

THE SUPREME FIVE-UNIT

RADIO TESTER

MODEL 444

OPERATING DATA

SUPREME INSTRUMENTS CORPORATION

GREENWOOD MISSISSIPPI

U.S.A.

Stock No. 6199

C O N T E N T S *

THE SUPREME FIVE-UNIT RADIO TESTER

ANALYZER
OHMMETER
CAPACITY METER
OSCILLATOR
TUBE TESTER

| | |
|--|----|
| Meter Switch | 1 |
| Rectifier Accuracy | 1 |
| The Ohmmeter | 2 |
| Polarities | 2 |
| Point-to-Point Tests | 3 |
| Tube Terminals | 3 |
| Preliminary Tests | 4 |
| Tube Testing | 5 |
| Potential Measurements | 6 |
| Full-Wave Transformer Rectifier Circuits | 6 |
| Triode Tube Circuit Tests | 7 |
| "Top Cap" Tube Circuit Tests | 8 |
| Resistance Analyses | 9 |
| Rectifier Resistance Analysis | 9 |
| Amplifier Plate and Screen Resistance Analyses | 10 |
| Amplifier Cathode Resistance Analyses | 10 |
| Input Grid Circuit Resistance Analyses | 11 |
| Capacitor Leakage Test | 11 |
| Capacity Measurements | 12 |
| Miscellaneous Connections | 13 |
| The Oscillator and Output Measurements | 13 |
| A. C. Tube Testing | 14 |
| Neutralizing and A. V. C. Adapters | 15 |
| Guarantee | 16 |
| Other: Tabulation of Meter Ranges | |
| Model 444 Accessories Order Form | |
| Supreme Radio Tester 444 Owner's Registration Form | |
| 731-D Diagram (courtesy of Steve Johnson) * | |

MODEL 444 TUBE TESTING TABLE
(124 Tube Types)

| | |
|-------------------------------|---|
| Tube Types 1A6 - 25Z5 | 1 |
| Tube Types 25Z5 - 34 | 2 |
| Tube Types 35 - 64 | 3 |
| Tube Types 65A - 483 | 4 |
| Tube Types 484 - WUND-A | 5 |

* page not part of original manual

THE SUPREME FIVE-UNIT
RADIO TESTER

The Supreme Five-Unit Radio Tester incorporates, in one compact unit, all of the essential radio testing facilities heretofore required of a multiplicity of servicing devices. The five major testing functions of this new tester are listed as follows:

- (1) Analyzer.
- (2) Ohmmeter.
- (3) Capacity Meter.
- (4) Oscillator.
- (5) Tube Tester.

The order in which these major testing functions is listed above will be followed in the following pages which outline the various applications of the tester for practical radio servicing requirements. Other applications of the tester will become obvious to the user from time to time. It is believed that every application of the tester outlined herein is easily understood by the average radioman who is familiar with the fundamental principles of radio servicing technique, but the Service and Engineering Departments of the Supreme Instruments Corporation will gladly answer any inquiry relating to the operation of the tester. Each inquiry should include a detailed description of the attempted tests and of the reactions thereto; and every inquiry should mention the serial number of the tester which is engraved (but not whitened) in the tester panel.

Meter Switch. A rugged 4-position, 2-gang, rotary switch is utilized for selectively-connecting the meter for the following functions:

- (1) D. C. M. A., 0/5/25/125/250/500/1,250
milliamperes (D. C.),
- (2) A. C. V.-MFDS. 0/5/25/125/250/500/1,250
volts (A. C.) and
0/0.125/1.25/12.5 mfd's.,
- (3) D. C. VOLTS 0/5/25/125/250/500/1,250 and
- (4) OHMS, 0/1,000/10,000/100,000/1,000,000,

and since the current required for full-scale meter deflection is only milliamperes (0.001A), there is no appreciable drop across the switch contacts, so that practically no error is introduced by contact resistances.

Rectifier Accuracy. A new circuit is employed for compensating or minimizing the effects of temperature and other variations of the full-wave instrument rectifier unit and for utilizing a single rugged D. C. meter for both A. C. and D. C. measurements on a single uniformly-divided scale without the confusion of the usual "offset" scales or of scales with crowded divisions at the lower end. The shunt and multiplier resistors are selected within an accuracy tolerance of 2%, and all A. C. potential measurements above two volts are accurate within 5% of full-scale values,

Since practically all measurements required in radio servicing involve direct current of potential values, and since the few A. C. potential measurements required in radio servicing involve circuits which have comparatively wide tolerances, the lesser accuracy of the A. C. functions of this Analyzer is not objectionable. As a matter of fact, A. C. power supply potentials usually have a variation of about 10%, and this variation is reflected in the A C filament potential values by the same ratio. Most radio "power pack" rectifier circuits are of the full-wave type, and the AC plate potentials can be compared with each other without the necessity of an accurate measurement of these potentials. Output measurements require the use of a sensitive A. C. voltmeter, but such measurements are arbitrarily adjusted in practice for maxima indications, and accurate measurements in electrical terms are not required. Practically all other measurements involve D. C. values in the measurements which the rectifier unit of the Model 444 is not employed. The meter circuit is so designed that RMS values cannot be inadvertently read as D. C. values or vice versa; AC potentials will not register on the meter when it is set for DC measurements, and DC potentials will not register on the meter when it is set for AC measurements. When shifting the 4-position rotary switch from one position to another, after potentials have been applied to the pin jack terminals on the right-hand edge of the panel, the meter needle may indicate the discharge of the blocking capacitor which is included in the potential-measuring circuits. While this is a natural re-action, it is advisable to discharge the capacitor through the multiplier resistors by momentarily touching the free contact ends of the test lead conductors together before disconnecting the other ends of the leads from the voltmeter terminals on the lower right-hand edge of the panel. The AC functions of every tester are individually calibrated for 60-cycle power supply unless ordered for some other frequency. All DC potential measurements have a sensitivity resistance of 1,000-ohms-per-volt. If the meter needle backs off scale during any DC measurement, the connections to the meter should be reversed.

The Ohmmeter. A battery of three 1.5-volt flashlight cells (Eveready No. 935, or equivalent) should be obtained, locally, and inserted in the small battery compartment so that the positive brass terminals of each cell is towards the outside etched battery plate. The battery should be replaced when it depreciates to such an extent that the DC meter needle cannot be adjusted to full-scale deflection for any range of the ohmmeter functions. The ohmmeter terminals are located on the upper right-hand margin of the panel, and the DC meter movement is connected to these terminals by setting the 4-position "METER SWITCH" to the "OHMS" position. The 0/1,000-ohm range is available between the "OHMS COMMON" and "1,000" pin jacks, the 0/10,000-ohm range between the "OHMS COMMON" and "10,000" pin jacks, and the 0/100,000-ohm range between the "OHMS COMMON" and "100,000" pin jack terminals. For the 0/1-megohm range, an ordinary 45-volt battery should be connected to the "45 VOLTS" pin jacks with the polarity relations as indicated at these pin jacks, after which this resistance-measuring range is available at the two "ONE MEG." pin jack terminals. The DC meter is adjusted to the battery potential, for any range, by temporarily holding the free contact ends of the test probe conductors together while adjusting the "OHMMETER ADJUST-ER" control knob for an exact full-scale meter indication of zero ohms, after which the resistance value of a resistor of unknown value, disconnected from power-supplying circuits, will be indicated on the "OHMS" scale of the DC meter when the free contact ends of the test probe conductors are contacted to the terminals of the unknown resistor. The markings of the "OHMS" range of the meter are direct for the 0/1,000-ohms range, should be multiplied by 10 by adding a zero for the 0/10,000-ohms range, by 100 by adding two zeros for the 0/100,000-ohms range, and should be multiplied by 1,000 by adding three zeros for the 0/1-megohm range.

Polarities. It is obvious that there are no polarity relationships in the connections to the meter of the tester when the 4-position rotary "METER SWITCH" is set at the "A. C. V.-MFDS." position and the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position for the A. C. potential measurements at the pin jack terminals on the lower right-hand edge of the Analyzer panel, and for capacity measurements at

the pin jack terminals along the upper left hand edge of the panel. For D. C. potential measurements at the pin jack terminals along the lower right-hand edge of the panel, with the 4-position rotary "METER SWITCH" set the "D.C. VOLTS" position, and set the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position. The "VOLTS, COMMON" terminal is negative and the other terminals, above the "VOLTS, COMMON" terminals, are positive to the meter. For direct current measurements, the 4-position rotary "METER SWITCH" should be set at the "D. C. M. A." position, and the pin jack terminals along the lower left-hand edge of the panel used. The "D. C. M. A., COMMON" pin jack terminal in the lower left-hand corner is negative and the other milliampere terminals, above the "D. C. M. A., COMMON" pin jack terminals, are positive with respect to the meter. The ohmmeter circuits are arranged so that the negative terminal of the flash light battery is connected to the "OHMS, COMMON" pin jack terminal, the other ohmmeter terminals being positive with respect to the battery. When performing resistance measurements in radios in which electrolytic capacitors are used with the negative terminals of the capacitors grounded to the chassis, the common "OHMS" terminal of the ohmmeter should be connected to the chassis end of the resistors, or circuits so as to minimize errors in the resistance indications occasioned by the "leakage resistance" of paralleled electrolytic capacitors. By way of summary, it should be remembered that the "COMMON" terminals for all DC measurements are negative.

Point-to-Point Tests. By reason of their knowledge of electrical fundamentals, most radiomen are familiar with the method of connecting calls on telephone switch boards whereby any telephone subscriber can be easily connected with any other subscriber. The principles of the flexibility of the telephone switchboard are incorporated in the miniature terminal arrangement of this tester, so that (1) any one of the 25 ranges of (2) the four functional meter circuits may be applied (3) across any pair of the eight analyzer cable circuits, or (4) in series with the six of these circuits which are provided with "ANALYSIS" circuit-breaking switches, or (5) any of these meter and analytical circuits can be connected externally to other apparatuses for innumerable testing combinations. Such flexibility in the application of a tester could not be obtained by any principle of construction other than the point-to-point arrangement. The rapidity with which the fundamental tests of radio servicing may be performed with this tester appeals to the practical radioman who sees in this tester a device which covers the entire field of testing requirements ranging from the simple plate current analyses to the more detailed individual unit testing procedure which requires the use of test probes with all types of testers.

Tube Terminals. The standardizing committees of the Radio Manufacturers Association have recently established a standard system for numerically-designating tube and socket terminals. These terminal numbers are shown around the sockets on the panel of this tester, and it will be noted that the numbers conform to a clockwise sequence beginning with the number "1" grid terminal nearest the conventional plate terminal which will, in the future, be designated as the number "2" terminal; and the terminals numbered "3" and "4" are the filament or heater terminals on all types of tubes, regardless of the total number of terminals. A 4-pin tube has no number "5" terminal which represents the conventional cathode in practically all tubes which have more than four terminals. The terminals numbered "6" and "7" are applicable to tubes which have more than five base terminals. The conventional control grid terminal is designated as the "TOP CAP" and abbreviated "T. C." in the new RMA standards, and is so marked on the panel of this tester. The "TOP CAP" and "T. C." pin jacks on the tester panel are connected directly through the analyzing cable to the lug which terminates the short flexible insulated conductor at the top of the analyzing plug. It is believed that it is preferable to have this lug connected through a flexible lead so as to enable connections with various lengths of "top cap" tubes, as such connections are often difficult to effect when the lug is rigidly attached to the analyzing plug. Either one of the "TOP CAP"

pin jack terminals on the tester panel may be connected to the top cap of any tube which may be placed in a socket on the tester panel. The two "T. C." pin jacks are located below the meter between the "7 and "1 pin jacks. All of the numbered pin jacks which are located just above the red push buttons are connected through master circuit switches to correspondingly-numbered contacts of the terminal tube sockets and to corresponding terminals of the analyzing plug or of the analyzing plug adaptors.

Preliminary Tests. In view of the fact that the plate current of the tube is the result of practically all of the electrical factors involved in the circuits leading to the tube, a normal plate current value is fairly conclusive evidence that the circuits leading to the tube are performing their normal functions. It is, therefore, usually sufficient, in the preliminary analysis of a radio, to measure only the plate current of each tube, in turn, until a tube is encountered in which the plate current is incorrect, when other readings for that tube may be taken in an effort to isolate the defect in the circuit leading to the tube in which the incorrect plate current is observed. An abnormally high plate current reading usually suggests (1) an open grid circuit, (2) a shorted or leaky bypass capacitor across the grid biasing resistor in the cathode circuit, (3) a leaky capacitor coupling the grid of the tube to the positive plate of the preceding stage, or (4) an excessively gaseous tube when resistance-coupled to the preceding stage. A low plate current indication usually suggests (1) a leaky plate bypass capacitor, or (2) a leaky screen bypass capacitor. No plate current usually suggests (1) an open grid bias resistor in the cathode (or filament) circuit, (2) a shorted plate bypass capacitor, (3) a shorted screen grid bypass capacitor, (4) an open plate circuit, or (5) an open screen grid circuit. There are other possible causes of incorrect plate current values, but those enumerated are the most usual. The use of high resistance coupling circuits in modern radios introduces errors in practically all voltage measurements, because of the multiplier effects of the resistors in the coupling circuits of such radios. Furthermore, potential measurements will vary with different ranges of ordinary service voltmeters applied to high resistance circuits, so that the voltage readings published by a radio manufacturer may be found quite different by the radioman when analyzing with a voltmeter of the same sensitivity but of a different range from that used by the radio manufacturer. Such differences are much less likely to exist in milliammeter indications, and these factors make it advisable to rely more upon plate current and less upon voltage readings for indications of amplifier circuit conditions. This procedure of preliminary analysis by means of plate current indications, only, saves time and is usually sufficient for all practical servicing purposes. Plate current measurements with this tester are accomplished in the following manner:

- i. Complete all connections to the radio under test with all tubes in the proper sockets for normal operation.
- ii. Remove all test lead conductors from the tester panel.
- iii. With the radio turned "Off," remove a tube from the radio, place the tube in the proper tester socket, and connect the top terminal of the tube, if any, to the "TOP CAP" pin jack on the tester panel.
- iv. Set the "TUBE TEST SELECTOR" to the "ANALYSIS" position and set the "FILAMENT-HEATER SELECTOR" to the "ANALYSIS" position.
- v. Insert the analyzing plug into the vacant radio tube socket and complete the radio "TOP CAP" terminal connection, if any, to the lug at the top of the analyzing plug, and turn the radio "On." As the tubes attain their normal operating temperature, adjust the

volume and tuning controls of the radio for normal response to broadcast signals or to whatever positions may be recommended by the radio manufacturer for circuit analyses.

- vi. Set the 4-position rotary "METER SWITCH" at the "DC MA, COMMON" position, connect a test probe conductor between the "DC MA, COMMON" and upper No. "2" pin jack, connect the lower No. "2" pin jack with a test probe conductor to the "250" mils. pin jack, on the left-hand edge of the tester panel, and depress the No. "2" push button. After observing the plate current reading, release the push button.

It is usually advisable to first observe the plate current reading on the 250-mil. range, after which the connector may be shifted down to a suitable lower range. The above procedure may be continued, without changing the connections, from tube to tube until the plate current measurements have been made for all of the tubes in the radio; or until a tube is encountered in which there is an indication of an incorrect plate current value, in which case the radioman should undertake a more detailed analysis in an effort to isolate the cause of the incorrect plate current condition by potential and resistance measurements as outlined in these instructions.

Tube Testing. When a radio is in its normal operating condition, the use of the analyzing unit of this tester for testing the tubes in the radio tube sockets constitutes an excellent means for the detection of weak and/or noisy tubes. It is very often found that, after tubes have been in use for a long period of time, a rattling or raspy noise will be emitted from the loud speaker when the tubes are very lightly thumped or tapped with a pencil or other small object, although the tubes may be indicated as satisfactorily operable by the usual meter tests. It is, therefore, advisable to clean the tube pins and gently thump or tap each tube during the regular tests preferably while the tube is in the analyzer socket and held away from the radio so that any noises observed may be definitely assigned to the tube rather than the vibration of some loose part in the radio chassis. An exception may be observed in the case of detector tubes which will produce a ringing sound in the loudspeaker when the tube is thumped or tapped. A ringing musical sound may be natural, but a raspy or rattling sound is not generally natural, and the experienced radioman soon learns the difference between natural and unnatural sounds accompanying the test procedure. The logical explanation for the benefit of the customer is that tubes with vibratory noises will respond to the loudspeaker vibrations and distort the reception; and that if the noises are caused by loose elements, short circuits may develop which might harm other parts of the radio. Tube test readings of amplifier tubes are obtained with this tester as a logical step following the measurement of plate current as described in the preceding paragraph, and is accomplished by connecting the self-contained battery to the pair of pin jack terminals which corresponds to the input grid of the tube in which the plate current is being observed. In the type 26 and 27 tubes, the number "1" terminal corresponds to the input grid, and the following tube testing procedure is recommended:

- i. After observing the plate current reading, release the number "2" push button.
- ii. Connect a flexible connector from the "OHMS, COMMON" pin jack to the lower number "1" pin jack.
- iii. Connect a flexible connector from the "10,000" pin jack to the upper number "1" pin jack.
- iv. While depressing the number "2" (plate current) push button, depress the number "1" (input grid) push button for observing the

change in the plate current, and release both push buttons.

In the types 24 and 35 tubes the input grid is connected to the "top cap" terminal, and the battery should be connected to the "T. C." pin jacks instead of to the Number "1" pin jacks; the tube test is then obtained by depressing the "T. C." instead of the No. "1" push button. Similarly, the terminals numbered "6" or "7" may represent the input grids of the other types of tubes, and the radio man must determine from radio service notes or commercial tube data charts the functions of the terminals of the tubes and circuits encountered in service. The multiplier and shunt resistors of the ohmmeter prevent short-circuiting the battery before depressing the corresponding input grid switch button. The connections described above place the positive terminal of the battery nearest the grid so that the plate current is increased during the test, but the connections may be reversed, if desired for decreasing the plate current. It is the amount of increase or decrease in the plate current which indicates the extent to which the input grid controls the plate current output which corresponds to the amplifying ability of the tube. An amplifier tube in which the plate current remains unchanged when the battery is connected to the input grid circuit will not amplify signals and should generally be replaced. Because of the variations in different radio circuits, definite discard limits cannot be defined, and the radioman must use his own good judgment, based on his experience, in determining when tubes should be discarded. Additional data on tube testing will be found in the discussions relating to the AC tube testing and oscillator functions of this tester.

Potential Measurements. After proceeding with the preliminary procedure of plate current measurements and tube testing until a tube socket is encountered in which the tube is passing incorrect plate current, and in which the replacement of the tube does not correct this condition, it is advisable to resort to more specific tests for the purpose of isolating the circuit which is defective. For this purpose the following procedure is recommended.

- i. Remove all test conductors from the tester panel.
- ii. Set the 4-position rotary "METER SWITCH" at the "D. C. VOLTS" position, set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, and set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position, and set the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position.
- iii. Connect a test probe conductor between the "VOLTS, COMMON" pin jack and one of the pin jacks which corresponds to the cathode terminal of the tube circuit.
- iv. Connect one end of a test probe connector to the "250" or other suitable pin jack on the right-hand edge of the panel; and apply the free ends of this conductor to the pin jack terminals numbered "1," "2," etc., for the purpose of measuring the potentials applied to the tube with respect to the terminal which corresponds to the cathode element.

It should be observed that the push button switches should not be operated during potential measurements. The potential readings obtained should be compared with those published for the radio involved in the tests in an effort to determine which circuit contains the defect causing incorrect plate current values. After determining the defective circuit, the ohmmeter should be utilized for locating the defective part. This procedure is described in connection with the use of the ohmmeter in resistance analysis. In the following paragraphs, some typical and representative potential analyses will be described.

Full-Wave Transformer Rectifier Circuits. The following procedure is recommended for the analysis of full-wave rectifier circuits which are transformer supplied:

- i. Remove all test conductors from the tester panel.
- ii. Set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, and set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position, and set the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position.
- iii. For the first potential measurement, set the 4-position rotary "METER SWITCH" to the "A. C. V.-MFDS." position, connect suitable test lead conductors from the "VOLTS, COMMON" and "1,250" terminals on the right-hand margin of the panel to the No. "3" and one of the No. "2" pin jacks, and observe the meter indication of the plate voltage. After observing the meter reading, remove the test probe conductor from the No. "2" pin jack.
- iv. For the second plate potential measurement, insert the free test probe conductor into one of the No. "1" pin jacks. If the meter reading differs considerably from that observed in the preceding sub-paragraph, some of the high voltage plate transformer secondary windings may be shorted, although a slight difference between these two readings may be caused by the capacity effects of the tester cabling.
- v. For the filament potential measurement, set the 4-position rotary "METER SWITCH" to the "A. C. V.-MFDS." position and connect a suitable voltage range of the meter from the right-hand margin of the panel to the No. "3" and "4" pin jacks, and observe the meter indication for potential measurement.
- vi. Turn the radio "Off," replace the tube in the radio socket, and remove all connectors from the tester panel.
- vii. The test readings obtained by the above procedure may be compared with those specified by the radio manufacturers concerned.

The primary functions of the above test is to determine whether or not some of the turns of one side of the secondary plate winding of the power transformer are shorted. Since these windings carry the highest potentials of the transformer, they are usually the first windings to break down. It should be remembered that short-circuited windings in any transformer result in an oversaturation of the iron core with resultant overheating and lowered output potentials.

Triode Tube Circuit Tests. A Triode tube is any amplifier tube with four or five terminals in which the input grid is connected to the base terminal numbered "1." The following test procedure is recommended:

- i. Remove all test leads from the tester panel.
- ii. Set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position, and set the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position.
- iii. For the plate potential measurement, set the 4-position rotary switch at the "DC-VOLTS" position, connect an insulated test lead conductor from the "VOLTS, COMMON" pin jack to one of the No. "5" pin jacks when analyzing 5-pin triode tube circuits or to the No. "4" pin jack terminal when analyzing 4-pin triode tube circuits.
- iv. Connect one of the No. "2" pin jacks with a test conductor to the

- "250" volts pin jack, observe the meter indication of the plate voltage, and remove the test probe conductor from the No. "2" pin jack.
- v. For the cathode potential measurement of 5-pin triode tube circuits, insert the free test conductor plug into the No. "3" pin jack. If the meter needle backs off scale, reverse the connections. After observing the meter reading, remove the test conductor plug from the No. "3" pin jack.
 - vi. For the grid potential measurement, insert the free test conductor plug into one of the No. "1" pin jacks.
 - vii. For the filament or heater potential measurement, set the 4-position rotary "METER SWITCH" at the proper position, and connect a suitable voltage range of the meter to the Nos. "3" and "4" pin jacks. After observing the meter reading, remove the test probe conductors from the tester panel.
 - viii. Turn the radio "Off," replace the tube in the radio tube socket, and remove the connectors from the tester panel.
 - ix. The test readings obtained by the above procedure may be compared with those specified by the radio and tube manufacturers concerned.

"Top Cap" Tube Circuit Tests. In the normal use of the screen grid tubes, such as the types 24 and 35, a small negative potential is applied to the top cap of the tube which is generally called the "control grid" connection, while a positive potential, ranging between $1/3$ and $1/2$ of the plate potential, is connected to the grid prong of the tube base. The following procedure should be followed in testing screen grid tube circuits, or other circuits which involve tubes with "top cap" terminals:

- i. Remove all test lead conductors from the tester panel.
- ii. Set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position, and set the "CAPACITY, TUBE TEST" tumbler switch to the "TUBE TEST" position.
- iii. For the plate potential measurement, set the 4-position rotary "METER SWITCH" at the "DC VOLTS" position, connect a test conductor between the "VOLTS, COMMON" pin jack and one of the No. "5" pin jacks (or to the No. "4" pin jack if the tube does not have a separate cathode terminal), connect the "250" volts pin jack with a test conductor to one of the No. "2" pin jacks, observe the meter reading of the plate voltage, and remove the test probe conductor from the No. "2" pin jack.
- iv. For the screen potential measurement, insert the free test conductor plug into one of the No. "1" pin jacks. After observing the meter reading, remove the test conductor plug from the No. "1" pin jack.
- v. For the cathode potential measurement of the heater type tube, insert the free test conductor plug into the No. "4" pin jack. If the meter needle backs off scale, reverse the connections. After observing the meter reading, remove the test conductor plugs from the tester pin jacks.

- vi. For the input grid potential measurement, connect a test conductor between the "VOLTS, COMMON" and one of the unoccupied "T. C." pin jacks, and connect the "25" volt pin jack to one of the No. "5" pin jacks (or to the No. "4" pin jack, if the tube does not have a separate cathode terminal). If this grid of the radio tube socket being analyzed is resistance-coupled to the preceding stage, a more accurate reading of the applied control grid potential will be indicated by temporarily connecting a test conductor between one of the "T. C." pin jacks and the "grid return" which is usually the grounded chassis of the radio. After observing the meter reading, remove the test conductor plugs from the tester panel.
- vii. For the heater or filament potential measurement, set the 4-position rotary switch at the proper position, and connect a suitable voltage range of the meter to the Nos. "3" and "4" pin jacks. After observing the meter reading, remove the test probe conductors from the tester panel.
- viii. For screen grid current measurement set the 4-position rotary "METER SWITCH" at the "D.C.M.A." position and connect a test probe conductor between the "D.C.M.A. COMMON" and the upper No. "1" pin jack, connect a test probe conductor between the lower No. "1" pin jack and the "5 MILS." pin jacks, and depress the No. "1" push button. After observing the current reading release the push button.
- ix. Turn the radio "Off," replace the tube in the radio socket, and remove the connectors from the tester panel.
- x. The test readings obtained by the above procedure may be compared with those specified by the radio and tube manufacturers concerned.

Resistance Analyses. For general radio analysis, it is recommended that the plate current indications be relied upon as having primary importance, because correct plate current values almost invariably indicate correct potentials applied to the tube sockets. Whenever a socket is encountered during a general analysis in which the plate current fluctuates or is radically low or high, it is then advisable to concentrate the investigation at that socket in an effort to determine the cause of the radical plate current. This investigation may lead to the use of the ohmmeter functions of the tester for point-to-point tests of the component elements of the circuits of the sockets. Before undertaking such tests, the radio must be disconnected from the power supply outlet. The resistance analysis may be made between the pin jack terminals of the analyzer cable circuits, or from these terminals to the chassis or other reference points without removing the analyzing plug from the socket in which the circuit defect apparently exists. Resistance analyses should not be made in lieu of the usual current and potential analyses because some types of resistors change in resistance values when operating under their normal loads. Furthermore, it is generally advisable to disconnect resistors from parallel circuits in order to test them, whereas current and potential values can be analyzed without disturbing normally permanent connections.

Rectifier Resistance Analysis. The most common defect of rectifier circuits which utilize the types 80, 81, 82 and 83 rectifier tubes is represented by short-circuited filter capacitor sections. This condition is usually evidenced by heavy rectifier plate current values. When this defect is suspected during the analysis of the rectifier socket, the radioman should proceed as follows:

- i. Turn the radio "Off," and disconnect the current range of the meter from the No. "2" or from the No. "1" pin jacks in case the second plate current is being observed.
- ii. Set the 4-position rotary "METER SWITCH" at the "OHMS" position, set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, and set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position.
- iii. Connect the "OHMS, COMMON" pin jack to the No. "2" pin jack with a suitable conductor.
- iv. Connect a test lead conductor from the "10,000" pin jack to the No. 3 pin jack.

If the resistance reading is considerably less than 10,000 ohms, a shorted paper filter capacitor section or a defective electrolytic capacitor should generally be suspected.

Amplifier Plate and Screen Resistance Analyses. The resistance of any amplifier plate circuit can be measured from the plate contact at the tube socket to one of the filament contacts of the rectifier tube socket, or to the plate contact of another amplifier or detector tube to which the same plate potential is applied as that which is specified for the plate circuit of the socket under test. With the analyzing plug in an amplifier tube socket, the following procedure is recommended for plate circuit resistance measurements:

- i. Turn the radio "Off," and disconnect all test leads from the tester panel.
- ii. Set the 4-position rotary "METER SWITCH" at the "OHMS" position. Set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, and set the "FILAMENT-HEATER SELECTOR" to the "ANALYSIS" position.
- iii. Connect the "1,000," "10,000," or "100,000" pin jack, depending upon the desired range, to the No. "2" pin jack with a suitable test lead conductor.
- iv. Connect the "OHMS, COMMON" pin jack with a suitable test lead conductor to one of the filament contacts of the rectifier tube socket, or to the plate contact of the socket of another amplifier or detector tube of the radio. The meter needle will indicate on the "OHMS" scale the total resistance of the plate circuit.

If the plate circuit resistance appears to be normal for a good tube in which the plate circuit is considerably lower than the specified value, it is recommended that the resistance between the No. "2" pin jack and the radio chassis be measured, or that the resistance between the No. "2" and the No. "5" or No. "4" pin jacks be measured for the purpose of determining whether or not the defective condition is caused by a short-circuited plate bypass capacitor. A procedure similar to that described above may be followed for the measurement of screen grid circuit resistance values from the No. "1" pin jack, or for resistance measurements of other circuits to which positive potentials are applied through resistors from the filament circuit of the rectifier tube.

Amplifier Cathode Resistance Analyses. In the earlier types of 4-pin triode tubes for use in A. C. power supplied radios, such as the types 26, 71A, and 45, the filament performs the functions of a cathode element, and is usually connected to the

chassis or to the negative side of the filter system through a resistor across which the negative input grid potential is developed by the plate current of the tube. In the later types of amplifier tubes with more than five base pins, a separate cathode element is heated by the filament and terminates at a cathode pin which usually corresponds to the No. "5" pin. The following procedure is recommended for cathode circuit resistance measurements:

- i. Turn the radio "Off," and disconnect all test lead conductors from the tester panel.
- ii. Set the 4-position rotary "METER SWITCH" at the "OHMS" position, set the "TUBE TEST SELECTOR" to the "ANALYSIS" position, and set the "FILAMENT HEATER SELECTOR" to the "ANALYSIS" position.
- iii. Connect the "1,000," "10,000," or "100,000" pin jack, depending upon the desired range, to the No. "5" pin jack for a tube with more than four pins or to the No. "4" pin jack for a tube with four pins, utilizing a suitable test lead conductor.
- iv. Connect the "OHMS, COMMON" pin jack with a suitable test lead conductor to the chassis of the radio, or to one of the plate contacts of the rectifier socket. The meter needle will indicate on the "OHMS" scale the total resistance of the cathode circuit.

In some radios the volume control constitutes a part or all of the cathode resistance for some of the tubes. If the cathode resistance is considerably less than the specified value, the bypass capacitor across the cathode resistor may be short-circuited or very "leaky;" this condition will tend to reduce the negative input grid potential with a resultant high plate current value.

Input Grid Circuit Resistance Analyses. In the latest types of tubes, the No. "1," "T. C.," No. "6," or No. "7" terminals connect to input grids, and the radioman must determine from service data pertaining to radios which utilize these tubes the terminals which connect to the input grids. The circuit diagrams of such radios are helpful in determining the points between which the resistance values of the input grid circuits should be measured. In view of the fact that input grid circuits carry practically no direct current, wide variations in the resistance values may have negligible effect upon the plate current, but considerable effect upon the amplification of signals. For example, it was found that the transformer secondary winding of the first audio transformer of a Model 70 Majestic radio had increased in resistance value to 40,000 ohms without changing the input grid potential or the plate current of the type 26 first audio tube; but the signal strength of the radio was considerably reduced.

Capacitor Leakage Test. While the higher ranges of the ohmmeter may be used for measuring the leakage resistance of paper capacitors, the leakages which can be detected in this manner are so far in excess of the permissible leakages for paper capacitors that the use of higher potentials is recommended for such leakage tests. The Radio Manufacturers Association recommends that the insulation resistance of fixed paper capacitors should not be less than 500 megohm microfarads, at a capacitor temperature of 68 degrees Fahrenheit, the test being made by raising to a direct potential of 250 volts a completely discharged capacitor and maintaining this potential for 3 minutes before insulation resistance is measured. These conditions can generally be sufficiently approximated in practical service procedure by utilizing the 250-volt DC potential of the tester in series with the 250-volt DC range of the meter, in the following manner:

- i. Remove the analyzing plug from contact with any conductors, and do not allow the body to contact the plug pins during the test.
- ii. Set the "CAPACITY, TUBE TEST" and "OSCILLATOR, TUBE TEST" tumbler switches at the "TUBE TEST" positions.
- iii. Set the rotary "TUBE TEST SELECTOR" switch to the "G" position.
- iv. Set the rotary "FILAMENT-HEATER SELECTOR" switch at the proper position for the rectifier tube which will be used for the test, and place the rectifier tube in one of the tester sockets.
- v. Attach the tester to a convenient AC power supply outlet, and set the 4-position rotary "METER SWITCH" at the "D. C. VOLTS" position.
- vi. Connect the "VOLTS, COMMON" pin jack to the negative "250 VOLTS D. C." pin jack with a suitable test lead conductor.
- vii. If the capacitor is polarized, connect the positive capacitor terminal to the positive "250 VOLTS D. C." pin jack, and connect the negative capacitor terminal to the "250" pin jack on the right-hand edge of the tester panel.

When the potential is applied, a good capacitor will take a charge through the meter which will indicate the charge by a maximum reading at the instant the connection is made, the reading decreasing to zero as the charge is completed. The instantaneous maximum reading varies with the capacities of capacitors under test. The failure of the meter to make any response to the charging potential would indicate an "open" capacitor, or a capacitor of a capacity too low to accommodate a discernible charge with the applied potential. A shorted capacitor will be indicated by reading on the meter of the full voltage of the DC power supply. A capacitor with a resistance leakage will be indicated by the failure of the meter needle to complete its decrease to the zero position. Paper capacitors which have any discernible leakage should be discarded, as it is likely to break down at any time. Electrolytic capacitors should generally be discarded when the DC leakage exceeds one milliamperere per rated microfarad. After determining by the above procedure that an electrolytic capacitor is not shorted, a suitable current range on the left-hand edge of the panel may be connected in series with the 250-volt potential and the capacitor, with the 4-position rotary switch set at the "DCMA" position, for measuring the leakage current.

Capacity Measurements. Because of the possibility of "blowing" the fuse located beneath the tester panel when attempting to measure the capacity of a shorted capacitor, it is recommended that every capacitor be subjected to the leakage test outlined in the preceding paragraphs before undertaking a measurement of the capacity. No attempt should be made to perform such measurements on capacitors which are connected to grounded radios or circuits. This test is not applicable to electrolytic capacitors, which require special circuits for capacity measurements. For capacity measurements with this tester a source of 60-cycle power supply at an approximate potential of 110-volts should be connected for the measurements in the following manner:

1. Set the 4-position rotary "METER SWITCH" to the "A. C. V.-MFDS." position, set the "CAPACITY, TUBE TEST" tumbler switch to the "CAPACITY" position.

- ii. Connect the capacitor, the capacity of which is to be measured, between the "CAPACITY, COMMON" and the "12.5 MFD." pin jacks.
- iii. Attach the tester to a convenient A. C. power outlet.
- iv. If the meter reading is less than "12.5" on the "125" of the meter, shift the capacitor connection from the "12.5 MFD." to the "1.25 MFD." terminal, and observe the meter reading. If the meter still reads less than "12.5" on the "125" scale, transfer the capacitor connection from the "1.25 MFD" to the "0.125 MFD." terminal.
- v. After observing the capacitive value, disconnect the power supply system, and remove all connections to the tester.

All capacitive values should be read on the "125" scale of the meter; all readings should be divided by 10 for the "12.5-MFD" range, divided by 100 for the "1.25-MFD." range and by 1,000 for the "0.125-MFD." range. If the tester is designed on special order for some power frequency other than 60 cycles, the frequency for which the tester is designed should be applied instead of a power supply of 60 cycles.

Miscellaneous Connections. In view of the fact that all of the analytical circuits, except the filament or heater circuits numbered "3" and "4" may be broken by depressing the red push buttons, numerous other uses may be found for these facilities, such as the connection of headphones, loudspeakers, etc., in the plate circuit during analysis for special tests. In some types of audio circuits phonograph pick-up devices may be inserted in the cathode or No. "5" circuit or in other circuits for demonstrational purposes. These miscellaneous tests are enabled only in point-to-point testers which utilize the circuit principles of the Model 444.

The Oscillator and Output Measurements. In order to dispense with the use of a calibration chart or a graph with a tuning curve, the oscillator of this tester is designed for tap switch tuning. The available frequency settings of the rotary "OSCILLATOR FREQUENCY" switch cover more than 95% of all of the superheterodyne radios in use. The fact that the modulation of most D. C. operated oscillators is about 30%, whereas the modulation of an A. C. operated oscillator is practically 100% makes the oscillator of this tester ideal for adjustments of modern radios in which the blasting effect of strong signals is minimized by volume level circuits which are most efficient when operating with signals from a 100% modulated broadcast station. If strong r. f. signals are applied to a sensitive radio of this type by an unmodulated oscillator it is possible to overload the detector with r. f. energy without having any appreciable loudspeaker output of a. f. energy. In some radios, an overloading of the above mentioned circuits with r. f. energy may result in two maxima or peaks of the radio output and in broad tuning when the modulation is considerably less than 100%. It is, therefore, obvious that the loudspeaker output is greatly dependent upon the percentage of the modulation of the input r. f. signals. The procedure for the operation of the oscillator for output measurements is very simple and is outlined as follows:

- i. Set the "OSCILLATOR, TUBE TEST" tumbler switch to the "OSCILLATOR" position, set the "CAPACITY TUBE TEST" to the "TUBE TEST" position, and attach the tester to a convenient power outlet.
- ii. Insert the black dummy antenna pin plug into the "GND." pin jack of the tester oscillator.
- iii. Insert the dummy antenna pin plug into the "ANT." pin jack of the tester oscillator.

- iv. Attach the "+" dummy antenna clip to the "ANTENNA" binding post of the radio, or to a contact point specified by the radio manufacturer.
- v. Attach the remaining dummy antenna clip to the "GROUND" of the radio.
- vi. With the radio turned "Off," remove a power output tube from the radio, place the tube in the proper tester socket, and connect the top cap, if any, of the tube to the "TOP CAP" pin jack on the tester panel.
- vii. Insert the analyzing plug into the vacant radio tube socket and complete the radio top cap terminal connections, if any, to the lug at the top of the analyzing plug, and turn the radio "On."
- viii. Set the 4-position rotary "METER SWITCH" to the "A. C. V-MFDS." position.
- ix. Connect the "VOLTS, COMMON" pin jack with a test load conductor to the No. "3" pin jack (or to the No. "5" pin jack if the tube has more than five base terminals).
- x. Connect the "250" pin jack on the right-hand edge of the tester panel with a test load conductor to the No. "2" pin jack.
- xi. Set the rotary "OSCILLATOR FREQUENCY" switch for the desired frequency, tune the radio to the oscillator, adjust the radio volume and tester "OUTPUT CONTROL" for the desired signal strength, and proceed with the radio re-adjustments in accordance with the procedure outlined by radio manufacturers for such adjustments.

A failure to hear the signals indicated by the meter would suggest a defective output transformer or defective speaker circuits. If desired, a range lower than the "250" volts range may be used when necessary for better readability. The "POLICE" tuning range is calibrated at 1,875 kilocycles (160 meters) unless the tester is ordered calibrated at some other frequency in the 160-meter band. The 80-meter, 40-meter and 20-meter short wave bands are coverable by the 2nd, 3rd and 4th harmonics, respectively, of the 160-meter "POLICE" band. It is generally advantageous to keep records of the output readings of various radios for comparative and reference purposes in future adjustments. The oscillator and output meter constitute an ideal method for comparative tube testing with operative radios. This method of tube testing is accomplished by observing the effect on the output meter readings resulting from the replacement of questionable tubes with new tubes. Tubes tested by this method are usually designated as "set tested" tubes. This method of testing is also ideal for detecting fading conditions within the radio or tubes, and is being practiced by many leading radio service engineers as a result of the recommendations of some of the leading tube manufacturers.

A. C. Tube Testing. In addition to the provisions for (1) testing tubes from the sockets of operative radios and (2) by means of an oscillator and output meter, this tester is provided with facilities for testing tubes with A. C. power supply by the usual "grid shift" transconductance (or mutual conductance) principle, in the following manner:

- i. Attach the tester to a convenient A. C. power supply outlet, and set the "CAPACITY, TUBE TEST" and "OSCILLATOR, TUBE TEST" tumbler switches to the "TUBE TEST" positions.

- ii. Set the 4-position rotary "METER SWITCH" to the "D. C. M. A." position and connect the "D. C. M. A., COMMON" pin jack to the upper No. "2" pin jack.
- iii. Connect the "125," or other suitable pin jack on the left margin of the panel, to the lower No. "2" pin jack.
- iv. Set the "TUBE TEST SELECTOR" and "FILAMENT-HEATER SELECTOR" to the positions indicated by the Tube Testing Table which accompanies the tester, place the tube, which it is desired to test, into the proper tester socket, and complete the "top cap" connections, if any, to one of the "TOP CAP" pin jacks.
- v. Depress the No. "2" button for observing the plate current measurement.
- vi. While depressing the No. "2" button depress the "GRID SHIFT" button for observing the change in plate current, and compare the difference between the two readings with the discard minimum indicated in the Tube Testing Table.

While depressing the No. "2" button, the "SECOND PLATE" button may be depressed for measuring the plate current load of the second plate of full-wave rectifying tubes. When the "K.-H., LEAKAGE" button is depressed, while the No. "2" button is being depressed, the meter needle should return to the zero position; otherwise, it may be concluded that there is a leakage between the cathode and heater elements of the tube. A comparative test of the gas content of the tube may be had by depressing the "GAS TEST" button while depressing the No. "2" button; the effect of this test should be compared with that of a new tube. No definite limits can be established for this gas test, as the limits would vary with different tubes under various circuit conditions.

Neutralizing and A. V. C. Adapters. The Supreme Neutralizing and A. V. C. Adapters are indispensable for those who are equipped with an oscillator or who utilize the signals from a nearby broadcasting station for re-neutralizing adjustments, or for tuning capacitor re-adjustments in A. V. C. radios in which manufacturers recommended the replacement of A. V. C. tubes with "dummy" tubes during such re-adjustments. The proper Neutralizing and A. V. C. Adapters may be used in lieu of a corresponding type of "dummy" tube where it is desired to more accurately re-adjust any radio-frequency stage to the tube which is to remain in that stage for the regular operation of the radio. This procedure removes the possibility of incomplete balancing through the use of a "dummy" tube, the inter-electrode arrangement and capacities of which may not match those of the tube which is to normally occupy the stage to be neutralized. Besides the assurance of more efficient re-adjustments, the adapter has economical advantages in that it eliminates the necessity for sacrificing perfectly good tubes of each type encountered in service to provide "dummies" which require valuable space in the radioman's kit, and which are liable to be broken or to suffer displaced elements in handling thereby minimizing their efficiency or destroying their utility. The use of either adapter serves to open the filament circuit of the tube occupying the stage being re-adjusted. These adapters are not essential as a part of the necessary equipment of the tester, but may be ordered for the purpose outlined above.

Guarantee. All products of the Supreme Instruments Corporation are guaranteed to be free from defects in workmanship or material for a period of 90 days after delivery to the original user by an authorized agency of the Supreme Instruments Corporation; and the Corporation agrees to repair any such defect in material or workmanship without charge when the instrument or defective part is delivered, transportation charges prepaid to the

SUPREME INSTRUMENTS CORPORATION

GREENWOOD, MISSISSIPPI

U. S. A.

TABULATION
OF
METER RANGES

| RESISTANCE "OHMS" | SCALE USED | MULTIPLY BY |
|------------------------|---------------|----------------|
| 0-1,000----- | 1,000----- | None |
| 1,000-10,000----- | 1,000----- | 10 |
| 10,000-100,000----- | 1,000----- | 100 |
| 100,000-1,000,000----- | 1,000----- | 1000 |

| "D. C. M. A." & "VOLTS" | SCALE USED | MULTIPLY BY |
|----------------------------|---------------|----------------|
| 0-5----- | 5----- | None |
| 5-25----- | 25----- | None |
| 25-125----- | 125----- | None |
| 125-250----- | 25----- | 10 |
| 250-500----- | 5----- | 100 |
| 500-1,250----- | 125----- | 10 |

| "CAPACITY" MFDS. | SCALE USED | DIVIDE BY |
|---------------------|---------------|--------------|
| 0-0.125----- | 125----- | 1,000 |
| 0.125-1.25----- | 125----- | 100 |
| 1.25-12.5----- | 125----- | 10 |

MODEL 444 ACCESSORIES ORDER

TO

SUPREME INSTRUMENTS CORPORATION
 GREENWOOD, MISSISSIPPI
 U. S. A.

PLEASE SHIP TO.....
 STREET ADDRESS.....
 P. O. & STATE.....

| <u>QUANTITY</u> | <u>STOCK NO.</u> | <u>DESCRIPTION</u> | <u>PRICE</u> | <u>TOTAL</u> |
|-----------------|------------------|--|--------------|--------------|
| ..... | 7 | Adapter, 4/4-pin Neutralizing and A. V. C. | 0.75 | ..... |
| ..... | 16 | Adapter, 5/5-pin Neutralizing and A. V. C. | 0.75 | ..... |
| ..... | 935 | Battery, 1.5-volt, 3 required | 0.10 | ..... |
| ..... | 6288 | Chart, Analysis, per pad of 50 | 0.25 | ..... |
| ..... | 731-D | Diagram, Blue Print Circuit | 0.70 | ..... |
| ..... | 6104 | Fuse, 1.0-ampere, 1-inch | 0.09 | ..... |
| ..... | 6376 | Fuse, 1.0-amperc, 1.25-inch | 0.06 | ..... |
| TOTAL |  |  |  | ..... |

Delivery and collection costs will be paid, if not covered by the enclosed deposit, when the merchandise is accepted. It is understood that any of the items, listed above, may be returned to you if unsatisfactory; and that you will refund the amount paid for such items.

.....193..... (Signed).....

SUPREME RADIO TESTER
444

OWNER'S REGISTRATION

.....:193.....

Registration Department,
Supreme Instruments Corporation,
Greenwood, Mississippi, U. S. A.

Gentlemen:

Please register the present ownership of the Supreme Five-Unit
Radio Tester, Model 444:

Serial No.....

Purchased.....193.....

From.....

.....

.....

We will mention the serial number of this tester in all future
correspondence:

Owner's Name (Printed).....

User's Name (Printed).....

Local Address (Printed).....

P. O. & State (Printed).....

MODEL 444 TESTER

PACKING LIST

Effective November 22, 1933

Accessories included in original Model 444 5-Unit Tester Shipments.

| Quantity: | Stock : | | | :Packer's |
|-----------|----------|---|--|-----------|
| Included: | Number: | Description | | :Check |
| 1 | : 6349 | : Adapter, small 7-hole plug to 4-pin | | : |
| 1 | : 6348 | : Adapter, small 7-hole plug to 5-pin | | : |
| 1 | : 6347 | : Adapter, small 7-hole plug to 6-pin | | : |
| 1 | : 6346 | : Adapter, small 7-hole plug to large 7-pin | | : |
| 1 | : 6025 | : Cable, shielded Antenna, 50" | | : |
| 1 | : 6200 | : Chart, Tube Testing | | : |
| 1 | : 1111-B | : Connector, 50" Black test probe | | : |
| 1 | : 1111-R | : Connector, 50" Red test probe | | : |
| 1 | : 1112 | : Connector, 15" Top cap | | : |
| 2 | : 6135 | : Connector 27" pin plug | | : |
| 1 | : 6199 | : Data, Operating | | : |
| 1 | : 6288 | : Sample Analysis Chart | | : |
| 1 | : | : Accessories Order Form & Registration | | : |

The above list of items was checked by the undersigned who is responsible for the completion of this package.

..... (Signed).....
 (Serial Number(*)

*The serial number of this tester is engraved (but not waxed) in the panel and should always be mentioned in all correspondence pertaining to the tester.

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GREENWOOD, MISSISSIPPI

U. S. A.



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