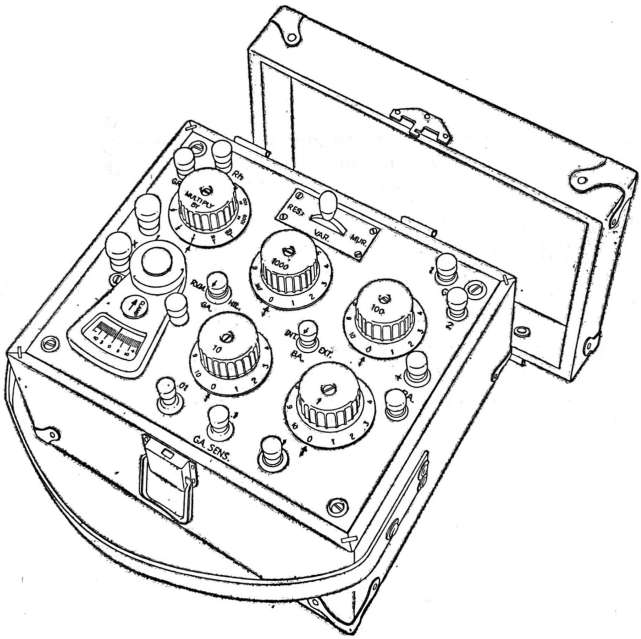
1. GENERAL

1.01 This section replaces Issue 1. It covers the KS-14959 Test Set (portable Wheatstone bridge) used to locate faults in cable conductors, or in buried or open wire. Either the 5430A Test Set manufactured by the Leeds and Northrup Company or the RN3 Test Set manufactured by the Industrial Instruments Company may be supplied under the KS-14959 Test Set designation.

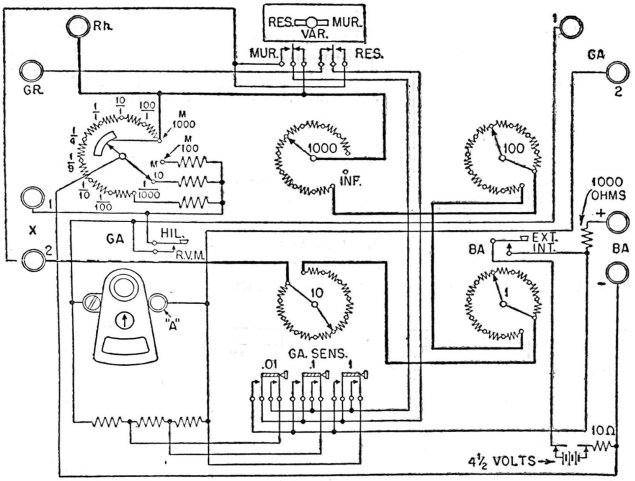
2. DESCRIPTION

L and N 5430A Test Set

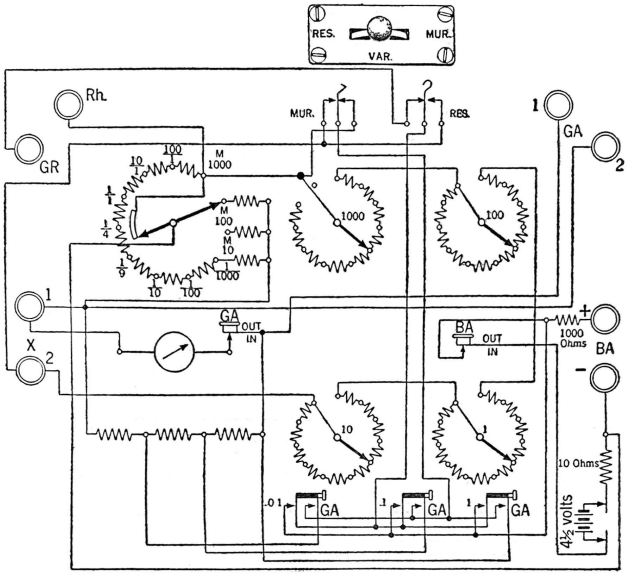
2.01 The L and N 5430A set is illustrated below. The superseded L and N 5430 set is similar to the 5430A except for the following differences in the faceplates: The galvanometer key is marked IN and OUT instead of R.V.M. and HIL and the battery key is marked IN and OUT instead of INT and EXT. These sets are contained in a wooden case 9 inches long, 7-1/2 inches wide and 6-1/2 inches high and weigh about 9-1/2 pounds. Three KS-14711 Dry Batteries are required; these must be ordered separately.



2.02 The circuit diagram of the L and N 5430A set is shown below:



2.03 The circuit diagram of the superseded L and N 5430 set is shown below:



2.04 The designations of the various dials, keys and binding posts on the 5430A and 5430 Test Sets and the function and operation of each are given below:

R Arm: The R arm or balancing rheostat has four dials marked 1000, 100, 10 and 1 and is variable from 0 to 10,110 ohms in steps of one ohm. In operating the bridge, the 1000 dial is adjusted first, starting at zero and working to the value directly below the one which causes a reversal in the movement of the galvanometer needle. The 100, 10 and 1 ohm unit dials are similarly adjusted in the order named until no deflection is apparent or until a change of one position on the 1-ohm unit dial reverses the deflection.

Ratio $\frac{A}{B}$: The markings on the "MULTIPLY BY" dial indicate the relative values of the two resistances known as the A and B arms of the bridge. These arms together with the R arm constitute the three variable

resistances generally used in making Resistance and Varley M M M measurements. The markings 1000, 100, 10 indicate the dial positions in which the A arm has the designated resistance and the B arm is eliminated. The M settings are used in making Murray Loop measurements. The ratios used in Varley and Resistance measurements are 1/1000, 1/100, 1/10, 1/9, 1/4, 1/1, 10/1 and 100/1. These ratios provide for measurements up to one megohm and Varley and Murray measurements of any length of conductor likely to be encountered. The 1/9 and 1/4 ratios are especially useful in the Three-Varley method of locating grounds, crosses and shorts.

Galvanometer: The moving system (needle, zero adjustment, locking device and scale) of the galvanometer is a removable unit mounted on the faceplate. The sensitivity of the galvanometer is such that one volt impressed through a resistance of one megohm will produce a deflection of at least one scale division. The set should be as level as practicable and the pointer should be set at zero by means of the zero adjustment knob before measurements are made. When the set is not in use, the needle should be held in place by means of the locking clamp.

Shunt Keys (GA SENS): These keys and their associated shunts are in the galvanometer circuit and control the amount of current that will flow through the galvanometer. With the GA.1 key depressed, maximum current flows through the galvanometer; one-tenth of this current flows through the galvanometer when the GA.1 key is depressed and one-hundredth when the GA.01 key is depressed. In balancing the bridge, the GA.01 key is depressed first. When the needle deflection has been reduced to one or two scale divisions, the GA.1 key may be depressed. When balancing has again reduced the needle deflection to one or two scale divisions, the GA1.0 key may be used to complete the balancing. The shunt keys also serve to connect battery to the bridge and, therefore, it is necessary to press only one key in balancing the bridge.

Loop Key: The three-position lever type key on the bridge provides means for setting up the desired circuit in making Resistance, Varley or Murray Loop measurements. The corresponding key positions are marked RES., VAR., and MUR.

Galvanometer Key (GA): In the 5430A set, the key has two positions marked R.V.M. and HIL. The key should be set at R.V.M. in making

Resistance, Varley and Murray measurements. The HIL (Hilborn) setting is no longer used. If an external galvanometer or telephone receiver is used in making a measurement, the internal galvanometer should be disconnected from the circuit by removing the knurled head galvanometer supporting screw.

In the 5430 set, the key has two positions marked IN and OUT. With the key set at IN, the internal galvanometer is operative. If an external galvanometer or a telephone receiver is used with the bridge, the key should be turned to the OUT position. The external galvanometer or receiver should be connected to the GA1 and GA2 posts.

Battery Key (BA): This is a two-position key marked INT-EXT in the 5430A set and IN-OUT in the 5430 set. With the key in the INT or IN position, the internal battery is operative. In the EXT or OUT position, an external battery can be connected to the BA+ and BA— posts. The internal battery consists of three KS-14711 dry batteries which can be replaced when necessary without removing the faceplate. With this voltage the bridge is sufficiently sensitive to permit balancing the R arm to an accuracy of .1 per cent when measuring the loop resistance of cable conductors or locating grounds, crosses and shorts of low resistance. In the case of faults having a resistance of several thousand ohms or more, higher voltage may be employed. In general, a higher voltage is preferable to a more sensitive galvanometer in locating faults of fairly high resistance as with a sensitive galvanometer fluctuations of the galvanometer needle due to interfering potentials are so magnified that the advantage gained from the greater galvanometer deflection is partially offset. A 1000-ohm current limiting resistance is connected in series with one of the BA binding posts. The resistance affords sufficient protection to the bridge for external battery potentials of approximately 45 volts. If a higher voltage battery is used, sufficient external resistance should be connected in series with the battery to make a total current limiting resistance equal to about 20 ohms per volt. An external resistance need not be used when a Megger or 45A test set is employed as the source of potential, as the internal resistance of these sets will limit the current sufficiently.

Binding Posts:

BA+ and BA—: For connecting external sources of potential to the bridge.

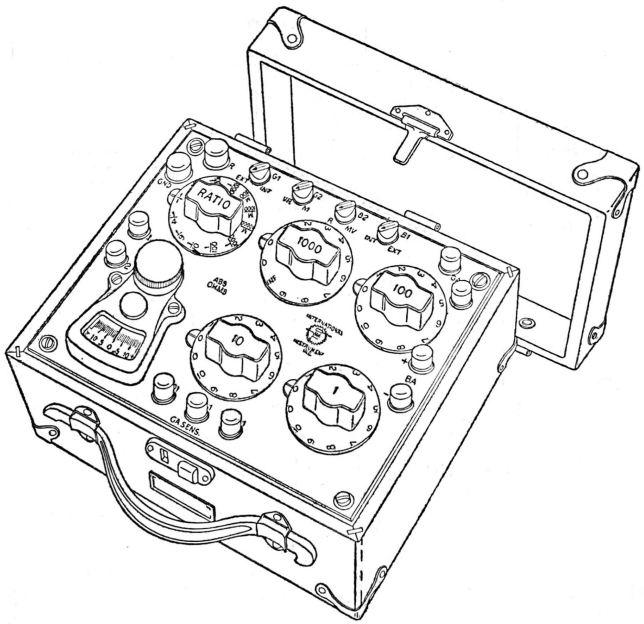
GA1 and GA2: For connecting an external galvanometer or receiver to the bridge.

X_1 and X_2: The "good" and "bad" wires and "ground"
GR: are connected to these posts in various ways, depending on the nature of the trouble, in making bridge measurements.

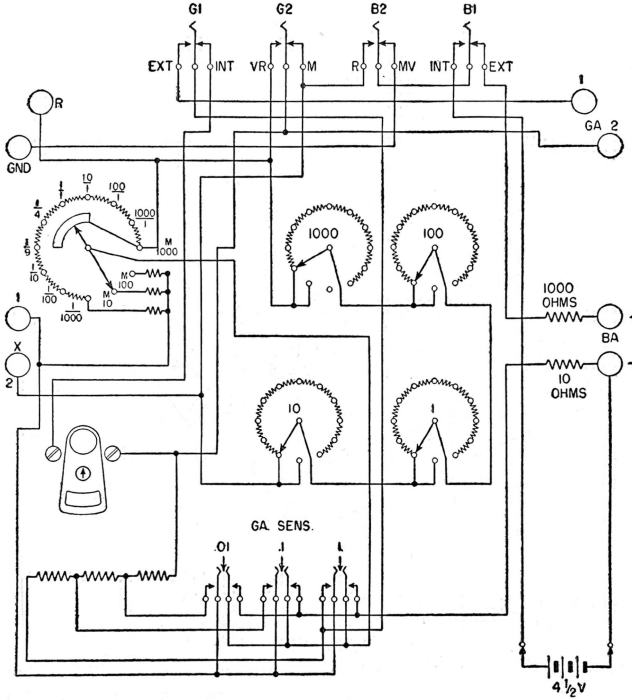
RH: The balancing rheostat of the bridge (R arm) is accessible for use as a variable resistance through binding posts RH and X_2. The RH post is not used in cable fault locating work.

I.I. Co. RN3 Test Set

2.05 The I.I. Co. RN3 set is illustrated below. The set is contained in a wooden case 9-1/4 inches long, 7-1/2 inches wide and 6-1/2 inches high and weigh about 9-1/2 pounds. Three KS-14711 Dry Batteries are required; these must be ordered separately.



2.06 The circuit diagram of the I.I. Co. RN3 set is illustrated below:



2.07 The designations of the various dials, keys and binding posts and the function and operation of each are given below.

R Arm: The R arm or balancing rheostat has four dials marked 1000, 100, 10 and 1 and is variable from 0 to 10,110 ohms in steps of one ohm. In operating the bridge, the 1000 dial is adjusted, starting at zero and working to the value directly below the one which causes a reversal in the deflection of the galvanometer needle. The 100, 10 and 1 ohm unit dials are similarly adjusted in the order named

until no deflection is apparent or until a charge of one position on the 1-ohm unit dial reverses the deflection.

Ratio: The markings on the Ratio $\left(\frac{A}{B}\right)$ dial indicate the relative values of the two resistances known as the A and B arms of the bridge. These arms together with the R arm constitute the three variable resistances generally used in making Resistance and Varley measurements. The markings M1000, M100 and M10 indicate the dial positions in which the A arm has the designated resistance and the B arm is eliminated. The M settings are used in making Murray Loop measurements. The ratios used in Varley and Resistance measurements are 1/1000, 1/100, 1/10, 1/9, 1/4, 1/1, 10/1, 100/1 and 1000/1. These ratios provide for measurements up to one megohm and Varley and Murray measurements of any length of conductor likely to be encountered. The 1/9 and 1/4 ratios are especially useful in the Three-Varley method of locating grounds, crosses and shorts.

Galvanometer: The galvanometer is similar to the galvanometer in the 5430A, L and N set.

Shunt Keys (GA Sens): These keys are similar to those in the 5430A, L and N set and operated in the same manner.

Loop Keys (G2 and B2): These are two turn keys which provide means for setting up the desired circuit to make Resistance, Varley or Murray Loop measurements. For a resistance measurement set the keys at VR and R, for a Varley at VR and MV and for a Murray at M and MV.

Galvanometer Key (G1): This is a two-position key marked EXT and INT. With the key set at INT, the internal galvanometer is operative. If an external galvanometer or a telephone receiver is used with the bridge, the key should be turned to the EXT position. The external galvanometer should be connected to the GA binding posts.

Battery Key (B1): This is a two-position key marked INT-EXT. With the key in the INT position, the internal battery is operative. In the EXT position, the internal battery is operative. In the EXT position the set can be operated by external battery. The internal battery consists of three KS-14711 dry batteries which can be replaced when necessary without removing the face plate.

With this voltage the bridge is sufficiently sensitive to permit balancing the R arm to an accuracy of .1 per cent when measuring the loop resistance of cable conductors or locating grounds, crosses or shorts of low resistance. In the case of faults having a resistance of several thousand ohms or more, higher voltages may be employed. In general, a higher voltage is preferable to a more sensitive galvanometer in locating faults of fairly high resistance as with a sensitive galvanometer fluctuations of the galvanometer needle due to interfering potentials are so magnified that the advantage gained from the greater galvanometer deflection is partially offset. A 1000-ohm current limiting resistance is connected in series with one of the BA binding posts. This resistance affords sufficient protection to the bridge for external battery potentials of approximately 45 volts. If a higher voltage battery is used, sufficient external resistance should be connected in series with the battery to make a total current limiting resistance equal to about 20 ohms per volt. An external resistance need not be used with the Megger or 45A Test Set.

Binding Posts:

BA+ and BA—: For connecting external sources of potential to the bridge.

GA: For connecting an external galvanometer to the bridge.

X_1 and X_2: The "good" and "bad" wires and "ground"
GR: are connected to these posts in various ways, depending on the nature of the trouble, in making bridge measurements.

R: The balancing rheostat of the bridge (R arm) is accessible for use as a variable resistance through the binding posts R and X2. The R post is not used in cable fault locating work.

3. PRECAUTIONS

3.01 The GA SENS (galvanometer sensitivity) keys should always be operated in the proper sequence to minimize off-scale readings; otherwise the accuracy of the galvanometer will be impaired.

3.02 The galvanometer needle should always be clamped when the set is not in use.

3.03 The GA SENS keys should not be operated when changing the setting of the R arm.

3.04 The set is an accurate and sensitive instrument and care, therefore, should be exercised in handling and transporting it in order not to damage the working parts.

4. MAINTENANCE

4.01 In general the set should require little maintenance aside from battery renewals. If the set is not working properly, it should be returned for repair in accordance with local routine.

4.02 The battery compartment, on the left-hand side of the case, is covered by a metal panel. To install batteries, remove the panel and worn batteries, then insert the new cells and replace the cover.

4.03 Replacement parts.

Battery, Dry, KS-14711