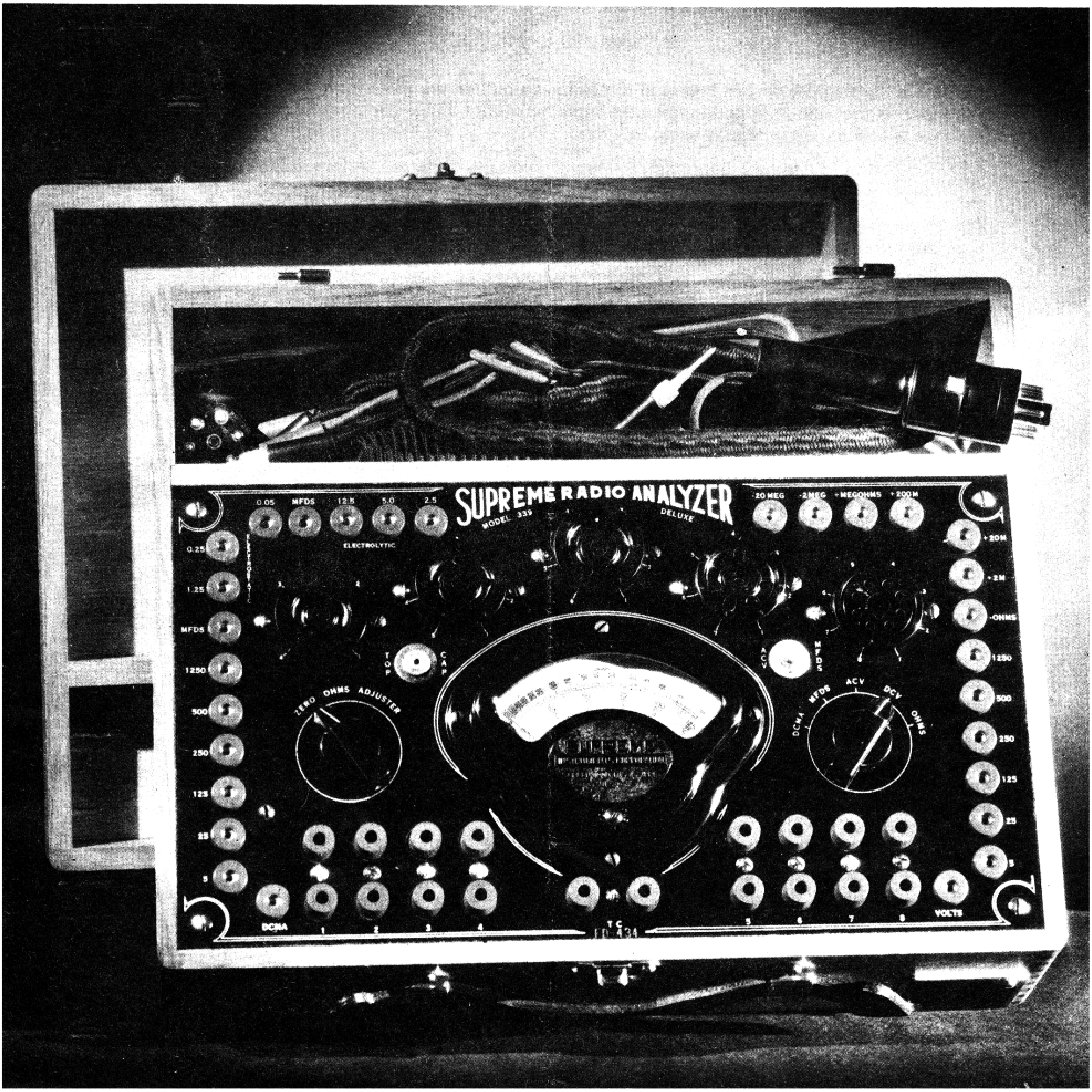
SUPREME *Presents*



The Supreme Radio Analyzer

Model 339-DeLuxe

By SAMUEL C. MILBOURNE*

IT is the purpose of this technical discussion to outline the more essential requirements of a modern radio analyzer as they are reflected in the new Supreme Model 339-D (DeLuxe) Radio Analyzer. For modern radio service practices, these requirements include:

(1) A sensitive d'Arsonval Supreme fan-shaped meter, with large, easily readable figures on 26% longer scales.

(2) A rugged 4-gang, 5-position rotary switch for selectively connecting the meter to any one of the following measuring circuits:

- (a) D.C. Milliammeter—0/5/25/125/250/500/m.a., and 0/1.25 Ampere.
- (b) D.C. Voltmeter—0/5/25/125/250/500/1250 Volts.
- (c) Ohmmeter—0/2000/20,000/200,000 ohms and 0/2/20 megohms.
- (d) A.C. Voltmeter—0/5/25/125/250/500/1250 Volts.
- (e) Capacity Meter—0/0.05/0.25/1.25/2.5/5.0/12.5 Mfds., electrostatic (paper) and electrolytic.

(3) The famous Supreme rectifier circuit for compensating the effects of variations of instrument rectifiers, and enabling the measurement of A.C. potential and capacitive values on an evenly-divided d'Arsonval scale; the circuit also includes a protective arrangement against overloads across the rectifier and meter caused by electrical surges from transformers, chokes, capacitors, etc.

(4) The exclusive Supreme Free Reference Point System of Analysis, with unusual flexibility for the accommodation of possible future developments, including new 8-pin tubes.

(5) On extension of all radio circuits to terminals on the analyzer panel for all regular tests, and for innumerable special tests, such as "grid shift" tube tests, connection of phonograph pick-ups, microphones, headphones, and other external devices.

The "straight-forward" testing procedure enabled by this tester has gained almost universal acceptance amongst the radio servicing profession, because it enables the user to actually see the connections which are being made above the tester panel, rather than leaving it to his imagination as is the case when such connections are made by the manipulation of confusing switches, which, like all mechanical devices, are likely to prove troublesome in service.

WEAK POINTS OF EARLIER ANALYZER TYPES

Up until a comparatively short time ago, radio analyzers had many objectionable characteristics, the main weaknesses being:

(1) Comparatively short service life before obsolescence, because of their not being easily adaptable to new tubes and circuits.

(2) Lack of simplicity of design and application, making their use confusing and awkward to the users.

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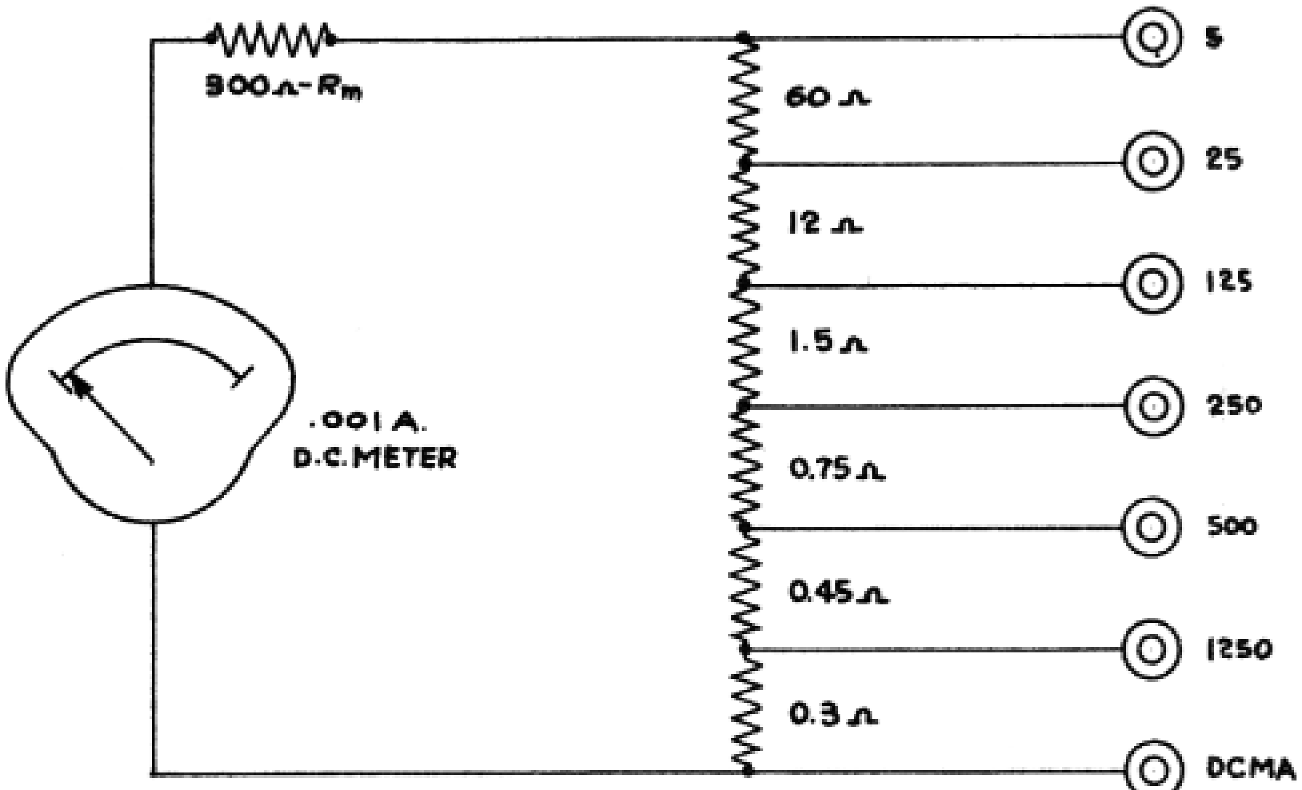


FIG. 1
D.C. M.A. CIRCUIT (SCHEMATIC)

(3) Lack of compactness and professional appearance.

These objectionable characteristics have been admirably overcome in this new "Supreme-by-Comparison" DeLuxe Analyzer which is now available at less than cost of the earlier types of analyzers.

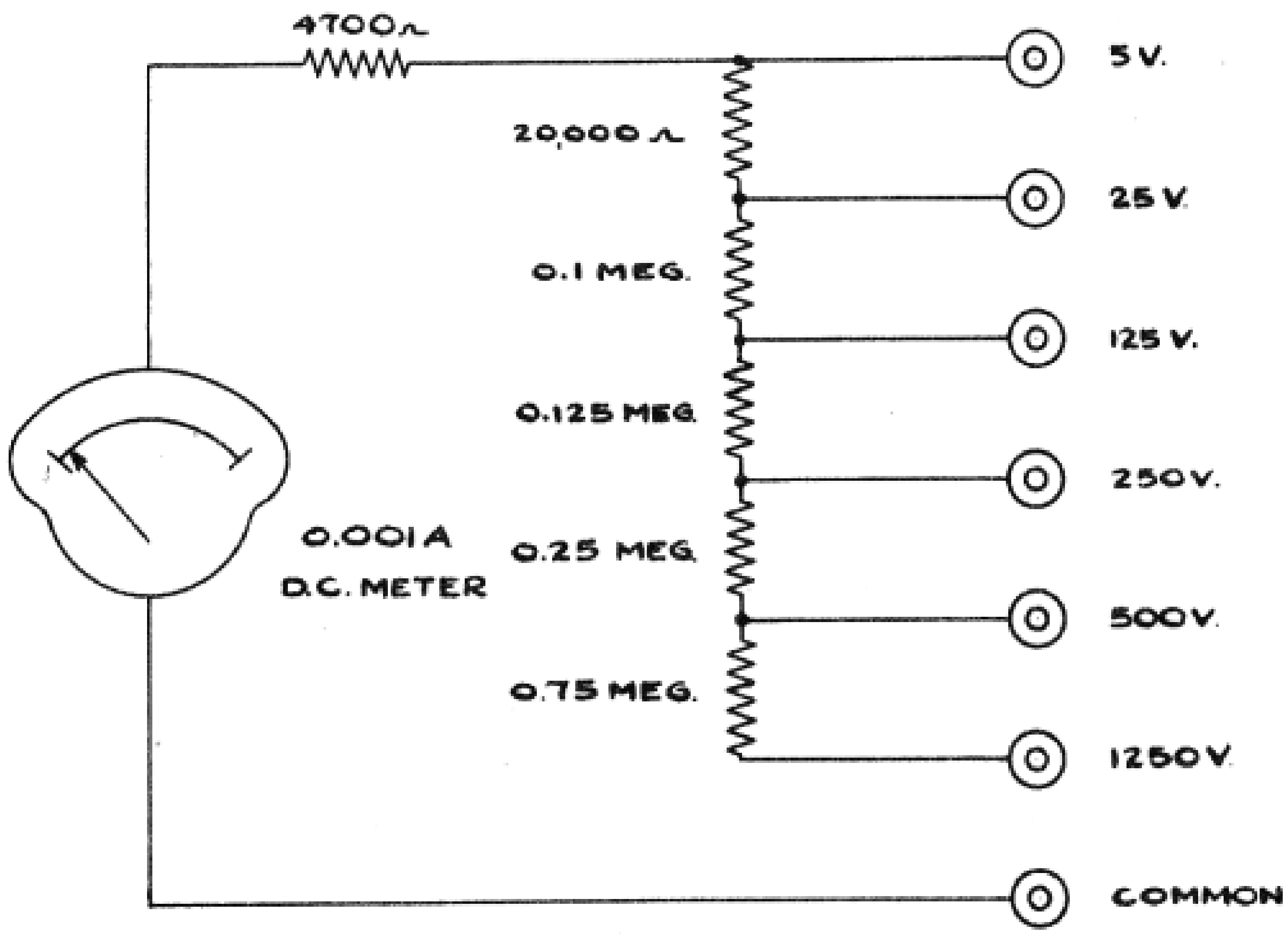
APPLICATION

The Supreme Model 339-D Analyzer may be used either for the preliminary radio testing procedure in a customer's home for estimating purposes, or for the "trouble-shooting" practices in the professional radio service engineer's laboratory to (1) find the trouble by selective and elementary tests, (2) check the replacement parts used in the course of the repairs, and (3) check the overall performance of the radio after the repairs are completed and before returning the repaired radio to the customer.

THE METER

Most electrical measuring devices are, basically, current-measuring devices, being either ammeters, milliammeters or microammeters. In form of construction, such a meter consists of a permanent horseshoe magnet between the two poles of which is suspended an armature to which is attached a pointer and a spring arrangement to hold the pointer to its zero position when no current is being passed through the armature coil. When a current is passing through the armature coil, it becomes an electro-magnet, with two poles of opposite polarity, and the re-action between the energized coil and the permanent magnet causes the coil to rotate on its axis so as to facilitate the attraction of the unlike poles and the repulsion of the like poles of the two magnets. The amount of the movement is determined by the balance attained between the resiliency of the spring mechanism and the strength of the magnetic field set up by the current flowing through the coil, and since the strength of the magnetic field set up around the coil is determined by the amount of current flowing through the coil, the movement can be calibrated in units of current; or in any other units, such as volts, microfarads, ohms, etc., which have a definite relationship to units of current. Usually, a meter which is calibrated for current measurements in terms of amperes, milliamperes, and microamperes, has a comparatively low resistance and is connected in series with the circuit in which the current is to be measured; and a potential measuring meter or voltmeter is of comparatively high resistance and is connected across the circuit across which a potential difference is to be measured.

The new, fan-shaped Supreme meter incorporated in the Model 339-D Analyzer is the first meter to be designed expressly for use in radio testing equipment. Having 26% longer scales and large, clearly readable figures, it offers better readability and more consistent accuracy. It has evenly-divided scales for all D.C. measurements and, when combined with a special impedance circuit, the same evenly-divided scales are also adaptable to all A.C. potential and capacitive measurements. The Supreme meter requires only 1.0 milliampere of current for full scale deflection, so that it has a sensitivity of 1000 ohms per volt for all D.C. potential measurements. Its accuracy tolerance is 2% of full scale values, and observational errors are reduced to a minimum by the use of a combination "spade" and "knife edge" type pointer for maximum accuracy and ruggedness. For current, potential and resistance measurements with this tester, the meter is "built up" to a resistance value of 300 ohms by means of a multiplier resistor connected in series with the meter, and all shunt and multiplier resistor values are calculated on the basis of a full scale current sensitivity of 1.0 mil-



D.C. VOLTMETER CIRCUIT (SCHEMATIC)

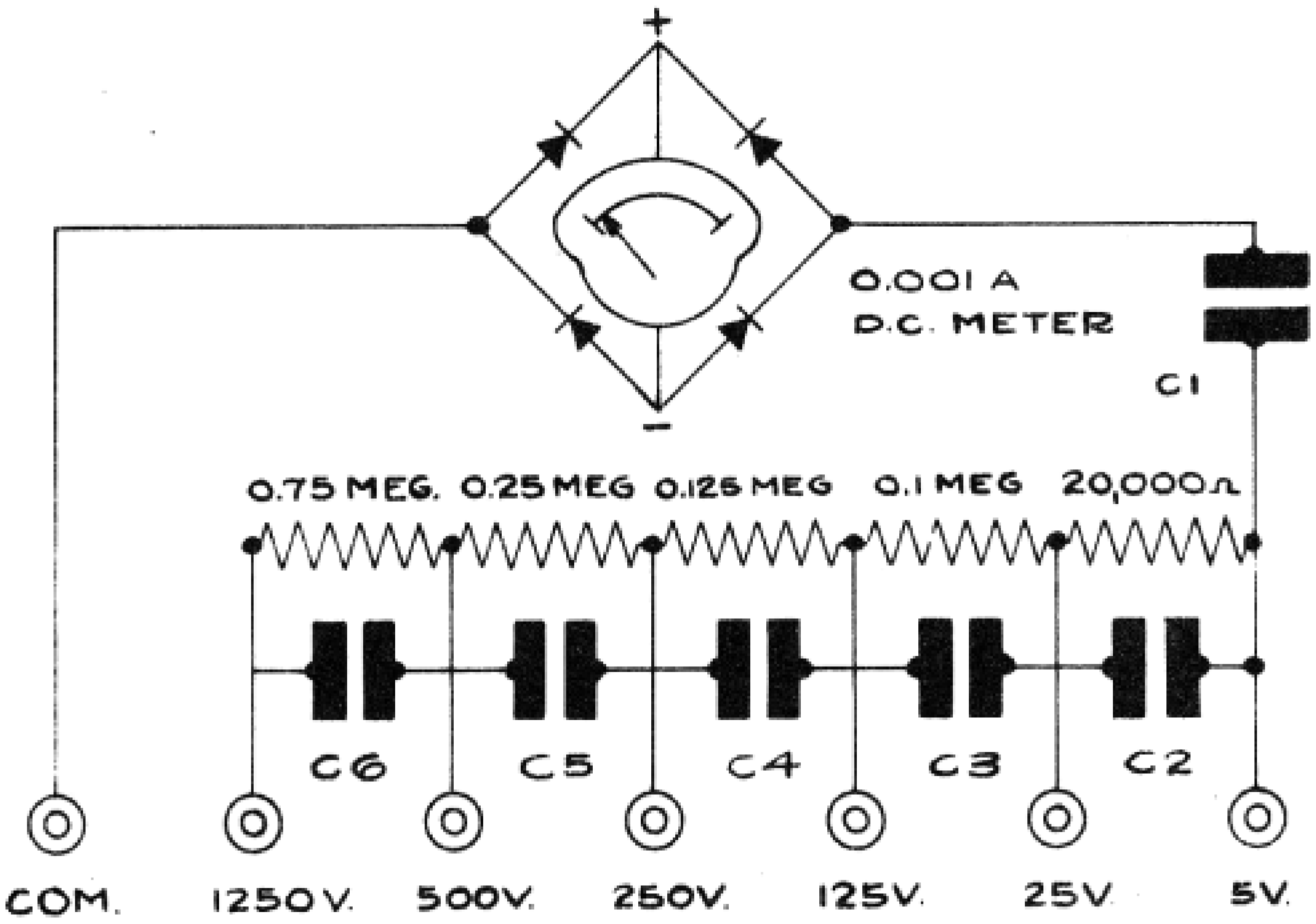
FIG. 2

liampere and a resistance value of 300 ohms for the meter. The actual armature resistance of the meter is about 115 ohms, which is more than the usual resistance value of a 1-milliampere meter; this higher resistance value is used so as to enable more turns of wire on the armature to provide a greater movement torque.

CURRENT MEASUREMENTS

The meter, when used for current measurements in terms of milliamperes, is shunted in the manner indicated in Figure 1. The total shunt value of 75-ohms is determined by the lowest current-measuring range of 5 milliamperes. The meter, with its resistance built up to a value of 300-ohms, requires a potential of 0.3 volt (300 millivolts) to cause a full scale current of 1.0 milliampere to pass through the meter. The shunt resistor for the 5-milliampere range, being in parallel with the meter, will have the same 0.3-volt potential difference. Since 1.0 milliampere of the 5-milliampere range will pass through the meter, the shunt resistor will pass the other 4.0 milliamperes and its value is determined by dividing 4.0 milliamperes (0.004 ampere) into 300 millivolts (0.3 volts). This division establishes the value of 75 ohms for the total shunt resistance value shown in Figure 1. For the current-measuring ranges above the 5.0 milliampere range, the 75-ohm shunt resistor is divided into smaller values, thereby forming what is known as a "ring type" shunt, the total "ring" resistance value being 375 ohms. The resistance values of the sections of the 75-ohm shunt resistors are determined by multiplying the total "ring" resistance by the full scale current of the meter, dividing the result by each range value, in turn, from the common terminal, and subtracting the sum of the preceding values from each newly-determined value. When the "ring" value of 375 ohms is multiplied by the full scale sensitivity value of 0.001 ampere, we have a value of 0.375 into which each range value is divided, in turn, for determining the required shunt values. For example, the shunt value for the 1.250-ampere range is determined by dividing 1.250 into 0.375, giving a value of 0.3 ohm for that range. For the 500-milliampere range, 0.500 ampere is divided into 0.375, giving a value of 0.75 ohm for the 500-milliampere range; but, since we already have a value of 0.3 ohm for the preceding range, it is necessary to subtract 0.3 ohm from 0.75 ohm, leaving a value of 0.45 ohm for the second section of the shunt.

For the 250-milliampere range, 0.250 ampere is divided into 0.375, giving a value of 1.5 ohms for the 250-milliampere range; but, since we already have a value of 0.75 ohm for the two preceding ranges, it is necessary to subtract 0.75 ohm from 1.5 ohms, leaving a value of 0.75 ohm for the third section of the shunt. The shunt sections for the other ranges are determined in a similar manner, and we can "check" the accuracy of our calculations by Ohm's Law. For example, the shunt value of 0.3 ohm for the 1.250-ampere (1250-milliampere) range is in parallel with the remaining 374.7 ohms of the "ring" circuit which, when multiplied by the meter current of 0.001 ampere, produces a potential drop of 0.3747 volt. With 0.001 ampere going through the meter, the remaining value of 1.249 amperes will be going through the 0.3 ohm shunt, producing potential drop of 0.3 times 1.249 or 0.3747 volt. Since the potential drop across both parallel paths is identical by Ohm's Law, it is concluded that the calculations are correct. The other ranges may be similarly "checked" by Ohm's Law.



A.C. VOLTMETER CIRCUIT (SCHEMATIC)

FIG. 3

D.C. POTENTIAL MEASUREMENTS

It is convenient to remember that "potentials" in electrical discussions are somewhat comparable to "pressures" in studies of hydraulics. When a milliammeter is used for measurements of electrical potentials, enough resistance must be connected in series with the milliammeter to limit the current to within the full scale sensitivity value of the meter. The required resistance is 1000 ohms per volt for a meter which has a full scale value of 1.0 milliampere. In the design of the analyzer under discussion, the value of the multiplier resistor for the 5-volt range is established by subtracting the meter resistance value of 300 ohms from the 1000-ohms-per-volt value of 5000 ohms, leaving a multiplier resistance value of 4700 ohms. For the higher ranges, the multiplier resistance values are calculated on the basis of 1000 ohms per volt. The D.C. voltmeter circuits are included in Figure 2.

RESISTANCE MEASUREMENTS

For resistance measurements, the meter is used primarily as a voltmeter, with the current passing through the meter calibrated on an "Ohms" scale instead of being calibrated on a "Volts" scale. In the multi-range ohmmeter circuits of this tester, however, shunts are used to enable the different sensitivities required for each range and, to this extent, the ohmmeter circuits resemble current-measuring circuits in which shunts are usually required. It will be observed in Figure 4 that, for the lowest or 2000-ohm range, the 33-ohm resistor is a shunt resistor, while the 297-ohm and the 2723-ohm resistors act as multipliers to the meter with its 700/4300-ohm shunting resistor made up of a fixed 700-ohm resistor and a variable 3600-ohm rheostat for accommodating battery potential variations. For the 20,000 ohm range, the 33-ohm and the 297-ohm resistors, totaling 330 ohms, act as a shunting resistor, with the 51-ohm and 2723-ohm resistors functioning as multipliers. For the 200,000-ohm range, the 33-ohm, 297-ohm and 2723-ohm resistors act as a shunting resistor, and a 3269-ohm resistor acts as a multiplier resistor.

In the course of the design of the ohmmeter functions of this tester, it was necessary to take into consideration the fact that (1) the meter requires a current value of 1.0 milliampere (0.001 ampere) for full scale deflection, (2) a small amount of current must be allowed for passage through the variable "zero adjustment" rheostat to compensate for the natural depreciation of a new battery, (3) these two current values, when added together, constitute the load for the highest resistance measuring range which can be enabled by the available battery potential which, in this case, is 4.5 volts, (4) in order that all resistance measuring ranges fall on the same "Ohms" scale, with the same set of scale divisions, the next lower range must carry ten times the current load of the highest resistance-measuring range, and (5) the lowest resistance measuring range must carry a current load which is one hundred times that of the highest range. This means that, if one-fifth milliampere should be passed through the variable meter shunt (zero adjustment rheostat) with a new battery, the total load for the highest resistance-measuring range would be 0.0012 ampere, the total load for the next lower range would be 0.012 ampere, and the total load for the lowest range would be 0.120 ampere, which is

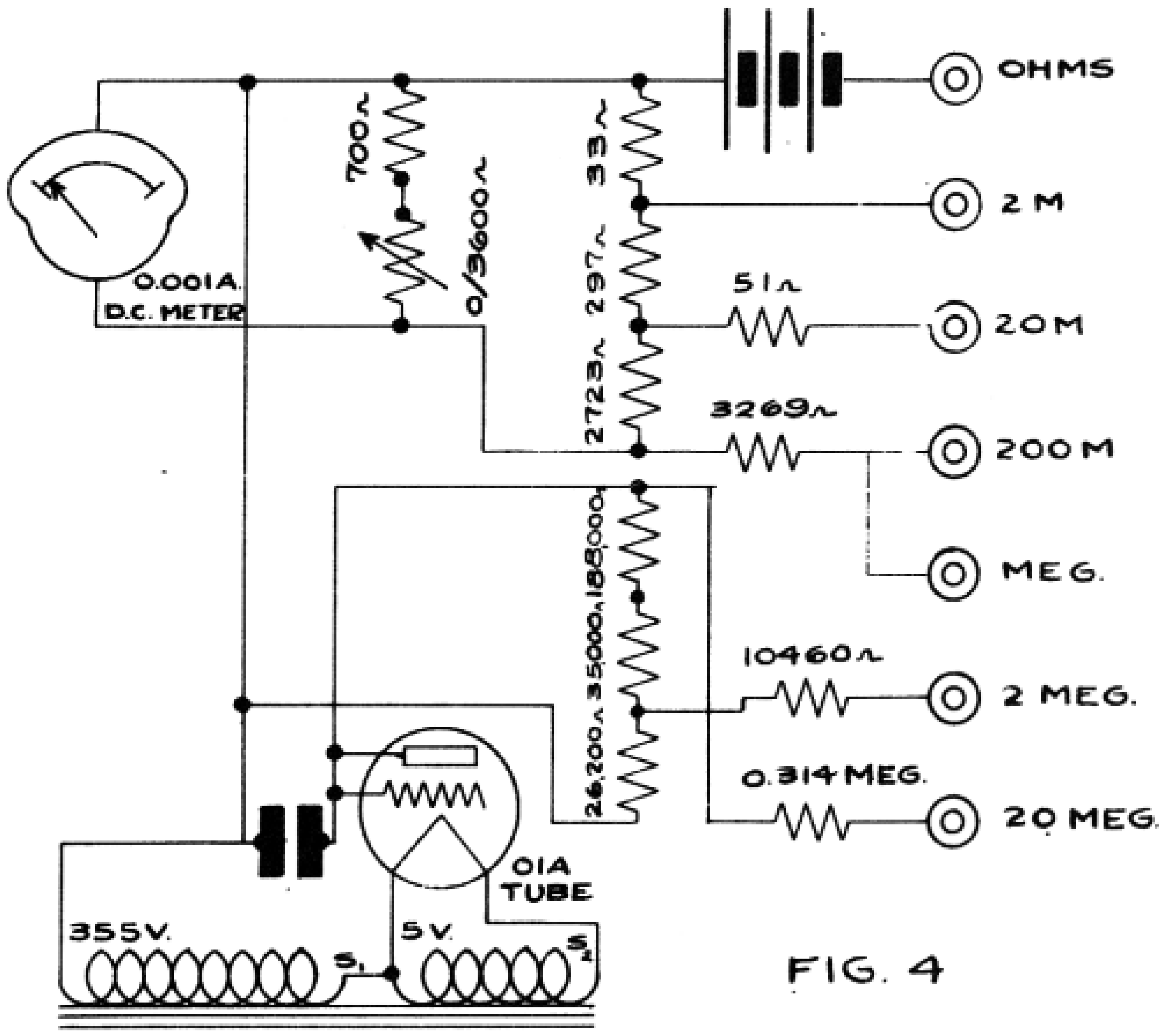


FIG. 4

about as much load as should be taken from a small flashlight battery. These facts immediately suggest that the meter, with its variable shunt, should be shunted, in turn, with a "ring" shunt divided in a manner somewhat similar to that suggested herein for the current measuring functions of the tester. However, since a fixed potential value, 4.5 volts in this case, is used for all ranges, which is not necessarily the case with the current-measuring functions of the meter in which the potential drop is not the same for all ranges, it becomes necessary to so arrange the network of the ohmmeter circuits that the effective internal resistance of each range be related to the effective internal resistance of each other range by the same ratio as that which exists between the current loads of the different ranges. In other words, if the effective internal resistance of the lowest resistance-measuring range be 35 ohms, then the effective internal resistance of the next higher range must be ten times as high, or 350 ohms, and that of the highest range enabled by the battery must be one hundred times that of the lowest range, or 3500 ohms, so that all three ranges will follow the same scale distribution. Actually, the value of 35 ohms, and the decimal multiples thereof, were found most suitable, so that the center-scale calibration of the "Ohms" range of the meter represents a value of 35 ohms, or a multiple thereof when one of the higher measuring ranges is used. This may be better understood by remembering that if a 0/120 milliammeter which has an internal resistance value of 35 ohms be shunted with a 35-ohm resistor, the meter pointer will deflect from the full-scale position to the center scale position.

Taking the values indicated in Figure 4, and assuming an average battery potential of 4.25 volts, which is half-way between the new value of 4.5 volts and a discardable value of 4.0 volts, we can determine, by different applications of Ohm's Law, that the variable shunt rheostat should be set at a position so that the used portion of the rheostat combined with the 700-ohm fixed resistance value totals 1400 ohms when the rheostat is adjusted for "zero ohms" with the lowest range terminals short-circuited. On the basis of the circuit conditions then prevailing, it may be of interest to the reader to analyze the elements involved to show that the effective internal resistance of the network is 35 ohms for the lowest measuring range, and decimal multiples thereof for the higher ranges. The joint resistance of 1400 ohms in parallel with the meter resistance value of 300 ohms is 247 ohms. This value of 247 ohms added to 2723 ohms and 297 ohms gives a total value of 3267 ohms. This value of 3267 ohms for the lowest resistance-measuring range may be considered as being in parallel with the shunt value of 33 ohms for the lowest range. The joint resistance of 3267 ohms in parallel with 33 ohms is 32.67 ohms which, when added to an internal battery resistance value of 2.33 ohms gives a total internal resistance value of 35 ohms for the lowest resistance-measuring range; that is, the 2000-ohm range. For the 20,000 ohm range, the joint resistance value of the meter and its variable shunt, 247 ohms, is added to 2723 ohms, giving a value of 2970 ohms which is in parallel with the value of 330 ohms made up of the two sections of 33 and 297 ohms. The joint resistance of 2970 and 330 ohms is 297 ohms which, when added to 51 and 2.33 ohms gives a value for the 20,000-ohm range, of 350 ohms, which is 10 times the resistance of the 2000-ohm range. For the 200,000 ohm range, the joint meter and rheostat resistance value of 247 ohms is in parallel with 3053 ohms, made up of the 33-ohm, 297-ohm and 2723-ohm sections. The joint resistance of 247 and 3053 ohms is 229 ohms. The total of 229, 3269 and 2.33 ohms is 3500 ohms for the internal resistance value of the 200,000-ohm range.

MILLI-AMPERES	OHMS
1.0	500
0.9	530
0.8	560
0.7	620
0.6	685
0.5	760
0.4	870
0.3	1030
0.2	1300
0.1	2000

FIG. 5

Reading the "Ohms" scale from left to right, the pointer deflection in percentage of full scale deflection for each division on the scale is determined by adding the value corresponding to each division to 35, and then dividing the total into 35. For example, if we want to know the deflection percentage for the 100-ohm division of the scale, we add 100 to 35 and then divide 135 into 35 to find that the 100-ohm division is 25.9% of the full scale deflection.

The resistance-measuring ranges beyond 200,000 ohms are powered from a miniature "power pack," so that the internal resistance of the tube which is used as a rectifier tube must be taken into account when determining the mutiplier resistance values required for the 2-megohm and 20-megohm ranges. Since the internal resistance value of the tube is not a constant value, but changes with varying loads, it cannot be expected that the 2-megohm and 20-megohm ranges will be as accurate as the lower ranges which are powered with the 4.5 volt battery.

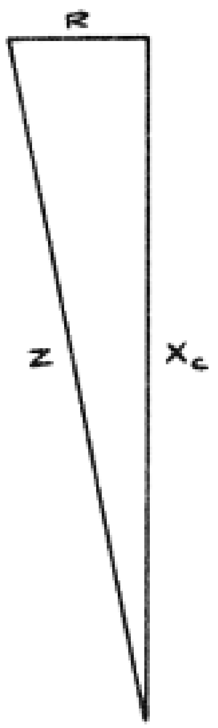
A.C. POTENTIAL MEASUREMENTS

The A.C. potential-measuring functions of this tester differ from the D.C. potential-measuring functions in that (1) the meter is connected to the output terminals of a full-wave instrument rectifier, (2) a capacitor is substituted for the 4700-ohm multiplier resistor, and the capacitor is connected in series with the rectifier input circuit, (3) each of the multiplier resistors above the 5-volt range is bypassed with a calibration capacitor. The elements involved in the A.C. potential-measuring functions are indicated in Figure 3. Before proceeding further with the discussion of the A.C. potential-measuring functions, it is probably advisable to give some thought to the non-linear characteristics of instrument rectifiers.

Alternating current values, as measured by ordinary A.C. instruments, will not be indicated as having the same values when rectified and measured with a D.C. instrument. For example, an alternating potential of 100 volts as measured with an ordinary A.C. voltmeter will, after full wave rectification, be indicated by a D.C. meter as having a value of about 90 volts. This is because the usual types of A.C. voltmeters, which are not sufficiently sensitive for many modern requirements, have the desirable characteristic of indicating **root mean square** (r.m.s.) values, whereas sensitive D.C. instruments indicate **average** values which are lower than **root mean square** values by the ratio of 1:1.11. In other words, **average** values must be multiplied by 1.11 in order to obtain correct **root mean square** values. This condition is true for sine-wave forms which are approximated in commercial practices. This characteristic suggests that some means must be provided for correcting the sensitivity of the meter between measurements of A.C. and D.C. values, so as to provide for this ratio between **root mean square** and **average** values. In the tester under discussion, the correction is effected by means of a series capacitor and parallel capacitors which have the effect of reducing the total impedance of the circuits for measuring A.C. values, so that more current is permitted to pass through the meter movement than is the case when using the tester for D.C. measurements. In this connection it may be well to state that the ratio of 1:1.11 may be modified by the electrical characteristics of the rectifier unit or of other circuit elements.

The "current density" characteristic of instrument rectifiers is another matter which must be taken into consideration in the design of a universal tester. This characteristic manifests itself in the form of an increase in the rectifier resistance with a decrease in the electrical load. This accounts for the departure from a linear scale in the usual rectifier type A.C. meter. The current density characteristic may be better understood by a tabulation of resistance values corresponding to current values, based on a typical rectifier unit which has an internal resistance value of 500 ohms, with a load of 1 milliampere, as shown in Figure 5.

The effect of the current density characteristic is reduced, however, by the usual multiplier resistors as used in A.C. voltmeters of the rectifier type. For example, a rectifier having the above tabulated resistance values, when used with a multiplier resistor for a 5-volt measuring range with a meter such as that described herein, would require a total circuit resistance of 4500 ohms, this value being obtained by dividing 5000 by the form factor of 1.11. At half-scale meter needle deflection, the total resistance of the circuit will increase



$$Z = \sqrt{R^2 + X_c^2}$$

FIG. 6

about 260 ohms, as indicated in the above mentioned table, so that the increase in the total resistance of the circuit is about 5.8%, as contrasted with an increase of about 52% if the meter were used without a multiplier for measuring a current value corresponding to half-scale deflection. The effect is still further reduced when the range of the meter is extended to higher voltage ranges as more multiplier resistance is added.

In the design of the tester under discussion, it was found advantageous to minimize the effect of the current density characteristic of the instrument rectifier by utilizing a series capacitor (C_1 Figure 3) for the low range as a multiplier reactor, instead of utilizing a multiplier resistor. This arrangement constitutes an impedance circuit wherein the potential developed across the capacitive reactance is 90 degrees out of phase with the potential developed across the meter and rectifier resistance, so that the impedance elements may be represented by a right-angled triangle in which the resistance of the circuit is represented by a short leg of the triangle and the capacitive reactance by a long leg; the resulting impedance is, of course, represented by the hypotenuse of the triangle. This condition is graphically represented in Figure 6, in which the resistance is shown as a value of 800 ohms, obtained by adding the resistance of the meter to the resistance of the rectifier unit with a full-scale deflection load of one milliampere. The capacitive reactance is shown as having a value of 3490 ohms, which is the reactance of a 0.76-mfd. capacitor. The resulting impedance is 3590 ohms, as determined by the solution of the impedance formula. These values were taken from a typically constructed analyzer so that the form factor of the rectifier unit is about 1.39 in this case, determined by dividing 5000 by 3590.

It will be observed from Figure 6 that slight variations in the length of that side of the triangle which represents the resistance will have comparatively little effect on the length of the hypotenuse, whereas the variations of the rectifier resistance would be considerable if the elements of the circuit impedance were additive; that is, capable of being represented by a straight line instead of by a triangle such as that described. It was shown above that the increase in the total resistance of a 5-volt circuit at half-scale deflection, by reason of the current density characteristic, when a 4500-ohm multiplier resistor is employed, amounted to 5.8% of the total resistance. It is now apparent that an increase of 260 ohms of the resistance leg of the triangle increases the length of the hypotenuse only 60 ohms, so that the increase in the impedance amounts to less than 1.7%. In other words, by using a capacitor as a multiplier reactor instead of using a multiplier resistor for the low-voltage A.C. range, readings are made to conform very closely to uniform scale distribution for practically all measuring requirements.

The adjustment of the 5-volt A.C. range of each Model 339-D tester is accomplished by adjusting the capacitor C_1 until the meter needle deflects to the full-scale position with an applied A.C. potential of 5 volts. This capacitor also serves to isolate the A.C. from the D.C. measuring functions of the tester, so that the meter will not register D.C. values when the switch is set for A.C. measurements, or vice versa; thereby enabling output measurements across the plate circuits of power output tubes.

After having adjusted the 5-volt range for measuring A.C. potentials, it is next necessary to consider the means employed for adjusting the higher ranges. As stated before, it is necessary to pass more current through the meter when measuring A.C. values than is required when measuring D.C. values. This is accomplished in the higher A.C. ranges by by-passing the multiplier resistors which are required for D.C. potential measurements. In view of the fact that another triangle is formed when a range somewhat higher than the basic 5-volt range is considered, it may be found that the higher range, indicated in Figure 3, as a 25-volt range, may not require a by-passing capacitor. A triangle which would represent the impedance of the 25-volt range would have a reactance leg represented by the capacity C_1 as in the first triangle, but with a resistance leg increased from 800 to 20,800 ohms. The resulting impedance, represented by the hypotenuse of the new triangle, may generally be found sufficient for the 25-volt range. However, the ranges above the 25-volt range require the use of small by-pass condensers. Their values average 0.0185 mfd. for the 125-volt and 250-volt ranges, 0.008 mfd. for the 500-volt range and 0.0025 mfd. for the 1250-volt range.

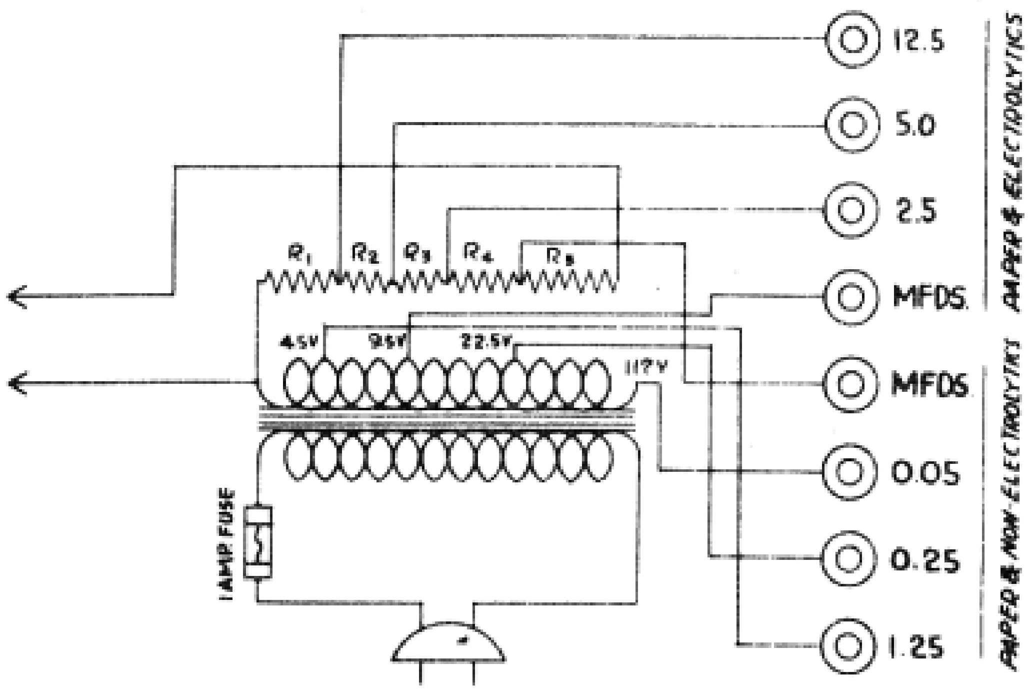


FIG. 7

The means employed for obtaining a uniform scale distribution for A.C. indications, as described above, are found to be accurate within 5% of full-scale values which is generally accepted as being sufficient for all practical A.C. measuring purposes.

A normally-closed push button switch is connected across the A.C. input terminals of the instrument rectifier, as shown in Figure 3, so as to protect it against overload electrical surges from transformers, capacitors, chokes, etc. It is expected that such surges will be dissipated through the switch before the operator has time to depress the switch button. A fuse, or other protective device cannot be used because the surges are more or less instantaneous and they can damage the rectifier before heating a fuse enough to open the circuit.

CAPACITY MEASUREMENTS

When a meter is used for capacity measurements, the resistance value of the meter and of the shunt and multiplier resistors associated with the measuring circuit constitutes one leg of an impedance triangle similar to that heretofore discussed for A.C. potential measurements. The reactance of a capacitor of unknown value, which may be connected into the measuring circuits for the purpose of determining its value, constitutes another leg of the same impedance triangle. It is obvious that the resistance value of the meter and of its associated shunt and multiplier resistors is a constant value for any particular capacity-measuring range, regardless of the capacitive value of any capacitor which may be connected to that range, and that the capacitive reactance, in every case, is determined by the capacitive value of the capacitor which may be subjected to the measurement; therefore, the capacitive leg of the triangle is the variable element. It is further obvious that the meter current is related directly to the hypotenuse of the impedance triangle and will not, therefore, have a linear relationship to capacitive values. For example, let's assume that we have an impedance triangle in which a full-scale meter current corresponds to a certain hypotenuse length and in which the reactance leg corresponds to a capacitive value of 5.0 microfarads; if we remove the 5.0-mfd. capacitor and put in its place a 2.5-mfd. capacitor, the length of the reactive leg of the triangle will be doubled, but the length of the hypotenuse will not be doubled and, therefore, the meter current will not be reduced to one-half of its former full scale value. In other words, a linear or evenly-divided scale cannot be used on the basis of fixed resistance values for the meter and its associated shunt and multiplier resistors.

From what has just been explained, it is natural to ask a question as to how capacitive measurements are enabled on an evenly divided scale in this tester. The answer lies in the fact that, although the meter, shunt and multiplier resistance values constitute a fixed resistive value for each capacity-measuring range, a variable resistive value is introduced by the full wave instrument rectifier employed, and shunts and multipliers are employed of such values as will enable the variable element of the rectifier resistance to approximately counter-balance the variable reactive element introduced by the different capacitive values which may be encountered for measurement. In other words, the divisions of a meter scale would be crowded on the upper end of the scale for capacitive measurements if the rectifier were linear in its characteristics, and the non-linear characteristics of the rectifier would cause the divisions of the meter scale to be crowded on the lower end of the scale if no capacitive variable elements are introduced into the circuit; but when both variable elements are introduced into the circuit in approximately equal and opposite proportions, the meter scale divisions can be equally separated across the whole scale or, what amounts to the same thing, the regular evenly-divided scales can be utilized for capacitive measurements.

For the measurement of electrostatic (paper) capacitive values, comparatively high A.C. potentials are used, but it is necessary to use comparatively low A.C. potential values for the measurement of electrolytic capacitive values, so as not to puncture the electrolytic film around the electrodes. Actually, the A.C. potential applied to electrolytic capacitors in the 0/1.25/2.5/12.5-mfd. ranges is about 9 volts. The capacity-measuring circuits are shown in Figure 7.

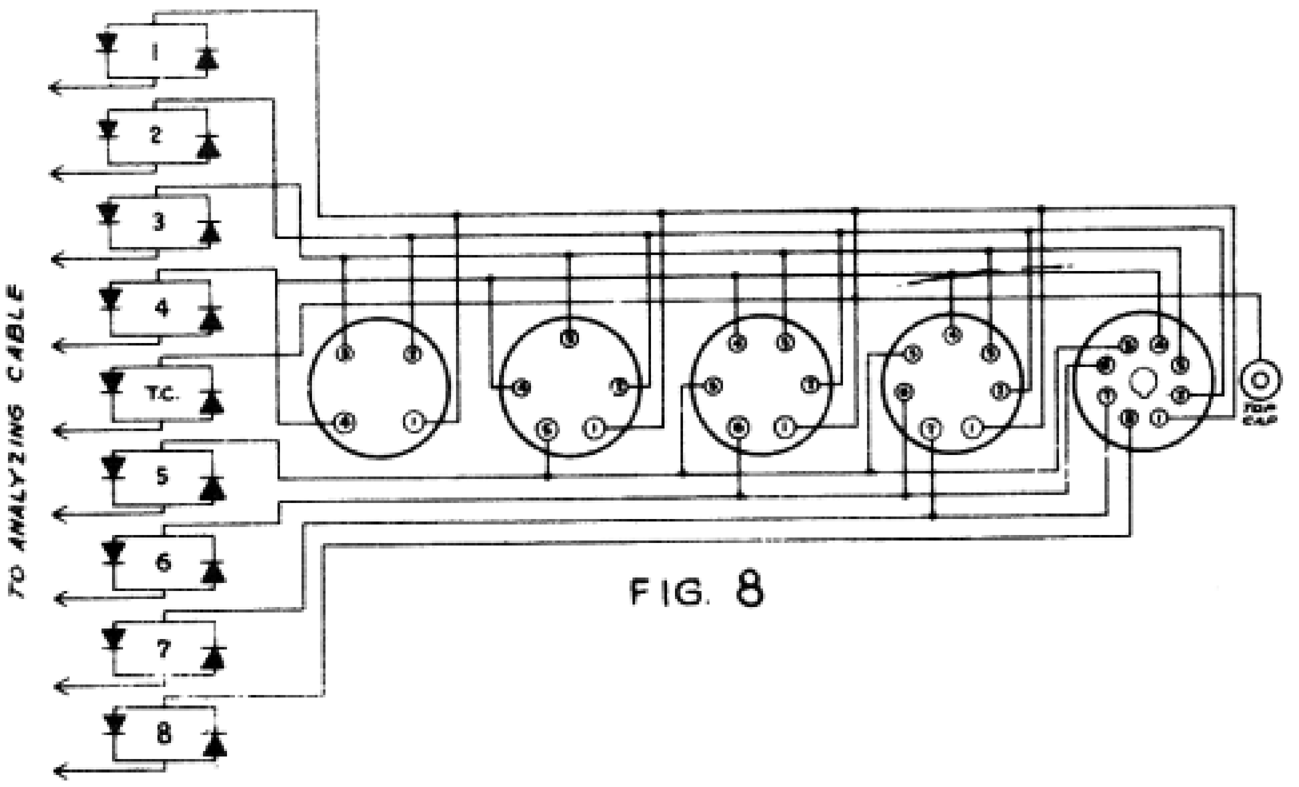


FIG. 8

THE ANALYZER CABLE CIRCUITS

As shown in Figure 8, five sockets are connected in parallel, with their terminals connected through nine circuit-breaking switches into the analyzing cable which is terminated with a "top cap" lug and an analyzing plug with seven pins and one receptacle contact for the 8th pin of an 8-pin analyzing plug adapter. The circuit-breaking switches are rather unique in their simple construction; actually, each switch includes two normally-closed contacts in parallel, so that it is necessary to open both sets of contacts in order to open the circuit into which the switch is connected. The contacts are so designed that they can be opened by the insertion of an ordinary pin plug which makes contact with the circuit, and when both contacts are opened with a pair of pin plugs, the pin plug connectors are in series with the circuit. The use of these switches enables a very flexible arrangement, as any device can be connected in series with any one of the circuits, or across any two of the circuits, by means of a simple pair of test lead connectors with pin plug terminals. These twin jack switches are numbered and lettered to correspond with the numbers and letters around the socket contacts and the "top cap" pin jack, so that the user knows exactly the circuits with which he is dealing at all times. The complete circuit diagram of the tester is shown in Figure 9.

SUMMARY

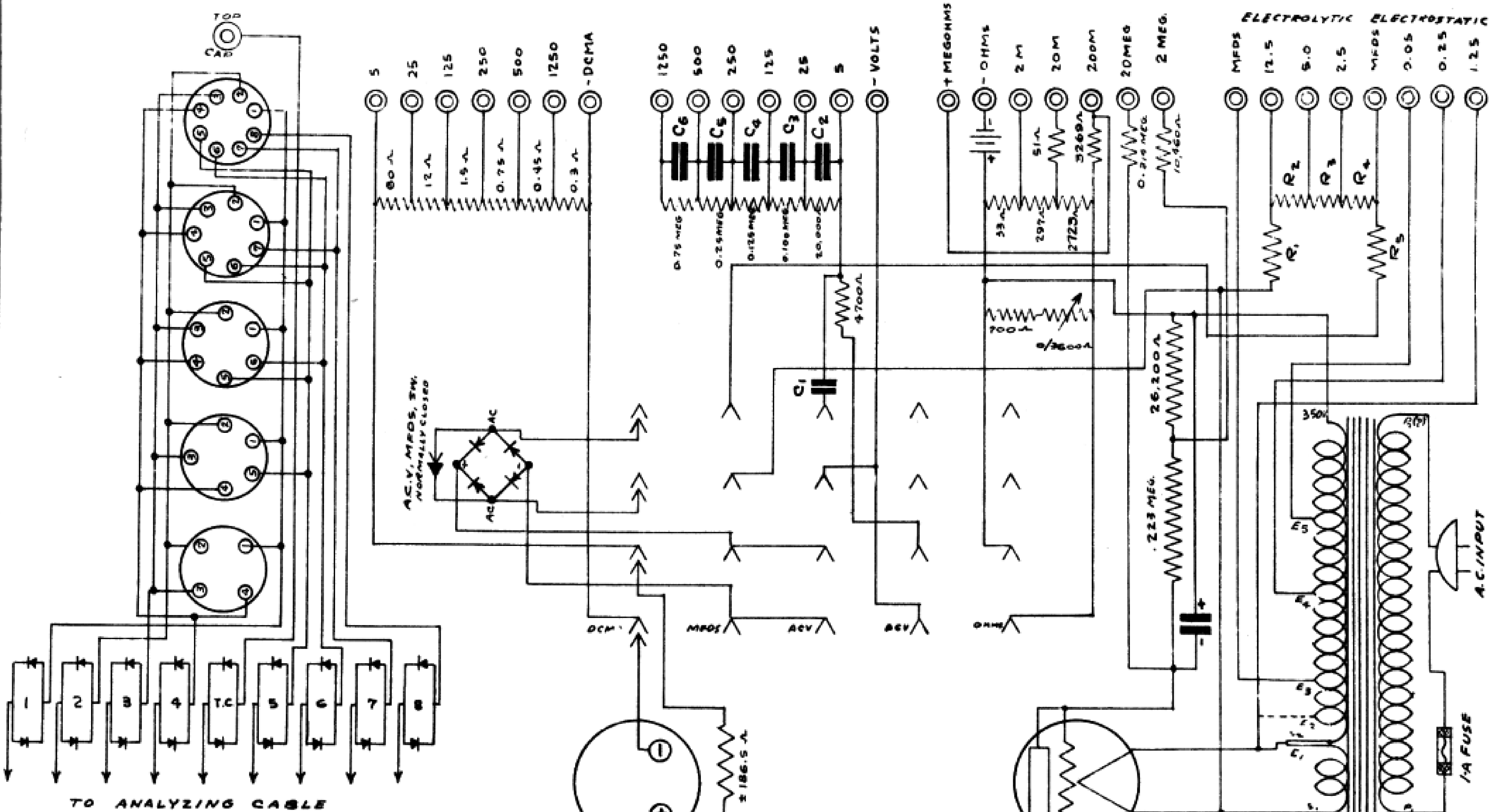
Our discussion has, so far, dealt with the electrical features of the Model 339-D Analyzer. The mechanical features and the professional appearance of the tester commend themselves to the favorable consideration of the professional radio service engineer who is alert to appreciate the outstanding features of what is believed to be the outstanding value in radio analyzers. Its neat appearance is in keeping with the quality of its design. This tester is offered for 110/120 volt, 60-cycle operation, unless a special frequency rating is otherwise ordered, at slight additional cost.

DEALER NET WHOLESALE PRICE $39.95

THE SUPREME MODEL 339-STANDARD ANALYZER

Many of the features outlined herein for the DeLuxe Model 339-D Analyzer are also applicable to the Standard Model 339-S Analyzer. The same quality of workmanship is utilized in both Models, but the Model 339-S utilizes a rotary switch for selecting the meter ranges as well as the metering functions, and has four instead of six current-measuring and potential-measuring ranges. The Model 339-S uses resistive multiplier circuits for A.C. potential measurements, instead of the reactive circuits utilized in the Model 339-D; therefore, an "off-set" scale is required for low-range A.C. potential measurements in the Model 339-S. The Model 339-S does not include the capacity measuring functions of the Model 339-D, and has two resistance measuring ranges of 0/2000/200,000 ohms instead of the five ranges of the Model 339-D. The Model 339-S is a real value for the radioman who prefers a lower priced quality tester without the DeLuxe features. It can be used with any power supply potential or frequency rating.

DEALER NET WHOLESALE PRICE $29.95



TO ANALYZING CABLE

f	CAPACITORS – MFDS						RESISTORS – OHMS					VOLTS – E				
	C_1	C_2	C_3	C_4	C_5	C_6	R_1	R_2	R_3	R_4	R_5	E_1	E_2	E_3	E_4	E_5
60~	0.73	0.077	0.0185	0.0185	0.008	0.0025	139	195	319	2069	1019	5		9.7	22.5	117.5
50~	0.9	0.067	0.0215	0.014	0.0014	0.002	122	181	280	1778	559	5		10.0	25.0	117.5
40~	1.3	0.08	0.0271	0.022	0.0103	0.003	254	363	566	3336	302	5		10.0	25.0	117.5
25~	1.85	0.14	0.04	0.035	0.0175	0.0065	456	634	899	2876	13	5	3	10.0	39.0	190.0

NOTE ON 25 CYCLE INSTRUMENTS THE LEAD FROM THE 1.25 MFD. PIN JACK IS CONNECTED TO E_2 AS SHOWN BY DOTTED LINE.

FIG. 9

MATERIAL ______ FINISH ______

UNLESS OTHERWISE SPECIFIED DECIMAL DIMENSIONS TO BE ± ______ OTHER DIMENSIONS TO BE ± ______ SCALE ______

REV	BY	MRE	DATE

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

SCHEMATIC WIRING DIAGRAM
MODEL 339 DELUXE

DRAWN	TRACED	DATE 6-13-35
F. B.	BILELLO	NO.
CHECKED	APPROVED	1002-B

MODEL 339-DeLUXE

Quick Facts

(1) 6 D.C. VOLTS RANGES

- 0-5 volts
- 0-25 volts
- 0-125 volts
- 0-250 volts
- 0-500 volts
- 0-1250 volts

(2) 6 A.C. VOLTS RANGES

- 0-5 volts
- 0-25 volts
- 0-125 volts
- 0-250 volts
- 0-500 volts
- 0-1250 volts

(3) 6 D.C. M.A. RANGES

- 0-5 M. A.
- 0-25 M. A.
- 0-125 M. A.
- 0-250 M. A.
- 0-500 M. A.
- 0-1250 M. A.

(4) 6 OUTPUT RANGES

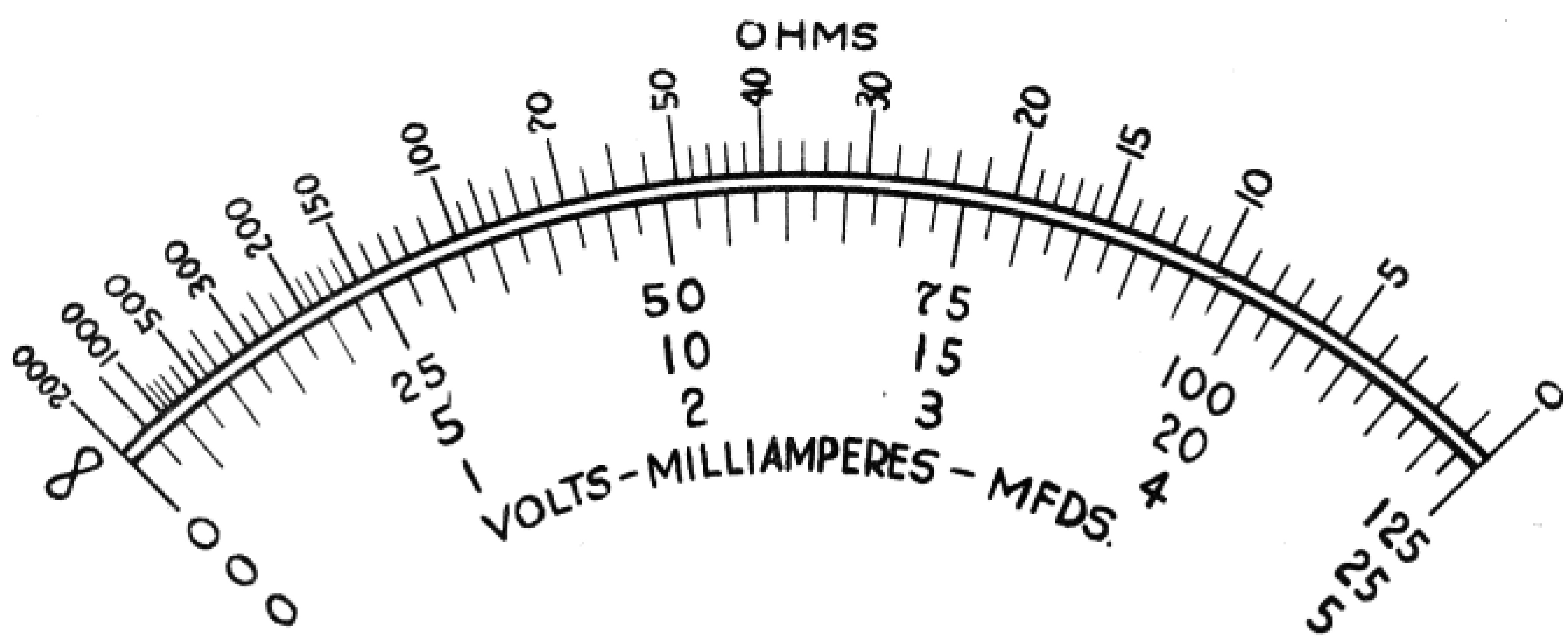
- 0-5 volts
- 0-25 volts
- 0-125 volts
- 0-250 volts
- 0-500 volts
- 0-1250 volts

(5) 6 CAPACITY RANGES

- 0.05 mfds.
- 0-0.25 mfds.
- 0-1.25 mfds.
- 0-2.5 mfds.
- 0-5.0 mfds.
- 0-12.5 mfds.

(6) 5 RESISTANCE RANGES

- 0-2,000 ohms
- 0-20,000 ohms
- 0-200,000 ohms
- 0-2,000,000 ohms (2 megohms)
- 0-20,000,000 ohms (20 megohms)



(7) Free Reference Point System of analysis.

(8) Point to Point Resistance, current and voltage analysis.

(9) All resistance ranges from SELF-CONTAINED POWER SUPPLY.

(10) Tube testing from radio sockets with self-contained "grid shift" battery.

(11) Six-range output meter for use without necessity of output adapters.

(12) A.C. and capacity measurements on uniformly-divided scales.

(13) Exclusive design 5-inch Supreme fan-type meter.

(14) Positive rectifier protection.

(15) Only 5 sockets for analyzing—no adapters—including octal tubes up to eight pins.

(16) Obsolescence probabilities reduced to a minimum.

(17) Simple to operate—workmanlike appearance—reasonable in price.

Supreme Instruments Corporation

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