The GENERAL RADIO EXPERIMENTER

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ELECTRICAL COMMUNICATIONS TECHNIQUE AND ITS APPLICATIONS IN ALLIED FIELDS

WHAT'S NEW IN RADIO

IN previous years, the main interest at the Trade Show of the Radio Manufacturers' Association has centered in technical developments of various sorts which have traced the development of radio receivers. In these shows the number and types of tube, the type of loudspeaker, and similar features have attracted great interest. Whole years have been identified by such developments as power tubes, alternating-current tubes, screen-grid tubes, and dynamic speakers. The prevailing emphasis at this year's show seemed to be price rather than any technical development. The price range is wide, with many receivers available at $40.00 to $60.00, complete with tubes. One receiver was shown at approximately $10.00.

As might be expected, no marked performance improvements occur in these sets as compared with the higher priced sets current in previous years. The sensitivity of the characteristic receiver this season is in the neighborhood of 30 to 50 microvolts—materially less than that of previous seasons. Considerable sacrifice of fidelity has undoubtedly been made in a number of cases. Selectivity seems to be reasonably well maintained. Whether or not radio presents better values than previously is a difficult question to answer, since we are dealing with intangibles. The user must answer for himself the value in dollars of an increase in the effective reproducing range of a receiver.

A number of interesting technical developments appear in this year's receiver and contribute materially to the price levels, although it would seem that little advantage has been taken of the possibilities of these developments in improving performance as distinguished from performance at a price. The superheterodyne circuit is almost universally used. The emergence of this circuit is, of course, not due primarily to a technical development, but to the release of the patents which have been available to RCA licensees only since last August. The outstanding advantage of the superheterodyne receiver is improve-

ment in selectivity and, in particular, a gain in uniformity of selectivity over the tuning range of the receiver. The commercial models of receivers having this circuit do not seem to be any more sensitive than those of previous years using the tuned radio-frequency circuit.

Another development which is incorporated in a number of receivers is the so-called variable mu tube. This is a recently developed vacuum tube in which the amplification factor is a function of the signal voltage impressed on the tube, the amplification factor decreasing as the signal voltage is increased. The effect of this tube is to limit increases in volume and to decrease crosstalk and distortion in the radio-frequency stages of the receiver.

Another technical development is the pentode or five-element power tube. This tube greatly increases the power-handling capacities of a stage of amplification using a single tube and greatly reduces the cost of the audio amplifier for a given output. An increase in phonographic attachments and accessories is noticeable. A large variety of automatic record changers of various types were on display. Home "talkie" equipment was shown by a number of manufacturers.

The public interest in television is obviously intense. Developments along this line continue to progress slowly. Demonstrations of two types which are in operation in connection with regular broadcasts were given. The principal advance has been the increase in area of the receiving screen and also the increase of the receiving field to the point where full length figures may be reproduced. When one ponders on the probable type of television program of the future in the light of present audible broadcast programs, one wonders if the vast amount of time and effort being put into the development of television could not be directed in a more useful and productive channel.

CHARLES T. BURKE

The author of these comments on the R. M. A. Trade Show is a veteran attendant at radio shows. He is an engineer with the General Radio Company

BEST SELLERS

NINETEEN HUNDRED AND TWENTY-FOUR and its desperate efforts to keep up the weekly production of condensers seems long ago. The growth of radio from hobby to industry is well illustrated as it is reflected in the following illustrations of a small condenser and a standard-signal generator. In 1924 the General Radio Company was selling condensers and transformers by the hundred thousands while preaching constantly the

"... the rheostat-potentiometer group...." Left to right are arranged the TYPE 371, TYPE 214, TYPE 410, and TYPE 301 Rheostats and Potentiometers

gospel of better laboratory methods to the few receiver manufacturers of that day. Most of the laboratory equipment, however, was sold to governments. One of the largest orders for laboratory equipment that year came from Japan, to replace apparatus destroyed in the great Tokyo earthquake. A business in laboratory equipment that was already large in '24 has grown with changes in the industry until now it forms the company's main objective. Many radio companies have come and gone in those seven years, but it is interesting to note that our largest accounts in the instrument field at that time are still the large accounts in 1931.

As radio came out of the kitchen and great manufacturing companies were organized to develop it, great sums were spent on developing the art and in perfecting manufacture. Gradually the emphasis shifted until this year our best seller, instead of a small condenser costing $5.00, is a complicated piece of laboratory equipment costing $600.00. Much radio history is summed up in that transformation. Need we add that the comparison is made not in units but in dollars.

Changed hardly less than our product is the plant and organization. Interesting years — years of change and growth usually are. Midnights when trucks stood in the driveway while equipment passed from work bench to test laboratory (and sometimes, alas, to work bench again) to shipping room and to waiting truck—to be in operation in the morning three hundred miles away.

Curiously enough some parts are selling better than ever before, mostly to manufacturers who use them in assembling laboratory and testing equipment. Thus the combined total

"The TYPE 371 Potentiometers ... were sold in some curious forms including tapered and compensated windings"

"The old TYPE 247 Condenser has fallen far from the days of its glory"

"In every race there has to be a finalist. . . ." The TYPE 309 Socket Cushion

of the rheostat-potentiometer group actually tops the signal generator. It also exceeds the precision resistor group. The TYPE 214 Rheostat was the best seller of the group, being largely used as current controls. The TYPE 371 Potentiometers ran a very close second. They were sold in some curious forms including tapered and compensated windings. This instrument is used very extensively for volume controls.

Far ahead in number of units, though only tenth in dollars sales, was the plug and jack group. It must be confessed that one of our rare lapses into commercialism was partly responsible for this. In recent years we have been equipping most of our apparatus with terminals to fit the TYPE 274 Plugs. The attention of purchasers is thereby forcibly attracted to the convenience of the plug connectors and the habit is soon formed irrevocably. The plugs have found all sorts of uses both in our own laboratories and in others. They have been also adapted on some of our standard equipment, and are sold in a number of convenient combinations. The ingenuity of the user suggests new combinations constantly.

The old TYPE 247 Condenser has fallen far from the days of its glory. A 1924 week's production would last five years now. While the condenser group was fifth, the TYPE 247 Condenser was topped by several types of laboratory condensers.

In every race there has to be a finalist — evidently the 1931 tube does not require much cushioning.

AIRPLANE BEACONS ▲ ▲ ▲ Because of the severe service conditions under which airplane beacon receivers must operate, and because of the seriousness of a failure in service, several transport companies are subjecting their equipment to rigorous inspection tests at regular intervals. Sensitivity is the most important point to be stressed, since most of the difficulties caused by aging tubes, condensers, and resistors show up in this measurement. The new TYPE 601-A Standard-Signal Generator was designed for this service.

THE CALIBRATED VOLTAGE DIVIDER

ONE of the most annoying jobs encountered in a small laboratory is that of obtaining accurate static characteristics of vacuum tubes. Usually it consists of varying a grid bias—by a tapped battery, for instance—observing the value of this bias on a voltmeter, and then measuring the plate current. By the time the grid voltmeter has been read, and the voltage adjusted to even values so as to make curve plotting easy, the vacuum tube may have aged somewhat and its characteristics changed. Where precise and rapid measurements are required, some simple means of obtaining the desired grid voltage in decimal steps is required.

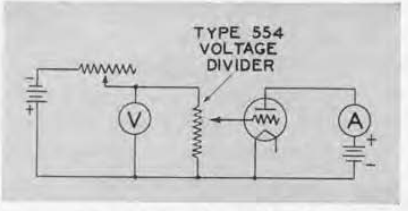

FIGURE 1. Circuit for taking grid voltage, plate-current characteristics of a vacuum tube. A calibrated voltage divider facilitates many measurements of which this is a simple example

The need for a voltage source adjustable in decimal steps is by no means confined to the problem just mentioned. In fact this one problem is typical of a host of others that frequently arise, and enough of them occur in routine laboratory measurements to justify our designing a suitable instrument.

This instrument is the General Radio TYPE 554 Voltage Divider. It is a calibrated potentiometer in which the use of tapped precision resistors permits obtaining any decimal voltage ratio between 0.001 and 1.000 from a source of either alternating or direct current. It is the practical equivalent of the expedient adopted by many laboratory workers when they use two decade resistance boxes connected in series. To make adjustments in this case, the total resistance is maintained constant by removing from one box the same value of resistance added to the other. This method is obviously entirely feasible,

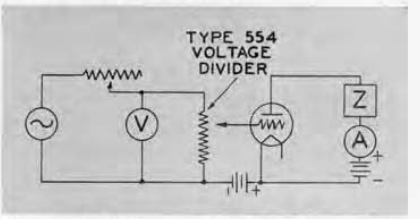

FIGURE 2. Many quantitative studies of detector behavior may be worked out in low-frequency "model" circuits. This diagram shows how plots of plate current, as a function of carrier voltage, are obtained

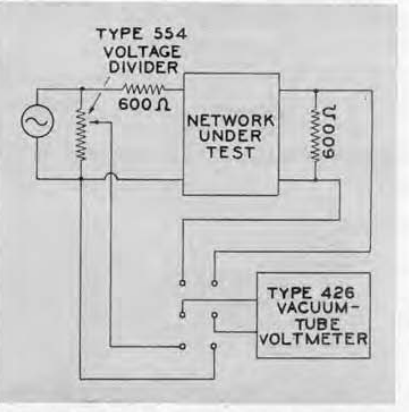

FIGURE 3. Circuit for measuring the loss in a network having terminal impedances of 600 ohms. The voltage divider, in this set-up, indicates directly the voltage ratio when the voltmeter reads the same for both positions of the switch

but it has the disadvantages of being clumsy to manipulate and of requiring vigilance to make sure that the sum of the two resistances remains constant.

Four typical uses for the voltage divider are shown in the accompanying diagrams. Figure 1 represents the taking of vacuum-tube characteristics. Figure 2 shows how the behavior of a detector tube may be investigated by the use of a low-frequency carrier. In the model circuit, Z has the same value (magnitude and phase angle) at the low frequency as the load circuit would have at the true carrier frequency. Inter-electrode capacitances in the tube are neglected, but even these may be simulated by suitably placed condensers of the proper value.

A way of measuring the insertion loss of a network is shown in Figure 3. This gives the loss directly as a voltage ratio which may be converted into decibels if desired. If the voltage divider be placed in the vacuum-tube voltmeter circuit, the arrangement becomes suitable for measuring voltage gain.

Figure 4 shows the usefulness of a decade voltage divider in experiments on

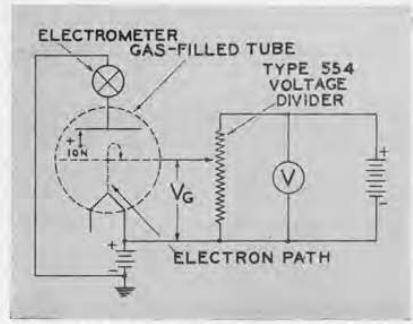

FIGURE 4. A schematic representation of a typical ionization potential measurement. The ionization potential for the gas in question is the value of V_g, which is just sufficient to produce ionization as shown by deflection of the electrometer

gaseous conduction. In the example it is desired to find the value of potential V_g through which electrons emitted from the cathode must fall to ionize the gas inside the tube. When ionization occurs, the positive ions are attracted to the negative "plate" and current flows in the electrometer circuit.

These are only a few of the possibilities of the TYPE 554 Voltage Divider, but they are enough to demonstrate the fact that it is a handy laboratory accessory.

JOHN D. CRAWFORD

The author of these notes on the decade voltage divider is an engineer with the General Radio Company and the editor of the EXPERIMENTER

BRIDGE WORK ▲ ▲ ▲ Preliminary experimental work here in the General Radio Company's laboratories indicates that the combination of a stable amplifier (like the TYPE 514-A Amplifier), with an output meter, compares favorably with the vibration galvanometer as a null detector in bridge measurements. The amplifier-meter combination has, moreover, certain advantages in price and in freedom from tuning difficulties.

JUDGING METERS ▲ ▲ ▲ Output meters and other meters having multipliers should be so designed that they have a practically constant percentage accuracy. This can be evaluated when judging the suitability of such a multirange meter by plotting the full-scale values for the different multiplier settings on logarithmic paper. The points obtained should be approximately equally spaced. The new General Radio TYPE 483 Output Meters closely approximate this ideal.

SIMPLE TUBE TEST ▲ ▲ ▲ A tube manufacturer has suggested a new use for the General Radio TYPE 404 Test-Signal Generator. Arguing that the only interesting fact about a tube is whether it will or will not function normally in a set, the suggestion is made — why not try it in a set? Of course such a test is not conclusive if the tube is just stuck in the set and the set tuned to a broadcast station and a listening test applied. If, however, the receiver checked for input required to give normal output, the tube performance is very accurately checked, and noise may be observed at the same time. The tube may be checked in its normal position in the receiver, and the receiver takes care of the supply of proper voltages.

We suggest the use of a TYPE 404 Test-Signal Generator and TYPE 486 Output Meter (equipment which we trust is available in every well equipped service laboratory). The input is adjusted and output measured for each tube, and defective tubes are shown up, or good tubes vindicated in a manner certainly more convincing to the customer than any tube tester provides.

THE GENERAL RADIO COMPANY mails the Experimenter, without charge, each month to engineers, scientists, and others interested in communication-frequency measurement and control problems. Please send requests for subscriptions and address-change notices to the

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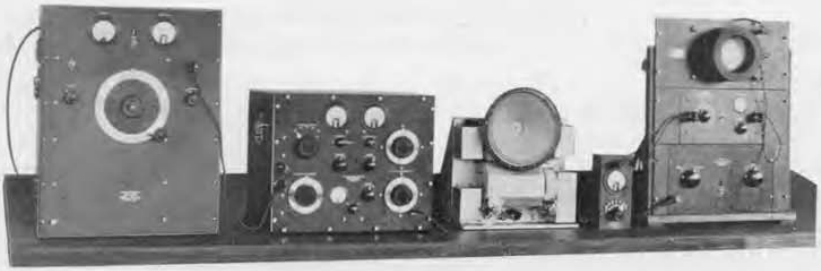

Testing a chassis for fidelity with a Type 600-A Standard-Signal Generator. In this photograph we see from left to right the Type 513-B Beat-Frequency Oscillator, the Type 600-A Standard-Signal Generator, the chassis under test, the Type 483 Output Meter and the General Radio Cathode-Ray Oscillograph

PRECISION AND SPEED

with the New Standard-Signal Generator

A complete set of standard sensitivity, band width, selectivity and fidelity characteristics can be taken with this new instrument in less than half the time and with greater precision than with any other. Here are a few of the features which make possible this outstanding performance:

ECONOMY
a vital factor

Intelligent economy is the solution for the problem which harasses every chief engineer in the radio industry today—*how to get greater results with reduced appropriations.*

Midget sets selling for $50 leave little margin for research, design and test, yet competition is keener and tolerances are pared closer to the bone than ever before. More, not less, engineering is the answer in radio, just as it was in the early days of the automotive industry.

This means the use of up-to-date laboratory apparatus incorporating the economy factor—*speed of operation*, as well as the old stand-bys, *precision* and *ruggedness.*

Output Voltage: Controlled solely by an attenuator with 260 discrete steps to cover the range between 0.1 and 316,000 microvolts (an attenuation ratio of 3 million to one). Accuracy 0.5% between adjacent steps.

Leakage: Any two points on the panel (including meters, terminals, etc.) are equipotential to less than one microvolt. Magnetic field entirely negligible even when testing 0.1 microvolt receivers.

Modulation: Any value between 0 and 100% linear amplitude modulation is obtainable. Frequency modulation and fly wheel effect are negligible. Percentage modulation indicated by a direct-reading meter whose operation is independent of the plate battery voltage.

Selectivity: A ±50-kc. control, calibrated at intervals of 1 kc., facilitates taking selectivity and band width characteristics at the standard test frequencies: 600, 1000 and 1400 kc.

The price of the Type 600-A Standard-Signal Generator is $885.00

We will gladly send you a copy of catalog supplement F-306 which describes this outstanding signal generator in detail

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