FORM 920-11-25-39

INSTRUCTIONS FOR OPERATING THE PRECISION SERIES 920 AND 922 DYNAMIC ELECTRONOMETERS

The Series 920 and 922 Dynamic Electronometers are modern push-button operated radio tube analyzers combined with rotary range selective systems for obtaining measurements of A.C. and D.C. voltages, ohms, decibels and current for all modern radio set analyses. They also provide a system for obtaining qualitative analysis of ballast units and of both paper and electrolytic condensers.

The tube analyzer circuit of these instruments makes use of an exclusive PRECISION engineered tube test system, which in one operation, effectively checks the two most important electrical characteristics of a radio tube, namely, MUTUAL CONDUCTANCE and CATHODE STRUCTURE (EMISSION).

The novel automatic interlocking PUSH-BUTTON element selector, incorporated in the Series 920 and 922 provides for simplicity in operation, visible filament continuity tests, speedy short check, cathode leakage, ballast unit tests, and rapidly locates all tube elements for application of individual test voltages.

From the features listed, it will be noted how both tube test and set testing can be efficiently and easily accomplished with the Series 920 and 922 laboratory testers.

TUBE ANALYZING FEATURES

1. A DYNAMIC TUBE TESTER employing an exclusive PRECISION engineered circuit, which in one operation, effectively tests all radio receiving tubes for both MUTUAL CONDUCTANCE and CATHODE STRUCTURE (EMISSION).

2. TESTS ALL TYPE TUBES: ACCOMMODATES ALL FILAMENT VOLTAGES from 1.4 to 110 volts, including the new 35, 45, 50, 70, 85 and 110 volt filaments. TESTS ALL LOKTALS, BANTAM JUNIORS (Miniature hearing Aid and Pocket Radio Tubes), BANTAMS, SINGLE-ENDED (Television Amplifiers), REGULAR OCTALS (MG, G AND METALS), SPRAY-SHIELD AND GLASS TYPES, and the NEW MINIATURE 7 PIN TYPES.

3. TUBE MERIT indications are read directly on a three colored ENGLISH READING SCALE.

4. DOUBLE WINDOW ROLLER TUBE CHART provides speedy, easy reading tube references. New charts furnished from time to time at no charge.

5. DUAL FREE-POINT FILAMENT TERMINAL SELECTION locates terminals of ALL filaments (single, double, center-tapped and tapped) regardless of any rotating pin positions.

6. VISIBLE FILAMENT CONTINUITY TESTS show up open filaments for ALL types of tubes regardless of filament base connections. This PRECISION developed feature eliminates delay by immediately determining whether or not the filament of a tube under test is intact.

7. AUTOMATIC PUSH-BUTTON SYSTEM: PRECISION designed interlocking push-button selector system affords the extreme in flexibility for non-obsolescent FREE POINT TUBE ANALYSIS and insures ability to accommodate future tube releases.

8. SPECIFIC INDIVIDUAL LOADS AND VOLTAGES (control grid, screen, plate, etc.) applied to respective elements of tube under test.

9. VARYING A.C. SIGNAL applied to control grids.

10. METER READS IN PLATE CIRCUIT: Indications therefore are entirely dependent upon control action of ALL intervening elements.

11. OPEN ELEMENTS: Shows up tubes with any open element. The PRECISION DYNAMIC TEST NECESSITATES ALL ELEMENTS intact for proper reading.

12. TESTS diodes, triodes, rectifiers, tetrodes, pentodes, multi-purpose tubes, gaseous types 0Z3-0Z4 and remote control gaseous types 0A4 and 2A4 regardless of varying filaments or other element positions.

13. MULTI-SECTION TUBES: Individual tests for each section of multi-section tubes including visible tests of the fluorescent screen and winking effect on cathode ray indicator tubes. No shifting of tubes necessary to obtain all tests.

14. HOT CATHODE LEAKAGE TEST: Sensitive neon method quickly shows up poor cathode structure in accord with leakage specifications of leading tube manufacturers.

15. HOT INTER-ELEMENT SHORT TESTS made ingeniously simple through the use of PRECISION Automatic Interlocking Push-Buttons.

16. NOISE TEST pin jacks incorporated for earphone or amplifier connection. Each element can be separately tested for noise through use of free-point Automatic Interlocking PUSH-BUTTON ELEMENT SELECTOR SYSTEM.

17. BALLAST TESTS: The regular tube test sockets accommodate all ballast unit tests for open and loose elements and leakage between sections of multi-section ballasts; made possible through the Precision Push-Button system.

18. PILOT LIGHT TESTS for all miniature screw base and bayonet type lamps.

19. ACCURACY of the tube test circuit is closely maintained by the use of individual calibrating controls, adjusted and sealed against laboratory standards.

20. LARGE MODERN PRECISION SQUARE METER.

21. TUBE SELECTION REFERENCES plainly marked on panel. Nothing to remember.

22. PILOT LIGHT ON-OFF INDICATOR: Fused line plug.

23. MICRO-LINE ADJUSTMENT read directly on meter, provided by use of variable heavy duty line voltage control. No arbitrarily tapped transformer employed.

24. TELEPHONE CABLED WIRING EMPLOYED THROUGHOUT.

SET ANALYZING FEATURES

25. SIX A.C. VOLTAGE RANGES at 1000 ohms per volt:
0-12; 0-60; 0-300; 0-600; 0-1200; 0-3000 volts.

26. SIX D.C. VOLTAGE RANGES at 1000 ohms per volt.
0-12; 0-60; 0-300; 0-600; 0-1200; 0-3000 volts.

27. FIVE D.C. CURRENT RANGES:
0-1.2; 0-12; 0-120; 0-600 MA; and 0-12 AMPERES.

28. FOUR RESISTANCE RANGES:
0-400 ohms (20 ohms center) SHUNT METHOD.
0-100,000 ohms (800 ohms center).
0-1 Megohm (8000 ohms center).
0-10 Megohms (80,000 ohms center).
All ohmmeter ranges powered by self-contained supply. A $4\frac{1}{2}$ volt battery powers the low, medium and 1 Megohm ranges.

29. SIX DECIBEL RANGES FROM -10 to +64 DB.

30. SIX OUTPUT RANGES:
0-12; 0-60; 0-300; 0-600; 0-1200; 0-3000 volts.

31. PAPER CONDENSER LEAKAGE TESTS. Sensitive neon method.

32. LEAKAGE MEASUREMENTS on all types of electrolytic condensers read directly on meter in terms of current per microfarad.

33. MASTER RANGE SELECTOR SYSTEM provides for obtaining all measurements and tests at only two polarized pin jacks except for 1200 and 3000 volts and 12 AMPERES.

34. SHUNTS WIRE WOUND to 1% accuracy on impregnated moisture proof bobbins. Metallized multipliers matched to 1% accuracy.

35. LARGE MODERN PRECISION SQUARE METER 2% accurate, D'Arsonval type. Base sensitivity of meter 400 microamps at 160 millivolts.

36. LARGE EASY READING scales and numbers. A.C. correction scale and decibel scale printed in red.

37. ACCURACY of the A.C. voltage and Decibel ranges is closely maintained through individual calibrating controls, adjusted and sealed against laboratory standards.

It is strongly suggested that the following be read carefully in order to obtain the utmost benefit in accurate tube and set testing results, which the Series 920 and 922 Dynamic Electronometers afford.

To obtain a quicker understanding for ease in operation, it is first best to take into consideration the function of each control, switch and part incorporated on the instrument panel.

CONTROL "A" serves a double purpose:

1. When rotated to 1,2,3,4,5,6,7,8 or 9, it selects the control grid of the particular tube under test regardless of element pin position and when in any one of these 9 positions, also allows the line-check meter indication.
2. When set to either the A.C. or D.C. position, it allows the multi-range meter facilities to be available at the two polarized "EXT. TEST" pin jacks located directly below CONTROL "D".

CONTROL "B" selects the correct filament voltage for the tube under test, providing a complete range of operating potentials from 1.4 through 110 volts. It will be noted that this control may be set to any one of 18 positions numbered from 1 to 18. Necessary filament voltages are applied when set according to roller chart data listed under column "B".

CONTROL "C" is a dual potentiometer and serves a double purpose:

1. When testing tubes, this control provides a variable A.C. signal which is automatically applied to the control grid selected by CONTROL "A".
2. When multi-range meter functions are being utilized, this control acts as ohmmeter adjustment for the first three resistance ranges.

CONTROL "D" is a special tapered potentiometer. When tube analyses are taken, this control functions as a variable meter shunt enabling the setting of calibration limits for all tubes as noted on the tube test roller chart.

CONTROL "E" is primarily a screen-grid selector. Its major function is to pick out (regardless of element pin position) the screen-grid of multi-element tubes and at the same time, apply correct screen voltage and load. CONTROL "E" also provides for the following:

(a) correct voltages and loads for general purpose triodes.
(b) correct voltages and loads for testing rectifiers and diodes.
(c) correct voltages and loads for testing the gaseous types 0Z3-0Z4 rectifiers.
(d) proper circuit connections for obtaining visible test of the fluorescent screens of all cathode ray tuning indicators.

CONTROL "F" serves a dual purpose:

When tube test functions are employed, this control acts as a free-point filament return terminal selector, with reference to the circled numbers, positions 1 through 12.

When multi-range meter functions are employed, this control acts as a MASTER RANGE SELECTOR allowing for all A.C. and D.C. measurements (except 1200v, 3000v and 12 Amperes) from the two polarized "EXT. TEST" pin jacks. This feature is available ONLY when CONTROL "A" is set to either the A.C. or D.C. position.

THE LINE ADJUSTMENT CONTROL serves a double purpose:

For tube analyzing, it is used to adjust the line voltage by bringing the meter pointer to arrow head center of the scale plate marked "LINE", and when employing the 0-10 Megohms Range, this control is used to accurately regulate the tester power supply. This control is a heavy duty wire wound potentiometer, thus assuring positive micro-voltage adjustment.

THE AUTOMATIC PUSH-BUTTON SYSTEM consists of 12 push buttons identified as "OFF - A (Filament Continuity) - B - C - D - E - F - G - H - J - READ METER - TUBE MERIT". These buttons perform the following functions:

OFF BUTTON:

"OFF" button, when in the down or depressed position, shuts instrument "off" and simultaneously releases any other buttons that may have been previously depressed.

To turn instrument "ON", press lightly on "double action" "TUBE MERIT" button located at opposite end of the push-button system.

TUBE MERIT BUTTON:

This double action button has been so designed as to perform two entirely different functions depending upon the operating pressure.

1. A light pressure, as described above, releases the "OFF" button and thereby turns instrument "on", and provides immediate "LINE" indication on meter, as long as CONTROL "A" is in any one of the tube testing positions 1 through 9.

2. When fully depressed, the "TUBE MERIT" button, aside from interrupting the "LINE" indication on METER, also provides an ingenious mechanical arrangement which allows any required number of the lettered buttons "A" through "J" to be held down ("locked") and remain in the depressed position.

READ METER BUTTON:

This button, (which is in no way mechanically interlocked with the rest of the push-button system), merely provides meter reading for tube quality indications.

LETTERED BUTTONS A-B-C-D-E-F-G-H-J connect to corresponding prong positions of the sockets, permitting an arrangement whereby any combination of electrodes required, may be connected into the appropriate portion of the test circuit, regardless of element pin positions. This lettered set of push buttons operates through the circuit in conjunction with CONTROLS "A", "E" AND "F", providing a complete FREE-POINT TUBE ANALYSIS SYSTEM affording extreme flexibility for future tube releases.

The manipulation of these lettered buttons serves the following purposes:

(a) Lettered BUTTON "A" provides for VISIBLE (NEON LAMP) FILAMENT CONTINUITY TESTS unless otherwise noted on roller tube chart.

(b) Provides for HOT INTER-ELEMENT SHORT CHECK and CATHODE LEAKAGE TESTS.

(c) Provides for proper tube circuit selections for quality indications.

(d) Provides for qualitative BALLAST UNIT TESTS, with CONTROLS "A" and "F" in position #12.

THE PROPER CONTROL AND PUSH-BUTTON SETTINGS FOR EACH TUBE TO BE TESTED ARE INDICATED ON THE TUBE TEST ROLLER CHART.

SOCKETS:

This instrument employs individual loktal, octal, combination 7 prong, Bantam Jr., 6 prong, 5 prong and 4 prong sockets. All tube analyses, i.e., filament continuity, hot cathode leakage, hot neon short check, tube quality tests and ballast unit tests are obtained from ANY ONE of the required sockets without the necessity of shifting the tube or ballast unit under test. This instrument also includes the new miniature "BUTTON" 7 pin socket.

OVERHEAD CONNECTOR CAP:

The bakelite encased twin grid cap, (connected to flexible lead) accommodates the top caps of both octal and non-octal types of tubes. This connector cap is attached to tubes requiring same, while all tests are made.

THE METER:

The meter employed is of large square, modern design and ruggedly constructed. The movement is a D'Arsonval type of 2% accuracy. The English reading scale plate incorporates a wide three color sector divided into markings of REPLACE - WEAK - GOOD for tube merit indication.

"CONDENSER TEST" TIP JACK:

This tip jack, in conjunction with either one of the "NOISE TEST" jacks, provides for checking leakages in paper condensers by the neon lamp method and also provides for neon lamp continuity testing.

"NOISE TEST" TIP JACKS: provide for the insertion of an earphone or amplifier to obtain audible noise tests on tubes.

THE NEON LAMP "SHORT INDICATOR" located immediately above "NOISE TEST" pin jacks, affords a sensitive visible indication for filament continuity tests, short checking tubes and testing ballast units.

THE PILOT LIGHT TEST SOCKET located in center of combination 7 prong socket, accommodates all miniature screw and bayonet base pilot lamps. Voltages are selected at CONTROL "B" in accord with corresponding filament voltage switch position, and CONTROL "F" at number 1.

GENERAL OPERATING INSTRUCTIONS

With "OFF" BUTTON depressed, connect fused plug of instrument to any 50-60 cycle 110-125 volt A.C. source.

(a) Refer to the tube test roller chart for the tube number required and set CONTROLS "A", "B", "C", "D", "E" and "F" to positions designated for that tube.

NOTE:-For simplicity in locating any tube type number, it will be helpful to note that all tubes are listed in strict numerical order beginning at the top of the left hand window opening, continuing downward to the end of the roll and thence to the top of the right hand window opening, etc.

(b) Lightly press (and then remove finger from) the "double action" "TUBE MERIT" BUTTON to turn instrument "ON". (It will be noted that this button thereby remains in the normal "UP" position.) Then rotate "LINE ADJUSTMENT" knob to bring pointer of meter to arrow-head (center of scale) marked "LINE".

NOTE:-In the even that "TUBE MERIT" BUTTON is accidentally fully depressed, then "LINE" indication will not be had. To disengage this button, merely depress the "OFF" button (which will ALWAYS release any previously depressed buttons); also "LINE" indication will be had on meter ONLY when CONTROL "A" is set to the tube test positions 1 through 9.

(c) Insert tube to be tested into its respective socket and allow to heat (connect overhead cap when necessary). Any deviation of the meter pointer from the "LINE" position should at this time be corrected by rotating the "LINE ADJUSTMENT" knob to again bring meter pointer to arrow-head (center of scale).

FILAMENT CONTINUITY, HOT CATHODE LEAKAGE AND INTER-ELEMENT SHORT TESTS.

After settings are made as noted above, then proceed to obtain these tests by simply depressing lettered buttons A-B-C-D-E-F-G-H-J in consecutive order and watch neon lamp SHORT INDICATOR for glow or continuous flicker.

IMPORTANT:-NEON LAMP INDICATION SHOULD BE HAD ONLY ON FILAMENT CONTINUITY "A" BUTTON, OR WHATEVER OTHER BUTTON OR BUTTONS MAY BE DESIGNATED ON TUBE CHART FOR FILAMENT CONTINUITY.

Inasmuch as the filament of the tube under test is disengaged when the "FILAMENT CONTINUITY" BUTTON is depressed, it is necessary that this button be immediately returned to normal position (by depressing any other button) and thereby allow tube to remain in a heated condition for further test. Tube under test should be rejected as defective (open filament) if neon lamp fails to glow when the "FILAMENT CONTINUITY" BUTTON is depressed.

DISREGARD ANY MOMENTARY NEON LAMP FLASHES AS BUTTONS ARE DEPRESSED. These flashes are merely the discharge of condenser in short check circuit.

NOTE:-When manipulating the lettered push-buttons for obtaining FILAMENT CONTINUITY, CATHODE LEAKAGE and INTER-ELEMENT SHORT TESTS, it is important that the "TUBE MERIT" BUTTON be in its normal or "UP" position. This will allow for individual tube element tests and automatic release action on each of the previously depressed buttons, thereby permitting only one button at a time to be in the down position.

A discernable neon lamp glow or continuous flickering when any one of the other lettered buttons "B" to "J" are depressed, indicates an inter-electrode high resistance leakage or short in the tube under test and should be rejected without further testing, (unless otherwise noted on the tube test roller chart).

While making combined CATHODE LEAKAGE and INTER-ELEMENT SHORT TESTS, it is advisable to tap the tube as each of the lettered buttons is depressed. Inasmuch as these tests are made while the tube is in a heated condition, the tube should be allowed time to heat up sufficiently. In this manner, shorts or leakages that may occur due to expansion of internal elements can be more readily detected.

Inasmuch as all tube elements connect to individual lettered push-buttons, there is no necessity to employ a separate cathode leakage button. Cathode leakage will therefore be detected when the respective button, corresponding to a particular tube's cathode. is depressed.

AUDIBLE NOISE TEST.

An audible noise test of defective and noisy tubes can be had if desired, by inserting an earphone or audio amplifier system into the "NOISE TEST" tip jacks. The testing procedure is the same as outlined for obtaining HOT CATHODE LEAKAGE TEST and HOT INTER-ELECTRODE SHORT TEST described above.

An intermittent or constant loud audible hum when making CATHODE LEAKAGE and HOT INTER-ELECTRODE SHORT TESTS will indicate loose or shorted tube elements, a cause for fading and noisy radio reception. A loud audible hum when "FILAMENT CONTINUITY" BUTTON is depressed, is normal and is indicative of a continuous filament.

DO NOT ATTEMPT TO OBTAIN TUBE QUALTIY METER INDICATION UNTIL AFTER SHORT TESTS ARE MADE, ELSE SERIOUS DAMAGE MAY RESULT TO INSTRUMENT.

TUBE QUALITY INDICATION.

With all controls set at their respective positions for the tube under test and line adjustment made, first fully depress "TUBE MERIT" BUTTON and then depress, one at a time, ONLY THOSE LETTERED PUSH-BUTTONS DESIGNATED ON THE TUBE TEST ROLLER CHART for that particular tube. After the buttons called for have been depressed, a tube quality indication on the meter will be obtained when the "READ METER" BUTTON is depressed and held down.

In the event that the wrong lettered push-button has been depressed, merely depress the "OFF" BUTTON which also functions as a GENERAL RELEASE. This action will disengage and return all buttons up to normal position. This same procedure should be followed after completion of test is made on a tube and it is desired to continue test procedure on another tube (or another section of a tube as noted below).

DIODE TEST INDICATION (NOTE CAREFULLY).

When testing the section of a tube identified by the word "DIODE" as noted on the tube chart, DO NOT REFER TO THE ENGLISH READING SCALE. It will be noted that within the red REPLACE sector, there is an arrow line with small letters marked "DIODES". A poor DIODE reading will be indicated if the pointer of meter does not reach the line marked "DIODES". A good DIODE reading will be indicated if the needle pointer falls anywhere beyond this line even though the pointer still remains in the REPLACE sector.

SPECIAL ROLLER CHART NOTATIONS.

1. As will be noted on the roller tube chart, certain few tubes are accompanied by notations such as "OK over $\frac{1}{4}$ of scale" or "OK over 1/3 of scale". This implies that even though the meter pointer may fall within the red REPLACE sector, the tube is not to be rejected unless it falls below the portions of the scale mentioned.

2. VISIBLE EYE TESTS. As noted on the tube test roller chart, the advanced tube test circuit features incorporated in the PRECISION Dynamic Electronometers provide two visible fluorescent screen (eye) tests aside from the regular triode section test.

(a) Visible indications of the fluorescent screen.

(b) Open and close effect of the shadow section.

PROCEDURE:- Upon completion of triode section test, (as noted on tube test roller chart), reset controls for EYE SECTION TEST and depress "TUBE MERIT" BUTTON. Depress the first button called for, and a visible luminous screen will be had when "READ METER" BUTTON is depressed. Then depress the second button called for, with "READ METER" BUTTON still held down, to obtain closing eye effect. DISREGARD METER INDICATIONS ON EYE TESTS.

3. 70A7 and 117N7 RECTIFIER TEST. Because of unusual internal connections, the 70A7 and 117N7 RECTIFIER sections require a special test procedure.

Buttons (A and E) or (A) respectively, as noted on the tube chart, must be depressed simultaneously along with the "READ METER" BUTTON. Normal meter indication will be obtained for a few seconds and will then gradually recede (fade) because the 70A7 and 117N7 filament connections must necessarily be isolated from the test circuit to provide merit indication for the rectifier section. RECTIFIER merit is therefore to be judged only by the initial meter deflection. Buttons (A) or (A and E) must be immediately returned to normal position if it is desired to keep the filaments of the 70A7 or 117N7 in a heated condition.

GAS TYPE RECTIFIERS 0Z3 and 0Z4.

When testing these gas rectifier types, it will be noted that the meter pointer will remain, for a short interval, in the REPLACE sector and then deflect into the GOOD sector. This condition is normal for a good gas rectifier. However, should the meter pointer remain constantly in the REPLACE sector (after the lapse of several seconds), then the gas rectifier can be termed as defective.

MULTI-SECTION TUBE TESTS.

Full wave rectifiers and multi-section tubes such as double triodes, triode-diodes, pentode-diodes, duo-diodes, frequency converters, pentode-triodes and pentode-rectifiers, contain either a second plate, a second triode or other combination of sections. These tubes are designated on the tube chart wherein each of these sections is separately described and settings given.

Treat each of these sections as if testing individual tubes for "TUBE QUALITY", as outlined above, by settings controls and lettered push-buttons designated for each section. The circuit employed in this instrument permits testing of the individual sections of multi-section tubes and it is therefore strongly suggested that a complete test be given to these types since any one poor section will hinder proper operation in the radio receiver.

NOTE:-It is advisable, when obtaining a TUBE QUALITY indication, to tap the tube under test. At times it will be noted that such tapping may cause a noticeable meter pointer fluctuation. Such fluctuation indicates loose internal element structure which may cause a noisy, fading condition when operating in a radio receiver.

TUBE BRAND VARIATIONS.

In determining the tube test limits for this instrument, Precision engineers in cooperation with the engineering divisions of leading tube manufacturers, have spent considerable time checking thousands of tubes in the production run of all tube types of each and every leading tube manufacturer. From the information so gathered, the data on the roller chart, accompanying this instrument, has been compiled.

Inasmuch as extensive and intensive research is constantly being made in the radio tube industry to improve and stabilize the electrical and mechanical construction of tubes, it is not uncommon for a tube manufacturer to make a change in a particular tube's specifications. This change, though not necessarily readily noticeable in radio set performance, may nevertheless be made to improve tube stability and life. This change or variation may, however, indicate itself on a dynamic tube tester and therefore necessitate a new set of test limits, for that particular type number produced by the manufacturer who has made this change.

Therefore, should a particular type number of a given manufacturer be found to vary consistently from the assigned average roller chart limits, merely redetermine the new CONTROL "D" average setting required to pass these tubes at approximately the center of the letter "G" of the word "GOOD" in the green sector, and record same for future reference with respect to that manufacturer.

It can readily be seen that a consistently low or high reading for any particular tube type of a definite manufacturer is not to be take as indicative of a poor or better run of tubes, nor as a defect in the tube tester.

PILOT LIGHT TESTS.

The miniature base socket located in the center of the combination seven prong tube socket accommodates all miniature screw and bayonet base type pilot lamps, Christmas tree bulbs, etc. Test procedure is as follows:

(a) Select proper filament voltage with CONTROL "B" in accord with voltage specifications as indicated in paragraph pertaining to the description and function of this control.

(b) Turn instrument "ON" and adjust for "LINE" before inserting bulb into miniature socket. Also set CONTROL "F" at position number 1 and CONTROL "A" at number 2.

IMPORTANT NOTE:-If difficulty is ever experienced when testing tubes with OVERHEAD grid caps, always FIRST check for continuity between flexible grid cap lead and bakelite encased dual cap connector. The flexible wire occasionally breaks at the point of entrance to the cap connector.

BALLAST INFORMATION

BALLAST TESTING: The neon short check circuit in conjunction with the lettered push-buttons provides a simple and effective method for obtaining the following ballast tests:

1. Point to point continuity test of each tapped section of multiple section ballasts.
2. Tests for loose elements.
3. Tests for leakage between separate sections of multi-purpose ballasts.

BALLAST RESISTOR CODE: A sample and interpretation of the code appearing on standard octal type and replacement type ballasts are as follows:

(RMA STANDARD OCTAL TYPE) BK49AG
(REPLACEMENT TYPE) BKX55AG

The first letter "B" on both types, if used, indicates ballast action.
The letter "K", "L" or "M" on both types, indicates type of pilot lamp.
The letter "X" or "Y" or "Z" immediately following the pilot lamp designation denotes a particular SERIES of base wiring and appears only on replacement type ballasts.
The numerals "49" or "55" appearing on the respective types, indicates the total voltage drop produced by the ballast resistor including the pilot lamp.
The letter "A" or B-C-D-E-E1-F-G-H-J, appearing on both types and immediately following the voltage drop numerals, designates the particular BASE WIRING circuit used.
The letter "G" following the base wiring circuit designation on both types, if used, indicates octal base glass unit.
A letter "J" following the base wiring designation such as K55CJ, refers to an internal jumper between pins 3 and 4. (See TEST PROCEDURE.)
Where the letter "P" or "PR" appears after the base wiring designation, such as K55CP or K55CPR, this indicates an additional resistor section is employed for the rectifier plate circuit. (See TEST PROCEDURE.)
FOR STANDARD RMA OCTAL TYPE BALLASTS, THE BASE WIRING DESIGNATION (A-B-C-D-E-E1-F-G-H-J) IS THE ONLY INFORMATION NECESSARY FOR TEST PURPOSES.
FOR REPLACEMENT TYPE BALLASTS, THE X,Y OR Z SERIES AND BASE WIRING DESIGNATION IS THE INFORMATION NECESSARY FOR THE TESTING OF THESE TYPES.

BALLAST TEST PROCEDURE

The OCTAL SOCKET is used to accommodate all octal base type ballasts.

1. ALL CONTROLS MUST BE IN THE FOLLOWING POSITIONS DESIGNATED BEFORE ANY ATTEMPT IS MADE TO TEST BALLAST UNITS:
   Set CONTROL "A" to #7 position
   Set CONTROL "B" to #16 position
   Set CONTROL "C" to 0 position
   Set CONTROL "D" to 0 position
   Set CONTROL "E" to #7 position
   Set CONTROL "F" to #12 position
2. Turn instrument "ON" and adjust for "LINE" indication on meter.
3. Refer to the test data list on bottom of page and classify the ballast unit to be tested according to its RMA or XYZ SERIES and BASE WIRING, and note LETTERED PUSH-BUTTONS called for and then insert ballast unit into its respective socket.

CAUTION:- NEVER DEPRESS "READ METER" BUTTON DURING BALLAST TESTS.

First fully depress "TUBE MERIT" BUTTON, so that locking action will be obtained on the lettered BUTTONS "A" through "J". The lettered push-buttons called for are then depressed, one at a time, in the order as indicated on previously mentioned BALLAST DATA LIST and each button depressed therefore remains in the down position. All depressed buttons are released to the normal "UP" position (by use of "OFF" BUTTON) only after all of the tapped sections of a ballast unit have been tested.

NOTE:-Disregard "FILAMENT CONTINUITY" marking on "A" BUTTON and employ this button, whenever called for, in the same manner as the other lettered buttons.

A continuous neon lamp glow after each consecutive lettered push-button called for is depressed, indicates that the section is not open. An open section (anywhere in the chain) will cause neon lamp to become extinguished when that section lettered push-button is depressed.
It is advisable to tap the ballast unit after each of the push-buttons called r is depressed. In this manner, loose elements can be ascertained by noticing any flickering of neon lamp.
Where letter "J" follows the base wiring designations such as K55CJ, then it is necessary to include BUTTON "B" for test purposes and it should be the last one to be depressed.

Where letter "P"or "PR" follows the base wiring designation such as K55CPR or K55CP, then it is necessary to include BUTTON "D" for test purposes and it should be the first button to be depressed.

The circuits of the base wiring designations "F", "G", "H" or "J" such as M42H, consist of two multi-purpose sections in one unit and as will be noted in the BALLAST DATA LIST, each individual section is tested as an independent unit. The necessary lettered push-buttons for either section are enclosed in parentheses.

* LEAKAGE TESTS: Tests for leakages between sections of multi-purpose ballast units having BASE WIRING designations "F", "G", "H" or "J" (as noted above) are accomplished by depressing both buttons "BJ" with all other push-buttons remaining in the (UP" normal position. A neon lamp glow will indicate leakage between the two independent sections, and the ballast unit should be rejected as being defective.

Where letter "J" follows the multi-purpose type base wiring designation "F", "G", "H" or "J" such as K49FJ or K49GJ, then it is necessary to include BUTTON "B" when testing the second section of such ballasts. This additional button should be the last one to be depressed when testing this section.

All ballast type resistors (used in battery and AC-DC receivers) having a single resistance element across the filament prongs of their respective bases, may be accommodated for test purposes by employing BUTTON "A", and unit inserted in proper socket.

TEST DATA LIST FOR RMA CODED OCTAL BALLAST UNITS AND FOR REPLACEMENT (Four and Octal Prong) "XYZ" SERIES

BASE WIRING	DEPRESS	BASE WIRING	DEPRESS	BASE WIRING	DEPRESS
A	A	C	AF	E	AFJD
X-A	A	X-C	AC	E1	AF
Y-A	F	Y-C	FH	F	(A) (J)*
Z-A	A	Z-C	AD	G	(A) (J)*
B	AF	D	AFJ	H	(AF) (J)*
X-B	AC	X-D	ACB	J	(AFD) (J)*
Y-B	FH	Y D	FHJ		
Z-B	AD				

* Check for leakage between sections as noted in Operating Instructions heading "LEAKAGE TESTS".

TO TEST PRIVATELY CODED BALLAST UNITS, REFER TO BALLAST UNIT MANUFACTURER FOR THEIR CONVERSION REPLACEMENT LISTINGS OF PRIVATELY CODED BALLAST UNITS.

QUALITATIVE PAPER CONDENSER TESTS:- The CENTER PIN of the "Bantam Junior" socket, located at the upper left hand side of panel, is used in conjunction with either one of the "NOISE TEST" pin jacks to obtain paper condenser tests by the sensitive neon lamp method. The self-contained power supply applies the necessary rectified voltage to the paper condenser.

PROCEDURE:

1. Connect instrument to any 50-60 cycle 110-125 volt A.C. source and turn instrument "ON".
2. With CONTROL "A" set to #1 position, rotate "LINE ADJUSTMENT" knob to obtain "LINE" indication on meter.
3. Then fully depress "TUBE MERIT" BUTTON and insert test leads into the previously mentioned jacks. Apply free ends across paper condenser to be tested, while observing indications on neon glow lamp.
   (a) A steady glow of the neon lamp indicates a low D.C. resistance or short circuited condenser.
   (b) A flickering neon lamp glow indicates a high resistance leakage condition.
   (c) No indication on neon lamp indicates that the condenser under test is open or the capacity is too small to cause neon lamp to register visibly.
   (d) A good condenser will cause an instantaneous neon lamp flash, the duration of which is dependent upon the capacity being tested. The greater the capacity, the longer the duration and vice versa.

Polarity need not be observed when testing paper condensers.

NOTE: The "NOISE TEST" pin jacks may not accommodate the insulated type of test tips as employed on multi-meter test leads, but rather require standard phone tips as found on earphone leads, in order to reach the deep-set open circuiting contacts.

GENERAL NOTES:

If the instrument fails to function, the two one ampere fuses incorporated in the "fused male plug" should be inspected and replaced if necessary. For fuse replacement, it is not necessary to take the plug apart. Two holes, to be found on the top of the plug, allow for insertion of a pointed object which will eject the fuses.

If difficulty is experienced in regard to proper operation of the instrument, replace the 80 type tube to be found on the underside of tester panel. A defective 80 tube will prevent obtaining proper line adjustment indication.

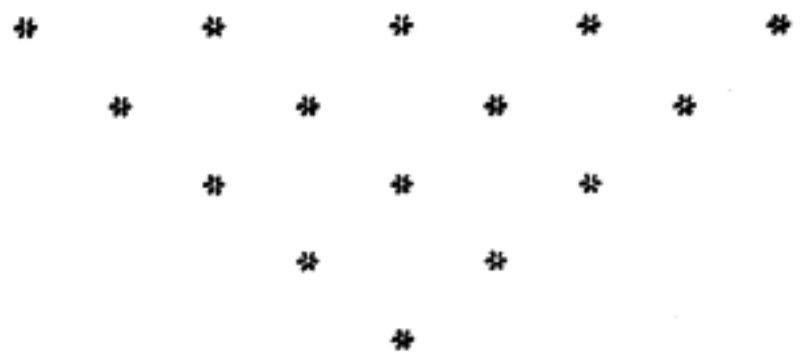
The neon lamp is a G-10 General Electric 115 volt, 1 watt, candelabra base. Replacement, if necessary, should be made only with this type or its equivalent. If difficulty is experienced in obtaining this neon lamp, it may be had by ordering direct from factory with remittance of 55¢ in stamps.

GENERAL INFORMATION

Instructions and guarantee card are enclosed with this instrument. Mail the guarantee card at once for future information to be mailed from this record. New roller tube charts are printed from time to time giving the latest tube data testing information. Unless the registration card is in our files, we have no means of forwarding correct charts. New roller tube charts are supplied, upon request, without charge. When writing for information, always mention Pattern number and Serial number of instrument.

TUBE TEST ACCESSORIES INCLUDED:

1 Set of instruction sheets
1 Tube test roller chart
1 Type 80 rectifier tube
1 #40, 6-8 volt pilot lamp
1 G-10 neon glow lamp
1 Registration card



PRECISION APPARATUS COMPANY
92-27 Horace Harding Blvd.
Elmhurst, L. I., N. Y.

RADIO SET ANALYZING

The Series 920 and 922 Dynamic Electronometers, in addition to complete tube analyzing, also incorporate a ROTARY RANGE SELECTOR system providing for the following:

1. A.C. and D.C. voltage measurements at 1000 ohms per volt from 0 to 3000 volts.
2. D.C. current measurements up to 12 Amperes.
3. Resistance measurements up to 10 megohms.
4. Output meter indications from 0 to 3000 volts.
5. Decibel readings in 6 ranges from -10 to +64 DB.
6. D.C. current measurements of leakage in electrolytic condensers.

The ranges employed and the method of selection in order to obtain these measurements and tests will be considered as if operating individual instruments.

FOR RADIO SET ANALYZING, IT IS IMPORTANT THAT CONTROL "A" BE FIRST SET TO THE "A.C." OR "D.C." POSITION BEFORE ATTEMPTING TO EMPLOY "RANGE SELECTOR".

As a safety factor, it is advisable to disconnect instrument "fused plug" from A.C. line source before making measurements except when employing the 0-10 Megohm Range as noted on following page.

A.C. VOLTAGE MEASUREMENTS.

Set CONTROL "A" to the A.C. position for all A.C. voltage measurements. Select suitable voltage range on the RANGE SELECTOR. Read A.C. voltage measurements on RED A.C. CORRECTION SCALE as follows:

0-12 volts read directly
0-60 volts read directly
0-300 volts read directly
0-600 volts read on 60 scale, multiply by 10
0-1200 volts read on 12 scale, multiply by 100
0-3000 volts read on 300 scale, multiply by 10

NOTE:-ALL A.C. and D.C. voltage measurements are made from the two "EXT. TEST" pin jacks except 1200 and 3000 volts. For these two extra high ranges, insert negative (-) test lead into minus (-) "EXT. TEST" jack and positive (+) test lead into either +1200v or +3000 tip jack. RANGE SELECTOR (CONTROL "F") SHOULD ALWAYS BE FIRST SET TO THE 600V POSITION WHEN USING EITHER OF THE TWO EXTRA HIGH VOLTAGE RANGES.

D.C. VOLTAGE MEASUREMENTS.

Set CONTROL "A" to the D.C. position for all D.C. voltage measurements. Select suitable voltage range on the RANGE SELECTOR. Read D.C. voltage measurements on meter scale as follows:

0-12 volts read directly
0-60 volts read directly
0-300 volts read directly
0-600 volts read on 60 scale, multiply by 10
0-1200 volts read on 12 scale, multiply by 100
0-3000 volts read on 300 scale, multiply by 10

NOTE:-All voltage measurements are made with test leads applied across load. Observe proper polarity at "EXT. TEST" tip jacks, located immediately below CONTROL "D".

D.C. CURRENT MEASUREMENTS.

Set CONTROL "A" to the D.C. position for all D.C. current measurements. Select suitable current range on the RANGE SELECTOR. Read D.C. current measurement on meter scale as follows:

0-1.2 MA read on 12 scale, divide by 10
0-12 MA read directly on 12 scale
0-120 MA read on 12 scale, multiply by 10
0-600 MA read on 60 scale, multiply by 10
0-12 AMPS read directly on 12 scale

NOTE:-The 12 Ampere Range is available only at the two separate (+) and (-) "12 AMPS" pin jacks located at the lower right hand portion of the panel, immediately below the "LINE ADJUSTMENT" control. RANGE SELECTOR MUST BE IN THE 600 MA POSITION TO USE THE "12 AMP" PIN JACKS.

NOTE:-When using the 12 Ampere D.C. range, never remove pin jacks while current is flowing through the circuit. Failure to observe this would result in arcing at the pin jack being removed, and though it would not injure the meter, the jack would gradually char.

All current measurements are made with test leads in series with load. Observe proper polarity at tip jacks.

CAUTION:-When voltage or current of unknown value is to be measured, it is advisable to employ the highest range first. If meter indication is slight, then select next lower range, etc. Adhere closely to the above to prevent slamming of meter pointer and meter overloading.

RESISTANCE MEASUREMENTS.

ALL RESISTANCE MEASUREMENTS ARE MADE WITH CONTROL "A" IN D.C. POSITION.

0-400 OHMS (Low Ohms) RANGE.

The LOW OHMS circuit makes use of the SHUNT METHOD (back-up scale) for low resistance measurements, thereby producing an immediate meter pointer deflection when RANGE SELECTOR is set to the "400 OHMS" position, with "TEST" tip jacks open (NOT SHORTED). Rotate CONTROL "C" (ADJUST OHMS CONTROL) to bring needle pointer to full scale (LO) deflection before applying open test leads across resistance to be measured.

Resistance measurements for this range are read directly on the LOWER PORTION of the OHMS SCALE. Indications for this range start from the left.

CAUTION:-NEVER ALLOW THE RANGE SELECTOR TO REMAIN IN THE "400 OHMS" POSITION WHEN THIS "LOW OHMS" RANGE IS NOT BEING EMPLOYED, ELSE CONTINUOUS CURRENT WILL BE DRAWN FROM BATTERY EVEN WHEN THE INSTRUMENT IS BEING USED FOR TUBE TESTING. THE RANGE SELECTOR MAY BE SET TO ANY OTHER POSITION (EXCEPT 400 OHMS) WITHOUT AFFECTING THE BATTERY.

0-100M OHMS RANGE.

Set RANGE SELECTOR to the 100M range and with test leads SHORTED, rotate (ADJUST OHMS) CONTROL "C" to obtain full scale deflection. Then proceed with measurements.

Resistance measurements for this range are read directly on the upper 0-100M ohms scale.

0-1 MEGOHM RANGE.

Set RANGE SELECTOR to the 1 MEG. range and with test leads SHORTED, rotate (ADJUST OHMS) CONTROL "C" to obtain full scale deflection. Then proceed with measurements.

Resistance measurements for this range are read on 0-100M scale multiplied by 10.

NOTE:-The above three ohmmeter ranges are powered by a self-contained type #5360 Burgess 4½ volt battery located on the inside of carrying case. This battery should be replaced when full scale deflection can no longer be obtained. RED lead should connect to 4½ volts plus (+), and BLACK lead to 4½ volts minus (-).

0-10 MEGOHM RANGE.

The 0-10 MEGOHM RANGE is made possible through the use of the tester power supply and it is therefore necessary to connect the instrument plug into any 50-60 cycle 110-125 volt A.C. source and instrument be turned on.

Set CONTROL "A" to D.C. position and RANGE SELECTOR to 10 MEGS; with test leads shorted, rotate "LINE ADJUSTMENT" CONTROL to obtain full scale hmmeter deflection, before taking resistance measurements for this high range.

Resistance measurements for this range are read on 0-100M scale multiplied by 100.

CAUTION:-Any resistance measurements to be taken should be free from ground and live voltage source. Always first disengage one end of resistance from the circuit before making resistance measurements, or else an indication of the true resistance value may not be obtained due to the possibility of the circuit therein involved effectively shunting the resistance to be measured, thus reducing the true reading by an amount proportionate to the resistance of the included shunt network.

OUTPUT METER INDICATIONS.

The A.C. voltage measurements at a high sensitivity of 1000 ohms per volt makes this instrument ideally suitable for use as an output meter.

There are two methods that can be used for obtaining output meter indications as listed below:

In the first method, make connections from the voice coil of speaker or secondary of output transformer to "EXT. TEST" tip jacks. In the event that easy access to the voice coil or secondary of transformer cannot be had, then refer to method outlined below.

In the second method, make connections from plate of output tube and ground or chassis of radio receiver to "EXT. TEST" tip jacks with a good quality .25 mfd. paper condenser in series with one of the leads in order to block the D.C. component. The voltage rating of this condenser should be comparable to the D.C. voltage appearing at the points across which the output measurements are taken.

PROCEDURE:

With the use of either method noted above, set CONTROL "A" to the A.C. position and rotary RANGE SELECTOR to highest voltage range. An output meter indication will be had when signal generator and radio receiver are put into operation. If the meter indication is slight, then use the next lower A.C. voltage range, etc.

Any gain or loss by reason of balancing or trimming will be accordingly noted by corresponding meter pointer deflection.

NOTE:-The output meter can also be used to great advantage for obtaining comparisons in tube performance by noting the difference in meter indications when any or all of the tubes are substituted in the radio receiver under test.

DECIBEL METER.

The Series 920 and 922 Dynamic Electronometers incorporate a direct reading and calibrated decibel scale enabling readings from -10 to +64 DB in six ranges.

The initial meter scale, reading -10 to +16 DB, is based upon a zero level of 6 milliwatts or 1.73 volts across a 500 ohm load, 500 ohms being that most commonly employed in audio work. The most common use of a decibel meter is that of a power level indicator across known impedances. Because of calibration at one definite impedance, conversions must be made to the new impedance when used at other than 500 ohms. Such tables may be found in a multiplicity of text books and technical magazines. (See last page of this booklet for Decibel Conversion Table.)

Caution must be observed in the use of the DB ranges that the circuit across which the meter is placed is isolated from all D.C., else the meter may be damaged or at least erroneous readings obtained, depending upon whether the D.C. voltage is greater or less than the voltage scale to which the decibel scale corresponds.

PROCEDURE:

Make connections across 500 ohm load to "EXT. TEST" tip jacks. Set CONTROL "A" to the A.C. position for all DECIBEL READINGS. Select suitable DB range on RANGE SELECTOR CONTROL "F" in the same order as the A.C. voltage ranges to which the Decibel Ranges correspond. For example: The first A.C. voltage range of 12 volts corresponds to the initial DB scale on the meter scale plate (minus 10 to plus 16DB). The second DB range corresponds to the second A.C. voltage range or 60 volts, etc.

The decibel scales read in order as follows:

0 DB range: (12 volts A.C.) read directly on initial DB scale (-10 to +16 DB).
+14 DB range: (60 volts A.C.) read on initial DB scale and add +14 DB. This makes the range (+4 to +30 DB).
+28 DB range: (300 volts A.C.) read on initial DB scale and add +28 DB. This makes the range (+18 to +44 DB).
+34 DB range: (600 volts A.C.) read on initial DB scale and add +34 DB. This makes the range (+24 to +50 DB).
+40 DB range: (1200 volts A.C.) read on initial DB scale and add +40 DB. This makes the range (+30 to +56 DB).
+48 DB range: (3000 volts A.C.) read on initial DB scale and add +48 DB. This makes the range (+38 to +64 DB).

CURRENT MEASUREMENTS OF LEAKAGE IN ELECTROLYTIC CONDENSERS.

The leakage in an electrolytic condenser is measured in terms of D.C. current (per microfarad) flowing through the condenser when rated D.C. voltage is applied.

All electrolytic condensers contain an inherent current leakage. However, if leakage above an allowable amount is present, it can then be termed as poor. An allowable current leakage is dependent upon such factors as age and manufacturers' specifications of a condenser, design of power unit, filter system and rectifier tube of the radio receiver in which the condenser is incorporated. In general, considering an 8 mfd. condenser that has been in use (rated at 450 volts), the maximum allowable leakage is approximately .5 MA per microfarad or 4 MA total.

The following will serve as a basis for computing approximate maximum allowable leakages:

(a) For condensers rated at 300 volts or more, leakage of approximately .5 MA per microfarad is permissible.
(b) For condensers rated between 100 to 275 volts, permissible leakages are approximately .2 MA per microfarad.
(c) For condensers rated below 100 volts, permissible leakages are approximately .1 MA per microfarad.

CAUTION:-WHEN OBTAINING ELECTROLYTIC LEAKAGE MEASUREMENTS, HIGH VOLTAGE IS EMPLOYED. IT IS THEREFORE EXTREMELY IMPORTANT THAT THE FOLLOWING INSTRUCTIONS BE ADHERED TO IMPLICITLY TO PREVENT DAMAGE TO METER.

PROCEDURE:

With condenser disconnected from radio receiver circuit, CHECK CONDENSER FOR SHORT with ohmmeter, using the 0-100,000 OHMS RANGE. POLARITIES MUST BE OBSERVED. The negative "TEST" tip jack is connected to outside can or negative terminal of condenser and the positive "TEST" tip jack is connected to the anode (positive) terminal of condenser. A decided low resistance reading or constant full scale deflection of ohmmeter pointer indicates that the condenser is shorted and should be rejected WITHOUT FURTHER TESTING.

When an electrolytic incorporated in a radio receiver is to be tested, the necessary rated voltage is automatically applied and the following connections are made for "forming" and measuring the current leakage, after being (ohmmeter) tested for short.

(1) Set CONTROL "A" to the D.C. position and rotate master RANGE SELECTOR to the 120 MA position.

(2) Remove lead from (positive) anode terminal of condenser and connect this lead to the positive "TEST" tip jack with a PROPER LIMITING RESISTOR IN SERIES. (Where voltage applied to condenser is above 100 volts, the limiting resistor should be approximately 5000 ohms.) When the applied voltage is below 100 volts, the value of the limiting resistor should be approximately 1000 ohms. This limiting resistor is very important and should not be omitted.

(3) Connect the negative "TEST" tip jack to the (positive) anode terminal of condenser. (From the above connections, it can be seen that the "EXT. TEST" tip jacks, limiting resistor, condenser terminals and voltage source are in series connection.)

(4) After series connections are made, turn on switch of radio set. The meter pointer will now deflect to near full scale and then gradually recede to the zero mark or near zero, after the expiration of about three minutes. THIS PROCEDURE IS KNOWN AS "FORMING" THE CONDENSER.

NOTE:-A steady meter pointer indication without receding to or near zero (after forming process) indicates a shorted or leaky electrolytic and the condenser should be rejected WITHOUT FURTHER TESTING.

(5) After "forming", short out the limiting resistor and read current leakage of condenser under test directly on the 120 MA scale. If meter indication is under 12 MA, set RANGE SELECTOR to the 12 MA position for a better meter reading indication and read on 12 MA scale, etc. (For computation of permissible condenser leakages, refer to basis noted previously.)

CAUTION:-After this test is completed, always first disconnect the negative test lead from circuit before turning off power supply to prevent slamming of meter pointer due to discharge of condenser under test.

To test electrolytic condensers not incorporated in a radio set, an external D.C. power supply is necessary, preferably one that employs various voltage taps suitable to application for the various D.C. voltage condenser ratings. In this case, adhere to the same testing procedure as noted above in paragraphs 1, 4 and 5, but making the following series connections:

(a) Select voltage tap of D.C. power supply approximating rated voltage of condenser to be tested.

(b) Connect positive potential of power supply to the positive "TEST"

tip jack with a 5000 ohm limiting resistor in series if applied potential is above 100 volts. If potential is 100 volts or under, use a 1000 ohm limiting resistor.

(c) Connect negative potential of power supply to outside can or negative terminal of condenser.

(d) Connect negative "TEST" tip jack to the (positive) anode terminal of condenser.

(e) Refer to paragraphs 1, 4 and 5 for obtaining current leakage measurements.

GENERAL INFORMATION

NOTE:-

A slight overload will damage or change characteristics of the meter rectifier incorporated. Rectifiers are checked before instruments leave the factory. It is important to note this fact inasmuch as rectifiers are not guaranteed when overloaded.

Instructions and guarantee card are enclosed with this instrument. Mail the guarantee card at once for future information to be mailed from this record. Always give Pattern No. and Serial No. when writing for information relative to this instrument.

920 and 922 MULTI-RANGE METER
ACCESSORIES INCLUDED:

1 #5360 4½ volt Burgess Battery.....$.35
1 Set of super-flex test leads.....75

NOTE:-

Extra accessories, if required, will be sent postpaid upon receipt of money order or stamps equivalent to prices noted above. Minimum billing $.50.

PRECISION APPARATUS COMPANY
647 Kent Avenue
Brooklyn, N. Y.

Form - BTI-4-1-41

BATTERY TESTING INSTRUCTIONS
FOR PRECISION SERIES 912-914-915-920-922-954

This instrument incorporates a highly efficient, DIRECT READING battery testing circuit, engineered and designed by PRECISION in conjunction with the engineering advisory staffs of leading battery manufacturers.

Stressing extreme simplicity in both operation and readability, the PRECISION battery test circuit nevertheless, DIRECTLY accommodates ALL POPULAR portable-radio "A", "B" and "C" batteries, from 1.5 through 135 volts, in eleven calibrated steps.

Through the use of a specially designed switching circuit, each battery is TESTED UNDER LOAD, simulating the actual operating conditions, which the battery may be required to serve in a receiver. The load conditions ARE NOT ARBITRARILY CHOSEN, but are those recommended by the battery manufacturer. The same thought applies to the calibration of each range, so that batteries will definitely be rejected when their LOADED terminal voltage no longer comes up to the stability requirements of good radio reception or similar usage.

To merely test a battery by the simple voltmeter method is entirely inadequate and misleading for two very obvious reasons:-

(1) - The terminal voltage of used batteries differs tremendously between the LOAD conditions of actual service and the negligible current drain of the usual 1000 ohms per volt or even more sensitive voltmeter. Accordingly, a 3 volt battery may very well read full 3 volts on a VOLTMETER and nevertheless drop to less than 1 volt when subjected to receiver OPERATING LOAD (current drain).

(2) - Aside from the above, without a calibrated battery tester, the serviceman would have to know at what point a battery is to be considered definitely no longer fit for service.

THESE TWO CONDITIONS OF LOAD AND REJECT POINT ARE AUTOMATICALLY ATTENDED TO WHEN EMPLOYING THE SIMPLE PRECISION BATTERY TESTER.

* * * * * * *

HOW TO TEST BATTERIES

ALL SELECTORS MUST ALWAYS BE SET TO THE APPROPRIATE POSITIONS BEFORE MAKING ANY BATTERY TESTS.

1. Instrument MUST be "OFF" or else disconnected from the power line.

2. Set Selector Switch "A" to position #1
   " " " "B" " " #18
   " " " "F" " " #11

3. Selector "E", in addition to its functions in the tube testing circuit, serves as the combination voltage and load selector for battery testing, and is set to the required position as follows:

#1 - 1½ volt batteries	#7 - 22½ volt batteries
#2 - 3 " "	#8 - 45 " "
#3 - 4½ " "	#9 - 67½ " "
#4 - 6 " "	#10 - 90 " "
#5 - 7½ " "	#11 - 135 " "
#6 - 9 " "	#12 - Not used

Once controls "A", "B" and "F" are set to their appropriate battery testing positions, Selector "E" is the ONLY switch whose setting changes for batteries of different voltages.

4. Insert test leads into (-) and (+) "BATTERY TEST" pin jacks and apply test prods (in proper polarity) directly across appropriate terminals of battery under test (*). -- Meter will immediately indicate the condition of the battery on the "REPLACE-WEAK-GOOD" scale.

(*) CAUTION:- IN THE EVENT THAT BATTERY TERMINALS ARE NOT IDENTIFIED AS TO POLARITY OR VOLTAGE, ALWAYS FIRST REFER TO RECEIVER OR BATTERY MANUFACTURER'S DATA SHEETS FOR THE NECESSARY INFORMATION BEFORE TESTING, TO AVOID THE POSSIBILITY OF OVERLOADING AND DAMAGING METER.

Batteries reading in the RED "REPLACE" sector should immediately and unquestionably be replaced.

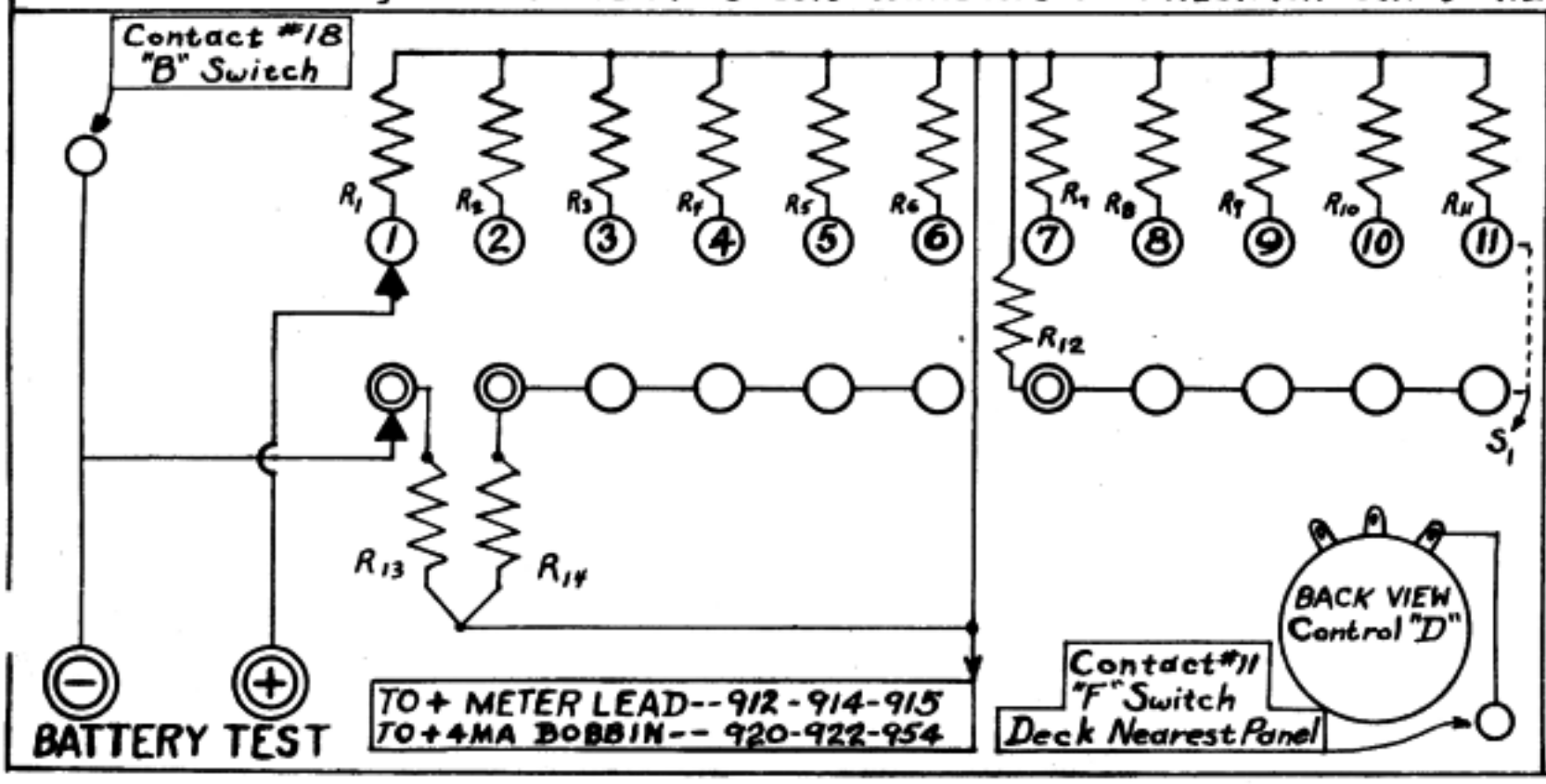
Batteries reading in the YELLOW "WEAK" sector, although normally still capable of use for a short period of time, should also be replaced. "WEAK" batteries are known causes of slow "fade-outs", drift and other receiver instabilities.

NOTE 1. When testing batteries used in test equipment ohmmeter circuits, the battery may test "GOOD" and nevertheless, not give full scale meter deflection in the ohmmeter circuit. This is simply explained by reason that the rejection point of ohmmeter batteries is considerably above that for receivers, test oscillators and similar devices. Accordingly, as far as ohmmeters are concerned, a battery is considered unuseable when full scale ohmmeter adjustment can no longer be obtained in the particular tester in which it is employed, as described by the test equipment manufacturer.

This same battery, if it reads "GOOD", may yet nevertheless furnish some additional service in one's own portable radio, though of course, its remaining useful life is considerably below that of a brand new battery, as its position on the battery test "GOOD" scale will indicate.

NOTE 2. All new batteries, regardless of voltage type, will, when new, and with the proper "E" setting, read at approximately the 66-72 indication on the 0-100 scale (Series 912-914-915) or else 78-84 on the 0-120 scale (Series 920-922-954). SOME LITTLE VARIATION IS TO BE EXPECTED BETWEEN BATTERY BRANDS. Because one brand of new battery may read a little higher than another, it is not an indication of its being better. This is attributable to certain initial chemical conditions within the battery, and in service, will all average around the same operating point.

Schematic showing "BATTERY TEST" circuit connections to PRECISION Series 912-14-15-20-22-54



PART	DESCRIPTION
R_1	7.0 Ω
R_2	58 Ω
R_3	88 Ω
R_4	118 Ω
R_5	148 Ω
R_6	178 Ω
R_7	2250 Ω
R_8	4500 Ω
R_9	6750 Ω
R_{10}	9000 Ω
R_{11}	13,500 Ω
R_{12}	15.07 Ω
R_{13}	.555 Ω
R_{14}	2.31 Ω
S_1	Combination #3 Deck-Top "E"

DECIBEL CONVERSION CHART

Power Level DB	Power Ratio to 0 DB	Power .006 Watt at 0 DB Watts	Voltage Ratio to 0 DB	Volts—Based on .006 Watt at 0 DB in	
				500 ohms	600 ohms
—10	0.1000	0.0006000	0.31623	0.5477	.6000
— 9	0.1259	0.0007553	0.35481	0.6145	.6732
— 8	0.1585	0.0009509	0.39811	0.6895	.7554
— 7	0.1995	0.0011972	0.44668	0.7737	.8475
— 6	0.2512	0.0015071	0.50119	0.8681	.9509
— 5	0.3162	0.0018975	0.56234	0.9740	1.0670
— 4	0.3981	0.0023886	0.63096	1.0928	1.1972
— 3	0.5012	0.0030071	0.70795	1.2262	1.3433
— 2	0.6310	0.0037857	0.79433	1.3758	1.5071
— 1	0.7943	0.0047660	0.89125	1.5437	1.6910
0	1.0000	0.0060000	1.00000	1.7321	1.8974
+ 1	1.2589	0.0075535	1.1220	1.9434	2.1289
+ 2	1.5849	0.0095093	1.2589	2.1805	2.3886
+ 3	1.9953	0.0119716	1.4125	2.4466	2.6801
+ 4	2.5119	0.0150713	1.5849	2.7451	3.0071
+ 5	3.1623	0.0189747	1.7783	3.0801	3.3741
+ 6	3.9811	0.0238865	1.9953	3.4559	3.7867
+ 7	5.0119	0.030071	2.2387	3.8776	4.2477
+ 8	6.3096	0.037857	2.5119	4.3507	4.7660
+ 9	7.9433	0.047660	2.8184	4.8816	5.3475
10	10.0000	0.060000	3.1623	5.4772	6.0000
11	12.589	0.075535	3.5481	6.1455	6.7321
12	15.849	0.095093	3.9811	6.8954	7.5536
13	19.953	0.119716	4.4668	7.7368	8.4752
14	25.119	0.150713	5.0119	8.6808	9.5094
15	31.623	0.189747	5.6234	9.7400	10.670
16	39.811	0.238865	6.3096	10.9285	11.972
17	50.119	0.30071	7.0795	12.2620	13.433
18	63.096	0.37857	7.9433	13.7582	15.071
19	79.433	0.47660	8.9125	15.4369	16.910
20	100.000	0.60000	10.0000	17.3205	18.974
21	125.89	0.75535	11.220	19.434	21.289
22	158.49	0.95093	12.589	21.805	23.886
23	199.53	1.19716	14.125	24.466	26.801
24	251.19	1.50713	15.849	27.451	30.071
25	316.23	1.89747	17.783	30.801	33.741
26	398.11	2.38865	19.953	34.559	37.867
27	501.19	3.0071	22.387	38.776	42.477
28	630.96	3.7857	25.119	43.507	47.660
29	794.33	4.7660	28.184	48.816	53.475
30	1000.00	6.0000	31.623	54.772	60.000
31	1258.9	7.5535	35.481	61.455	67.321
32	1584.9	9.5093	39.811	68.954	75.536
33	1995.3	11.9716	44.668	77.368	84.752
34	2511.9	15.0713	50.119	86.808	95.094
35	3162.3	18.9747	56.234	97.400	106.70
36	3981.1	23.8865	63.096	109.285	119.72
37	5011.9	30.071	70.795	122.620	134.33
38	6309.6	37.857	79.433	137.582	150.71
39	7943.3	47.660	89.125	154.369	169.10
40	10000.0	60.000	100.000	173.205	189.74
41	12589.2	75.535	112.20	194.34	212.89
42	15848.9	95.093	125.89	218.05	238.86
43	19952.6	119.716	141.25	244.66	268.01
44	25118.9	150.713	158.49	274.51	300.71
45	31622.8	189.747	177.83	308.01	337.41
46	39810.7	238.865	199.53	345.59	378.67
47	50118.7	300.71	223.87	387.76	424.77
48	63095.7	378.57	251.19	435.07	476.60
49	79432.7	476.60	281.84	488.16	534.75
50	100000.0	600.00	316.25	547.72	600.00

PRECISION APPARATUS COMPANY

Manufacturers of Fine Electrical Test Equipment

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