The GENERAL RADIO EXPERIMENTER

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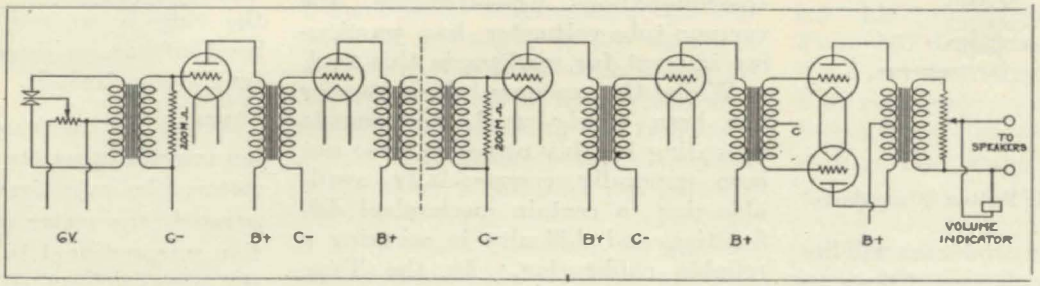
Notes on Group Address Systems

By C. T. BURKE, Engineering Department

With the approach of the political season, and modern methods of broadcasting messages, both locally and nationally, being used on a more extensive scale than ever before, interest in the mechanics (or, better perhaps the electrics), of the system by which it is accomplished is naturally aroused.

The group address system, by which a speaker's voice is made audible to groups ranging from a few hundred in local town halls to perhaps half a million in the open air, is essentially an overgrown audio amplifier. There are numerous modifications made necessary by the conditions under which the group address system is used, but the essential circuit is that of a multi-stage audio-amplifier, ending in a power stage.

The input to the address system is fed by a microphone, instead of a detector tube. This requires a modification in this portion of the circuit to the extent that a special type of transformer must be used to adapt the low impedance of the microphone to the high impedance grid circuit of the first amplifier tube. Both single and double button microphones may be used, requiring a different type of transformer for each. Connections for both types are shown on the next page.



A Typical Group Address System with Telephone Line Between Microphone and Power Amplifier

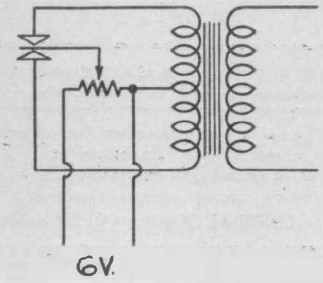
Between the microphone input circuit and the power amplifier there is interposed an audio amplifier of more or less standard design. The design of the audio amplifier system is closely tied up with a number of other factors. These include the type of microphone installation, i. e., whether the microphone is placed at a considerable distance from the source of sound, or whether the speaker is talking directly into it. Different types of microphones also require varying amounts of amplification.

Another factor frequently occurring in the group address system is distance between the pick-up and the place where the audience is located. This space may be covered either by wire line or by radio, and very often by a combination of the two. Where radio is the connecting link, the broadcast station's usual amplifier and modulation equipment are employed, and the received signal delivered from a radio receiver to a suitable power amplifier. When a telephone line is used, the practice is to split the amplifier into two sections, an input amplifier located at the speaker's end of the line, and a voltage amplifier feeding a power amplifier located near the reproducers. If the telephone line is used to cover long distances, there will be additional amplifiers at intervals along the line. These are the regular long-line telephone equipment.

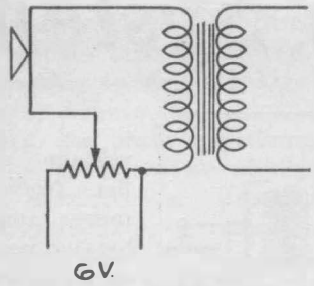
The design of the input amplifier following the microphone, will depend both on the strength of the signal impressed by the microphone upon the primary of the first transformer, and on the length of line to the next amplifier. As a general rule two stages are used. Since the telephone line presents a low impedance (about 500 ohms) it cannot be connected directly in the plate circuit of the second amplifier tube. An impedance adjusting transformer is inserted at this point. Another transformer is required at the junction between the telephone line and the power amplifier.

One or two stages of voltage amplification followed by a power stage are used at the reproducers. The amplification employed here is determined by the signal voltage required to operate the power tubes, which is, generally speaking, a function of the size of the audience which is to be reached. The voltage amplifier follows conventional lines, and the power stage is usually in the form of a push-pull amplifier, this

type of circuit possessing the ability to produce large power without overload. A volume control and volume indicator are generally connected across the feeder running to the reproducers.



Connections for Double Button Microphone



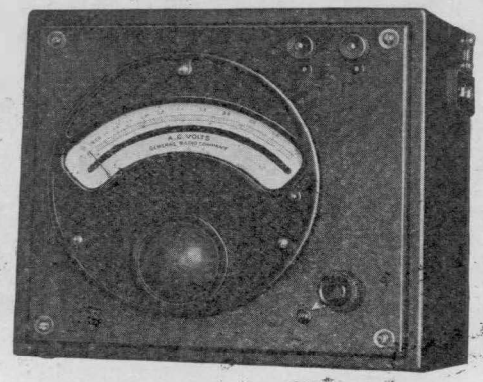
Connections for Single Button Microphone

The placing of reproducers will depend on the particular conditions to be met. In out-door installations, a group of reproducers is generally placed in the center of the audience, so focused as to throw sound equally in all directions. In auditoriums, the acoustics of the building must be taken into account. This often requires placing reproducers in several locations. Some times it is desirable to use a local power amplifier with each reproducer, rather than to feed all from the central amplifier.

The diagram on page 1 illustrates such a system as has been outlined, where a telephone line is used. This system is subject to many modifications as mentioned. If no telephone line is used, the microphone and power amplifiers are merged, and of course fewer stages are used. The type of tubes used in the various stages will depend on the requirements of the installation.

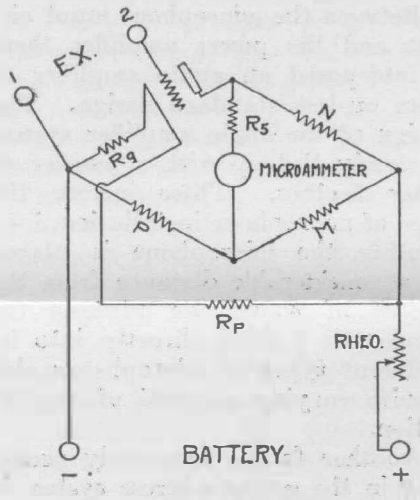
The power supply is generally from lighting circuits, with perhaps storage battery filament power. Mobile installations mounted on trucks generally use a motor generator for plate supply.

Type 426-A Thermionic Voltmeter



Vacuum-tube-voltmeters in various forms have been extensively used where an instrument of high input impedance is essential. Since this requirement is true of practically all communications measurements, the vacuum-tube-voltmeter has particular interest for workers in this field.

While the vacuum-tube-voltmeter has been widely used, instruments operating on this principle have not been generally commercially available due to certain mechanical difficulties, and difficulty in securing a reliable calibration. In the Type 426-A Thermionic Voltmeter, these



difficulties have been overcome to the extent that the instrument is entirely self-contained, and possesses a calibration which is good for 1000 hours use of the instrument. The single battery required is contained in a compartment within the instrument case. The only zero adjustment necessary is made with a rheostat mounted in the case. The single rheostat adjustment controls the filament current, grid bias and plate voltage simultaneously and is made by setting the meter pointer to zero. The instrument is then direct-reading. The voltmeter terminals must be closed through a direct-current path such as a measuring coil or a grid leak when this setting is made.

The vacuum tube is connected in the bridge circuit shown above, the plate-filament resistance forming one arm of the bridge. A voltage impressed between grid and filament changes the plate-filament resistance and unbalances the bridge, causing current to flow through the microammeter, which is calibrated. A single battery of 22.5 volts supplies the tube and the bridge voltages. Suitable resistors divide the total voltage to provide for filament and bias voltages. All the resistances except the rheostat are permanently adjusted at the time the meter is calibrated. The resistances are so related that the tube is worked near the lower bend of the grid-voltage plate-current characteristic.

When an alternating voltage is impressed across the terminals of the meter, the negative loops are suppressed, the meter giving an indication proportional to a value between the average and effective values of the wave. The calibration is made against root-mean-square values of a sinusoidal wave. Under usual conditions the calibration will be maintained to within 0.5% up to about 1000 hours, at which time the instrument should be returned to the factory for a new tube and recalibration. The wave-form error is slight. A 20% third harmonic in the wave produces an error of but 0.4% in the meter reading. The meter is extremely resistant to over-voltage. 50 volts may be momentarily impressed on the 3-volt meter without damage.

The voltage calibration is reliable over the entire audio-frequency range. The frequency error is less than 2% of full scale at 20 kilocycles and less than 3% at 300 kilocycles. The calibration is not reliable at broadcast and higher radio frequencies although the meter is useful at such frequencies as a resonance indicator or for voltage comparisons.

The price of the Type 426-A Thermionic Voltmeter (Range 0-3 volts) is $160.00.

Station Frequency Meter Type 532

Modern requirements for frequency stability of transmitters have forced constant improvements in means of reading station frequency. For extremely precise work, the piezo-electric oscillator has become established as the most satisfactory instrument. While the piezo-electric oscillator is extremely valuable as a primary standard, it has certain disadvantages as an operating standard. Most prominent among these is the fact that the actual frequency at which the transmitter is operating is not indicated when it is off its proper frequency. Ordinary types of wavemeters, on the other hand, do not permit sufficiently close readings for many modern requirements.

Where a transmitter, such as a broadcasting station, is operating on a fixed frequency, or over a narrow band of frequencies, a special type of meter may be used which possesses a high degree of accuracy over a narrow scale.

The Type 532 Station Frequency Meter consists of the usual resonance-circuit type of wavemeter with some additional features. A large fixed condenser is shunted across the variable, so that the entire scale of the meter covers only 0.3% of the station frequency, with the station frequency in the center. There are ten scale divisions per kilocycle. In addition to the spread scale, another feature contributes to the accuracy of setting of the Type 532 Station Frequency Meter. A small auxiliary condenser may be connected across the main condenser by depressing a push button. The capacity of this condenser is sufficient to shift the resonant frequency of the meter from one side of the transmitter peak to the other. The frequency meter is adjusted until the galvanometer reading is unchanged when the button is depressed. This method of locating the center or peak of the resonance curve is much more accurate than attempting to set to the top of the curve by observing maximum galvanometer deflection.

The Type 532 Station Frequency Meter supplements rather than displaces the piezo-electric oscillator. While the frequency meter permits a setting of the transmitter to within the Federal requirements, the stability of the meter is not as great as that of the piezo-electric oscillator, which should be maintained as a standard for checking the frequency meter. The piezo-electric oscillator, on the other hand, does not indicate how far off frequency the transmitter is, or in which direction, as the frequency meter does.

A certificate of accuracy is furnished guaranteeing the accuracy of the scale division representing the station frequency to 500 cycles for a temperature variation of 5° Fahrenheit from the temperature specified on the certificate. The time limit on the guarantee is six months. At the end of this period the instrument should be returned to the factory for recalibration, for which a fee of $10.00 will be charged.

The price of the Station Frequency Meter is $130.00.

G.R. Engineers Visit Europe

Melville Eastham returned to his office on August 20th after a three months' trip to Europe. Dr. L. M. Hull sailed September 1st for a two months' trip abroad.

While Mr. Eastham's visit was largely a pleasure trip, Dr. Hull will spend the most of his time studying recent developments pertaining to radio as applied to aeronautics. Dr. Hull will also attend the International Telegraphic Conference in Brussels where he will present a paper on Frequency Standardization.

A New Amateur Condenser

January 1, 1929 marks the beginning of a new era in amateur radio—an era of clean tones, accurate wavemeters, and stable receivers. The wise experimenter is revamping his apparatus now.

In designing short wave receivers, it is desirable to cover only a comparatively narrow range of wavelengths on one coil in order to separate properly stations and to minimize the chance of "slipping over" a wanted signal. It is usual to accomplish this by the simple process of removing plates from a standard type of receiving condenser until its coverage is satisfactory to the operator.

A new condenser is now available for this particular use. It is the Type 557 Condenser as used in the Type 558 Amateur Band Wavemeter. This condenser consists of six stator plates, two rotor plates of the straight-line wavelength type, and two additional rotor plates which are complete circular discs. These latter plates revolve with the shaft, but produce no change of capacitance. Hence they act as a fixed condenser, shunting a variable condenser. The minimum capacitance is approximately 43 MMF. and the maximum 70 MMF. The plates are widely spaced, the same as in our transmitting condenser, with the usual soldered plate construction, insuring constancy of capacitance.

The tuning range of a receiver using this condenser will be such that it covers the 75 to 85 meter band with a small margin to spare and other bands in the same ratio. Since the new 20 and 40 meter bands are narrower than the 80 and 160 meter bands, it may be advisable to reduce further the tuning range if there is no occasion to work in the 80 or 160 meter bands. This is easily done by removing the stator plate nearest the panel, using either a soldering iron or diagonal cutting pliers. It is obvious that care must be taken to get the correct inductance in the grid coil, or one end of a band may be off scale. Any standard dial made for a ¼" shaft may be used.

The price of this new panel mounting, amateur band condenser, which is known as Type 557, is $3.25. Deliveries are to start September 15.

Mutual Conductance Meter Type 443

There are three fundamental dynamic constants of the three electrode vacuum tube which lend themselves readily to simple bridge measurements, namely the amplification constant, the plate impedance, and the ratio of these two which is the mutual conductance. Knowledge of these constants is essential in predicting the behavior of a given tube in any particular circuit.

If a tube fails to meet the standard specifications of its type, that is, if it has a faulty filament emission or an incorrect spacing of the tube elements it will always show a mutual conductance below normal values. With this idea in mind, the General Radio Company has developed a simple and compact instrument for making rapid measurements of mutual conductance. Such an instrument is valuable both in the shop, store, or laboratory for checking one or a series of tubes to ascertain if they come within any prescribed limits. This device should not be confused with the G. R. Type 361-B Vacuum Tube Bridge which latter is essentially a laboratory instrument designed to give accurate measurements of all three constants.

The Type 443 Mutual Conductance Meter is a null-point bridge instrument excited by a self-contained microphone hummer and battery. A standard UX type of socket is provided, also a special socket for the five-pronged separate-heater tubes. All tube batteries are external. Any desired plate voltage may be applied to the tube as well as any desired grid biasing battery. The instrument is equipped with a voltmeter for indicating the voltage across the filament. By the use of one or the other of the rheostats mounted on the panel it is possible to adjust the filament voltage of various tubes to the correct value. A pair of terminal posts serve for attaching a telephone head set. If operating in a noisy environment an external stage of audio amplification may be inserted here.

Measurements having a precision of 1 to 2 per cent are quickly and easily made by the manipulation of a single dial to give silence in the phones. This dial is calibrated to read mutual conductance directly in micro-mhos from zero up to over 2500 micro-mhos. The dial spacing is not uniform but is graduated in such a manner as to maintain a better percentage precision of the lower values of mutual conductance.

The instrument is contained in a walnut cabinet approximately ten inches square and 4½ inches deep. Weight 6½ pounds. Price $55.00.

Catalog E

Due to the desirability of including some of our newest instruments, and the making of certain corrections, the printing of Catalog E, covering our entire line, was delayed. It is now expected that copies will be mailed about September first to all those who have requested them as the result of the notice in the July Experimenter.

In addition to revised prices and descriptions on present instruments, this catalog includes the following instruments not previously listed. Artificial Cable Boxes, Attenuation Networks, Mutual Conductance Meter, Filter Sections, Station Frequency Meter, Amateur Band Wavemeter, Magnetostriction Oscillator, Thermionic Voltmeter, Standard Signal Generator, Synchronous Motor, New Transformers.

Bargains!

Last month we listed several items of surplus stock at special prices. We will continue to follow this plan from month to month, thus giving our regular customers first opportunity of picking up any articles that may be of interest to them. Our direct to consumer policy makes these price concessions possible as we do not have to protect dealer stocks. The object of these sales is to keep current stocks fresh.

All offerings are subject to prior sale. *Be sure to refer to special sale price when placing order.*

500 Type 369 Coupling Impedances Standard Design. Overstock.

Quantity	Unit Price
10	$1.50
50	1.25
100	1.00

500 each Types 277-A and 277-B Coils. Standard Design. Overstock.

Quantity	Unit Price
10	$ .70
50	.50
100	.40

4000 Type 309 Socket Cushions Standard Design. Overstock.

Quantity	Unit Price
25	$ .15
100	.12
500	.10
1000	.08

125 Type 231-W Impedance Adjusting Transformers Discontinued. Former Price $5.00.

Quantity	Unit Price
10	$1.00
50	.75
100	.70

3000 Type 346 Adapters (UX-199 to UV Standard). Standard Design. Overstock.

Quantity	Unit Price
100	$ .10
1000	.05

3000 Type 301 10-ohm Rheostats Manufacturer's type without knob.

Quantity	Unit Price
10	$ .50
50	.35
500	.25

We regret that Bulletin 930 contains many errors, typographical and otherwise. A revised edition is in preparation and when ready will be announced in the Experimenter. In the meantime we ask that you apply the following price and code word corrections to the copy that may have already been sent you.

Page	*Correction*
9364	Type UX-280 or CX-380 Tube ..... Price $4.50
9367	Type 302 Dial ..... Code Word DAISY
9367	Type 303 Dial ..... Code Word DALLY
9368	Type 366 Choke ..... Price $5.00
9370	Type 276-A—160 Meter Crystal ..... Code Word LABOR
9370	Type 276-A— 80 Meter Crystal ..... Code Word LAYER
9370	Type 356 Crystal Holder ..... Code Word LASSO
9371	Type 309 Socket Cushion ..... Code Word SABER
9372	Type 280 Insulator ..... Price $0.12
9372	Type 260 Insulator ..... Price $0.20
9380	Type 334-V Condenser ..... Price $2.50
9380	Type 334-T Condenser ..... Price $2.75
9380	Type 334-V Condenser ..... Code Word BIPED
9380	Type 334-T Condenser ..... Code Word BILLY