JULY 15th 1933 15¢

RADIO WORLD

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The First and Only National Radio Weekly

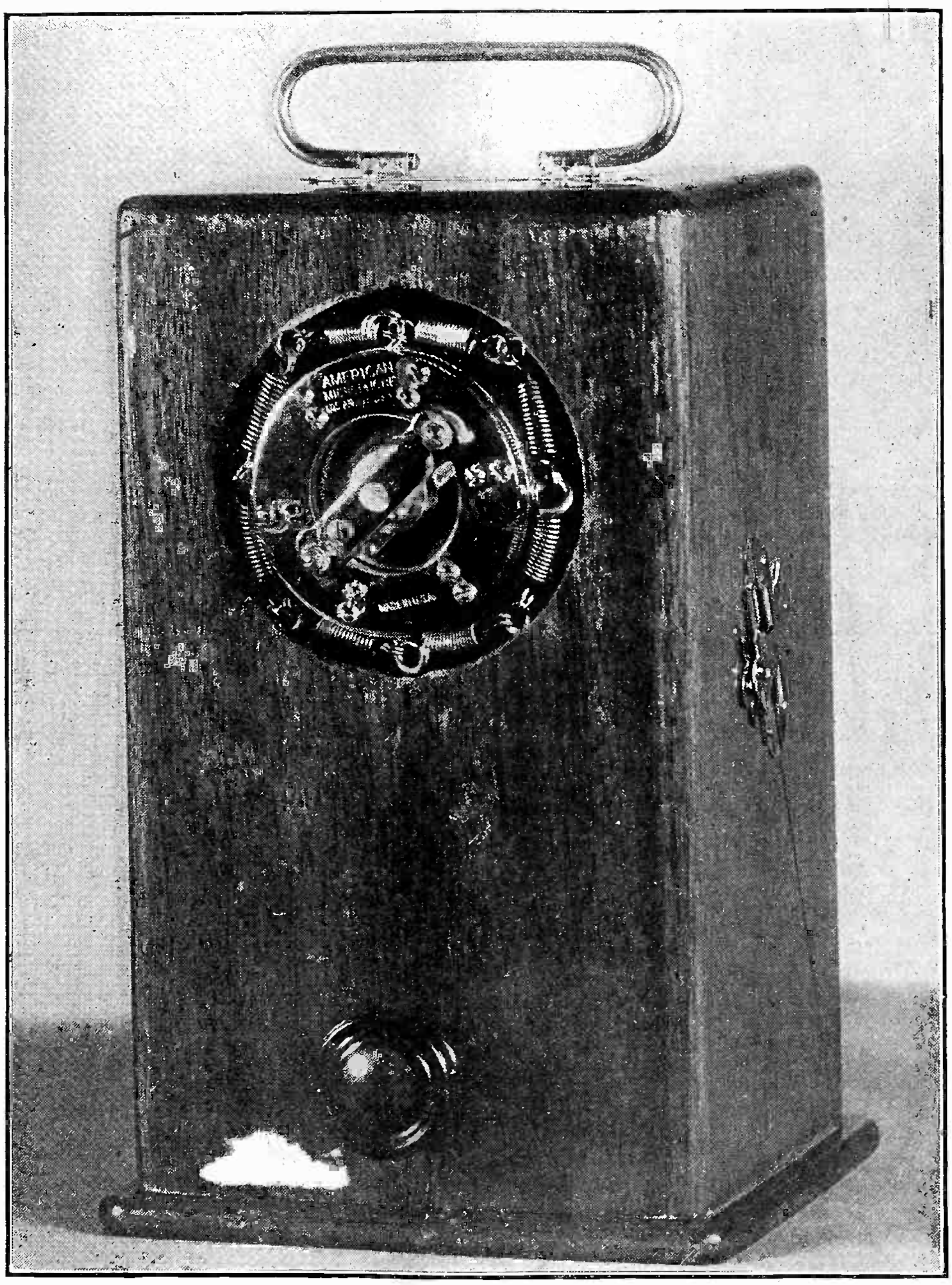
Twelfth Year *590th Consecutive Issue*

New Pentagrid Tube for Battery Sets

Electron-Coupled Oscillator

Percentage Modulation

A COMPACT PORTABLE AMPLIFIER



The Communicator, a four-tube portable amplifier with 2 watts output. The microphone is mounted on the front of a compact cabinet. The device may be used for office communication, store demonstrations and other purposes. See page 6.

Roland Burke Hennessy
Editor

Herman Bernard
Managing Editor

RADIO WORLD

The First and Only National Radio Weekly
TWELFTH YEAR

J. Murray Barron
Advertising Manager

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ELECTRON COUPLING

in a Grid-Current Type Oscillator

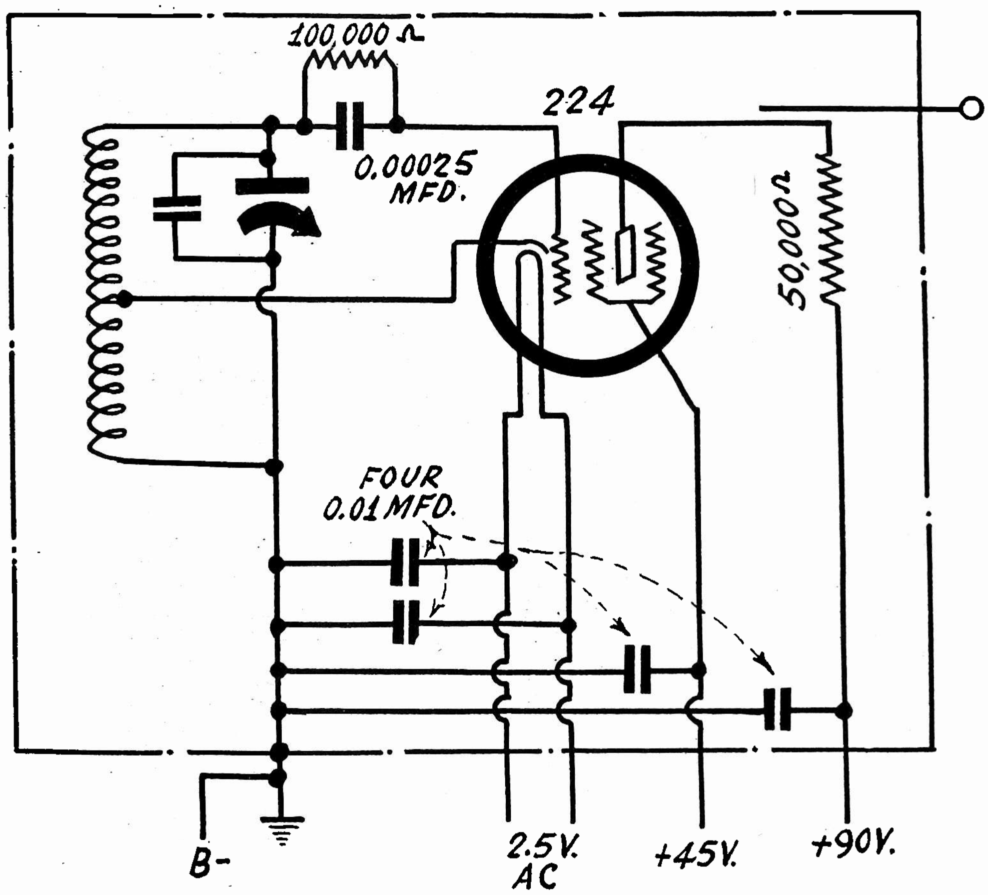
Editor Radio World:

THERE have been numerous articles in Radio World on various types of test oscillators. But there seems to be an avoidance of the one oscillator that is supposed to be the most stable of all, next to the crystal controlled. This is the electron-coupled type, using screen grid tube. It has been featured quite extensively in "QST" and all the "hams" are acquainted with it in transmitters and frequency meters. Surely it ought to be ideally suited to laboratory testing purposes, but I never see it mentioned much. Isn't it suited to variable frequency operation, or is its reputed stability only hearsay? It has been said that the plate voltage on these oscillators can be varied greatly without disturbing the frequency stability and operation is quite independent of load conditions.

I would like to see some comment in the pages of Radio World on this.

H. J. RICHARDSON,
4416 North 39th Street,
Omaha, Neb.

* * *



THE electron-coupled oscillator has been treated in these columns extensively, beginning with the original one as devised by Dow in various forms. The circuit used by "QST," taken from "The Radio Amateur's Handbook" (p. 73, 1933 edition), is shown in Fig. 1.

It can be seen this is the familiar grid current type of oscillator, but that there is electron coupling between the oscillator and the measured circuit, for the oscillator consists of the screen (used as plate), the control grid and the cathode, while the conventional plate is used as the coupling medium, so that the impinging electrons are taken off without disturbing the conditions of the oscillator proper. It is as if a three-element tube were used for oscillator and an extra element used for coupling. The commonness of the electrons of oscillator and output is in the space stream. This is electron coupling, therefore, or it might be called emission coupling.

The oscillator itself is a good one, as the frequency stability of the grid current type of oscillator is high. It is certainly an improvement on the dynatron oscillator, which amateurs had been using for a few years, and which the leading scientists working on stabilized variable-frequency oscillators have condemned virtually unanimously (Dow, Llewellyn, Argimbau, etc.).

The expression "frequency stability," relating to an oscillator, may prove confusing, and evidently does prove so, since the frequency stability has nothing to do with the output coupling method. Dow did not stress this point sufficiently, or perhaps overlooked it.

You might demand of an oscillator that when you set its frequency that it should generate just that frequency, and not wobble or shift. If you would have this freedom from frequency shifting built into the oscillator proper it should be frequency-stabilized, and if in addition you want relative freedom from change due to load conditions, the output has to be treated specially likewise.

The grid current type oscillator is the simplest good one, but it is not in the precision class. The "Handbook" sets forth that the accuracy may be 0.1 of 1 per cent. While this could be true under identical meteorological and mechanical conditions, it is considerable to expect such accuracy in practice. The absence of a constant temperature often renders inevitable a change in inductance with temperature (though a small change), while the magnetic content of the form on which the coil is wound, and the non-

(*Continued on next page*)

(*Continued from preceding page*)
hygroscopic nature of the entire coil, account for other changes.

Introducing Modulation

The condition existing during calibration would be duplicated only accidentally during actual use of the oscillator as a frequency meter. However, the degree of accuracy required for general work is nothing like 0.1 per cent. in broadcast practice, and the device then is not to be used as a monitor, or guide for the frequency of a broadcast transmitter. It is to be used for simple testing.

With R1 at 100,000 ohms there will be no modulation, and aside from the rushing noise in the set due to its reception of the oscillation frequency nothing special would be heard. Zero beats with carriers would be used. However, the leak value could be raised until the tube becomes also an audio oscillator, by motorboating, or grid current starting and stopping, and at around 500,000 ohms this will start, or higher leak value may be used for higher audio frequency modulations at greater intensity.

Such an oscillator may cover a fundamental of from 50 to 150 kc, thus affording use in lining up intermediate frequencies by fundamental or harmonic frequencies, and the broadcast band by the tenth harmonics. The circuit is a generous harmonic producer (we almost said a *vicious* one) and it oscillates so strongly that there will be coupling between oscillator and receiver even without any wire connection, as to broadcast frequencies, although for intermediate frequencies the output should be connected somewhere in the intermediate circuit, say, at plate of the first intermediate tube.

The Series Capacity

The output is capacitatively coupled to the tested circuit, and either a small condenser may be used, around 20 mmfd., or its equivalent produced by using a 3-inch insulated wire from the plate to R2's high end, and running another insulated wire parallel and close to the other wire for that distance, which would include the distance to the output binding post.

If a much greater length of wire is used (say, six inches) the detuning effect sets in. Thus the intended benefit may be vitiated, or, viewed from another angle, even electron coupling by itself does not represent perfect freedom from detuning effects caused by the load.

The detuning effect is least under all circumstances when the coupling medium is the ether, that is, the oscillator radiates and the radiation is picked up by the tested circuit. This is the same situation as obtains between broadcast transmitter and receiver, where the receiver does not change the frequency of the transmission. The only coupling between them is ether coupling. An ether-coupled frequency meter would be better than an electron-coupled one. Were it not for enlarged size this could be achieved in experimental practice by having the output act as transmitter in a shielded compartment, and a distant pickup coil feed an amplifier tube.

Coil Data

The question arises as to why there should be radiation even through the shield of the electron-coupled oscillator. The reasons are that the shield will not be a perfect shield, also some energy gets out through the line to the tested circuit (if the tested circuit is on the same line) and even a common ground at different potentials would result in some pickup, although this is a rarity.

For the frequencies of the amateur band intended originally, the bypass condensers may be as on the diagram, but for the lower frequencies here discussed, had better be larger.

For an oscillator that may be used as stated, 50 to 150 kc, with a 0.00035 mfd. tuning condenser, the coil may consist of a 1,300-turn honeycomb, tapped at the 500th turn from the ground end. The total winding is tuned. The inductance of the total winding is 25 millihenries.

For the broadcast band the coil may consist of 127 turns of No. 32 enamel wire, wound on 1-inch diameter outside, tapped at 30 turns from the ground end. The greater the number of turns between ground end and tap the greater the oscillation, but it soon reaches a degree that badly overloads the tube, resulting in double-peak beats. This proves to be quite a nuisance, and destroys any validity of claims of accuracy, so avoid too many tickler turns. They are tickler turns because from cathode to ground the coil is in both the plate and grid circuits.

Methods of calibration have been detailed in previous issues of RADIO WORLD, the latest dated December 3rd, 1932.

Stability Test

The fact that the grid current type oscillator, including the electron-coupled one, is found in the fact that, using heater tubes, and zero beating, the frequency changes after the tube heater supply is turned off, and the heater emission gradually subsides.

NEW TUBE WITH AN 8-PIN BASE TO BE OUT SOON

While information regarding tubes not yet nearly ready for the market is closely guarded, nevertheless it has been learned that a tube with an eight-pin base is to be announced. This will have a serious effect on servicing equipment, including testers, as there never has been an eight-pin-base tube before, although an adapter is being gotten ready to take care of existing servicing kits.

No official details have been obtained, but the general report is that the new tube will be of the twin push-pull type, Class A, and it has been stated also that there will be three grids, leading to the assumption that not only the output tubes but also the driver tube will be in the same envelope.

Other New Tubes Also

New tubes are being announced steadily, although radio set manufacturers have asked that there be a halt to the procession unless some radical improvement or simplification is introduced. However, special purpose tubes for 2.5-volt and 6.3-volt operation must be expected to be extended to 2-volt battery operation, and other new tubes are in the offing, besides the eagerly-awaited and most interesting eight-pin-base type.

The List Prices

With the advent of new tubes the prices of older ones have been lowered, and only the other day thirty tubes were reduced in list prices.

The present list prices of tubes is given in the annexed tabulation, not including, however, the 1A6, on which no list price has been fixed yet.

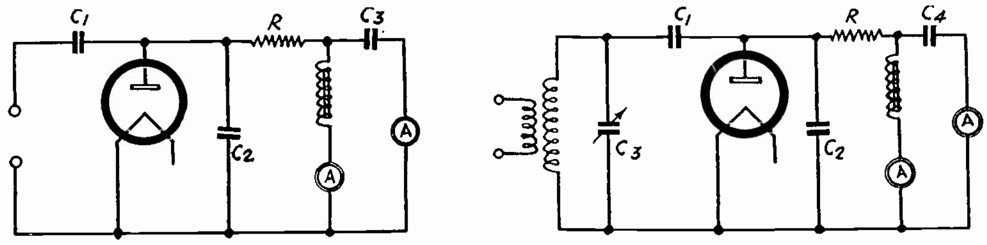
Descriptive Table of Tubes and List Prices Now Existing

Type	*List*	*Description Cathode*	**Volts*
2A3	$4.00	Power Amplifier Triode—Filament	2.5
2A5	1.60	Power Amplifier Pentode—Heater	2.5
2A6	1.60	Duplex-Diode High-Mu Triode—Heater	2.5
2A7	2.20	Pentagrid Converter—Heater	2.5
2B7	2.00	Duplex-Diode Pentode—Heater	2.5
5Z3	1.50	Heavy-Duty Full-Wave Rectifier—Filament	5.0
6A4	1.60	Power Amplifier Pentode—Filament	6.3
6A7	2.20	Pentagrid Converter—Heater	6.3
6B7	2.00	Duplex-Diode Pentode—Heater	6.3
12Z3	1.20	Half-Wave Rectifier—Heater	6.3
25Z5	2.00	Rectifier-Doubler—Heater	25.0
01-A	.60	Detector, Amplifier—D-C Filament	5.0
1	1.50	Half-Wave Mercury Vapor Rect.—Heater	6.3
1-v	1.25	Half-Wave Rectifier—Heater	6.3
10	5.00	Power Amplifier, Oscillator—Filament	7.5
112-A	1.30	Amplifier, Detector—D-C Filament	5.0
19	1.50	Class B Twin Amplifier—D-C Filament	2.0
22	2.00	Screen Grid RF Amplifier—D-C Filament	3.3
24-A	1.20	Screen Grid R-F Amplifier—Heater	2.5
26	.65	Amplifier—Filament	1.5
27	.70	Detector, Amplifier—Heater	2.5
30	1.30	Detector, Amplifier—D-C Filament	2.0
31	1.30	Power Amplifier Triode—D-C Filament	2.0
32	1.90	Screen Grid R-F Amplifier—D-C Filament	2.0
33	2.10	Power Amplifier Pentode—D-C Filament	2.0
34	2.15	Super-Control R-F Amplifier Pentode—D-C Filament	2.0
35	1.30	Super-Control R-F Amplifier—Heater	2.5
36	1.50	Screen-Grid R-F Amplifier—Heater	6.3
37	1.20	Detector, Amplifier—Heater	6.3
38	1.45	Power Amplifier Pentode—Heater	6.3
39-44	1.50	Super-Control R-F Amplifier Pentode—Heater	6.3
41	1.60	Power Amplifier Pentode—Heater	6.3
42	1.60	Power Amplifier Pentode—Heater	6.3
43	2.50	Power Amplifier Pentode—Heater	25.0
44-39	1.50	Super-Control R-F Amplifier Pentode—Heater	6.3
45	.75	Power Amplifier Triode—Filament	2.5
46	1.55	Dual-Grid Power Amplifier—Filament	2.5
47	1.30	Power Amplifier Pentode—Filament	2.5
48	3.00	Power Amplifier Tetrode—D-C Heater	30.0
49	1.70	Dual-Grid Power Amplifier—D-C Filament	2.0
50	4.00	Power Amplifier Triode—Filament	7.5
53	1.80	Class B Twin Amplifier—Heater	2.5
55	1.60	Duplex-Diode Triode—Heater	2.5
56	1.20	Super-Triode Amplifier—Heater	2.5
57	1.65	Triple-Grid Amplifier Detector—Heater	2.5
58	1.65	Triple-Grid Super-Control Amplifier—Heater	2.5
59	2.00	Triple-Grid Power Amplifier—Heater	2.5
71-A	.75	Power Amplifier Triode—Filament	5.0
75	1.60	Duplex-Diode High-Mu Triode—Heater	6.3
77	1.80	Triple-Grid Detector Amplifier—Heater	6.3
78	1.80	Triple-Grid Super-Control R-F Amplifier—Heater	6.3
79	2.60	Class B Twin Amplifier—Heater	6.3
80	.70	Full-Wave Rectifier—Filament	5.0
81	3.50	Half-Wave Rectifier—Filament	7.5
82	1.20	Full-Wave Mercury Vapor Rect.—Filament	2.5
83	1.55	Heavy-Duty Full-Wave Mercury Vapor Rectifier—Filament	5.0
84	1.75	Full-Wave Rectifier—Heater	6.3
85	1.60	Duplex-Diode Triode—Heater	6.3
89	1.80	Triple-Grid Power Amplifier—Heater	6.3
199	1.50	Detector, Amplifier—D-C Filament	3.3
200-A	4.00	Supersensitive Detector—D-C Filament	5.0
11	3.00	Detector, Amplifier—D-C Filament	1.1
12	3.00	Detector, Amplifier—D-C Filament	1.1
120	3.00	Power Amplifier Triode—D-C Filament	3.3
199	2.25	Detector, Amplifier—D-C Filament	3.3
240	2.00	Voltage Amplifier—D-C Filament	5.0
874	4.90	Voltage Regulator—Glow Discharge	
876	6.70	Current Regulator (Ballast Tube)	
886	6.75	Current Regulator (Ballast Tube)	
841	10.40	Voltage or R-F Power Amplifier—	
842	10.40	A-F Power Amplifier or Modulator—Filament	7.5
868	7.50	Phototube	
864	2.10	Amplifier, Detector—D-C Filament	1.1
852	28.00	100-Watt Oscillator or R-F Power Amplifier—Filament	10.0
865	15.00	12.5-Watt Screen Grid R-F Amplifier—Filament	7.5
866	6.75	Half-Wave Mercury Vapor Rect.—Filament	2.5

* *Either A.C. or D.C. may be used on the filament or heater, except as noted.*

PERCENTAGE MODULATION

WHAT IT IS AND HOW IT COMPARED TO "EFFECTIVE PERCENTAGE MODULATION" WHICH IS MORE CONVENIENTLY MEASURED



Two vacuum tube peak voltmeters. At left, for rectifier that presents a high impedance for speech frequencies, at right for rectifier that presents a low impedance for speech frequencies.

TWO vacuum tube peak voltmeters for measurement of effective percentage modulation are shown. Measurement of percentage modulation is complicated by the presence of harmonics and it requires rather elaborate laboratory equipment, including an oscillograph.

The difference between the percentage modulation and the effective percentage modulation may be expressed as a difference between the complex modulation of the carrier and modulation by a single tone. A compromise method applies to measurement of a single tone composed of two tones as an equivalent to measurement of speech modulation.

Percentage modulation is defined as the ratio of half the difference between the maximum and the minimum amplitudes of a modulated wave to the average amplitude, expressed in per cent.

The Simpler Case

The two vacuum tube voltmeters are peak voltmeters. Percentage modulation is generally determined by measuring the instantaneous value of the peak voltages either of the radio-frequency oscillations or of the rectified signal wave. Measurements made in this way may be vitiated by the presence of harmonics, especially under conditions of overloading. If the peak voltages are measured by means of oscillograph records these disturbing factors are of course apparent. The use of an oscillograph is difficult outside of a laboratory and it is therefore convenient to define a quantity which may be called the effective percentage modulation but which is more convenient to measure.

Effective percentage modulation, as applied to the modulation of a single carrier by a single sinusoidal signal wave, is the ratio of the amplitude of the fundamental component of the envelope to the amplitude of the carrier, expressed in per cent.

For the case of modulation by a simple sinusoidal wave, in the absence of distortion, it is evident that the percentage modulation and effective percentage modulation as defined above are identical. Effective percentage modulation, as applied to the modulation of a single carrier by two or more sinusoidal waves, is the sum of the effective percentages associated with the individual signal waves, each measured in the presence of the other.*

More Than 100% Is Possible

Thus the percentage modulation is $(E_{max} - E_{min}/2)/E_{av}$, where E_{max} is the maximum and E_{min} the minimum amplitude, and E_{av} the average amplitude. As the average is virtually always greater than half the difference between the maximum and the minimum, the percentage is less than 100, although it is possible to have instances of more than 100 per cent. modulation, which is a form of distortion.

The effective percentage modulation would be E_f/E_c, where E_f is the amplitude of the fundamental component of the envelope and E_c the amplitude of the carrier. The solution is always expressed in per cent.

Speech cannot well be broken down and syllables measured for percentage modulation. Yet speech intensity may be measured by volume indicators, which are power measuring devices although the indication is in arbitrary units of average speech energy. This average permits of a makeshift method that has won wide approval, due to the correlation of behavior, particularly distortion between speech and two tones of different intensities. The two tones should give the same indication on the volume indicator as does the speech to be measured.

Speech Measurement

Percentage modulation is concerned with speech amplitudes, not speech power. Two tones, the sum of whose amplitudes is double that of either, have together only twice the power of either. To obtain this double amplitude by a single tone involves multiplying the power by 4. This gives a power ratio of 2. Hence without change of meaning the effective percentage modulation for speech may be defined as being that for a single tone whose power reading on the volume indicator is double that of speech.

The percentage modulation measurement is made with Fig. 1 or Fig. 2 by choosing the proper constants so that the current through R is proportional to the radio-frequency voltage in it, at an audible rate. Since the instrument operates on peak voltages it reproduces the envelope of the radio-frequency wave and provides a detector of very satisfactory fidelity. Measurements of percentage of modulation may be obtained by recording the instantaneous values of the current in R by means of an oscillograph.

High and Low Impedances

Fig. 1 is for a rectifier providing a high impedance at speech frequencies, and the impedance of R is high compared to the internal impedance of the tube when the tube is conducting. The impedance of R, compared to that of C1, is high at the carrier frequency and low at the speech frequencies. This makes for the proportionality of current to input voltage.

If the rectifier presents a low impedance to speech frequencies the Fig. 2 circuit may be used.

Two Meters

In both Figs. 1 and 2 the direct current is separated from the alternating current, and both currents are read, one meter reading one current and the other meter the other current. Since a low impedance is required, a thermocouple is used, or a low impedance vacuum tube voltmeter, for the a-c values. The filter circuit should have an audio choke coil of high impedance and a large stopping condenser, that is, present negligible shunt admittance and series impedance. For the choke, since the current may be small, a value of 100 henries is obtainable, while C2, the stopping condenser, may be 10 mfd. or more, but should not be an electrolytic condenser. The impedance of this circuit should be small or independent of frequency.

Since the result is now treated on the basis of current, and since the current is proportional to the voltage, that is, the circuit behaves like a pure resistance, the effective percentage modulation by a single tone is $100\sqrt{2}\ I_2/I_1$, where I_1 is the direct current and I_2 is the root-mean-square value of the alternating current. For n equal tones the effective percentage modulation is $100\sqrt{2n}\ I_2/I_1$.

Steady Tone

For the speech measurement, the steady tone is introduced as previously discussed.

It can be seen therefore that the rectifier circuits have to be worked within the sensitivity limits of the meters, and therefore selection of the stage that yields the result may be resorted to, if shunts are not available for the a-c meter. In the a-c instance, popular rectifier type meters, on their a-c side, measure up to 1 ma, and hardly any less sensitivity is recommended for such meters, as inaccuracies result. However, within its limits, this universal type meter may be used for measuring the r-m-s values, for it is calibrated in r.m.s., although it reads peak values. The direct current meter offers no problem.

MAY EXCISE TAX

The Internal Revenue Bureau reports collections during May of the federal 5 per cent, excise tax on radio and phonograph records amounting to $110,747.70, according to official statement just released in Washington. The May collections on mechanical refrigerators were $376,188.35.

*"Methods of Measurement and Test," Year Book, Institute of Radio Engineers. 1931; p. 99.

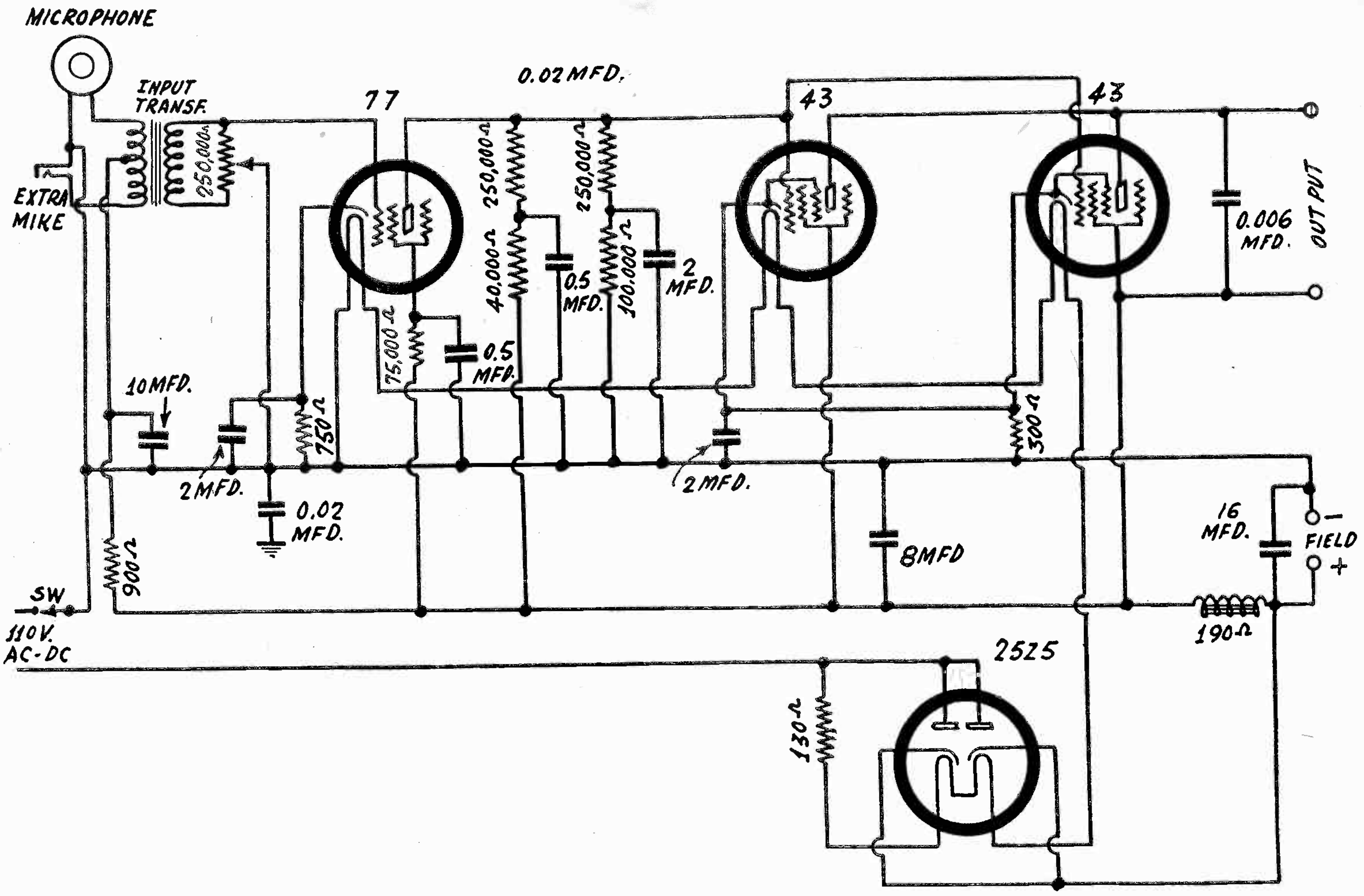
THE COMMUNICATOR

A 4-Tube Universal Amplifier

Robert G. Herzog, EE.

Engineering Department, Thor Radio Co.

INTER-OFFICE PHONE SYSTEM AND STORE DEMONSTRATOR



The circuit diagram of the universal 4-tube amplifier.

THE Communicator is designed to meet the ever-increasing demand for a low-cost, truly-portable universal amplifier, that is, one that works on a. c. or d. c. The entire four-tube amplifier, together with the microphone input transformer, is completely mounted and wired on a chassis 4 x 4 x ¾ inches. The use of special small size-condensers contributed largely to this end. This saving in space enabled use of a cabinet of overall dimensions of 5 x 5½ x 9 inches. It houses the microphone, which is mounted on springs in a 3½-inch hole cut in the front. This not only saves space but also saves the added expense of a microphone suspension ring.

The Communicator can be used with one or two single-button microphones, a double-button microphone or a low-impedance pickup. Microphone current is obtained from the power supply, dispensing with the need of a microphone battery.

Two-Watt Output

The Communicator delivers approximately two watts, which are usually sufficient for inter-office communication or retail store window demonstrations. It can be used with a good magnetic speaker or with one of the midget type dynamics having a field resistance of not less than 3,000 ohms. It will supply excitation for this type of field.

The Communicator is simple in design and construction and even the novice should experience little difficulty in building it from the kit of parts.

The tube sockets should be mounted first and all possible wiring between them made, taking care to get the wires as close to the chassis as possible. Shielding of plate leads is advisable to prevent feed back. All resistors should be covered with a rubber or spaghetti insulating sleeve so as to prevent shorting when two or more come together.

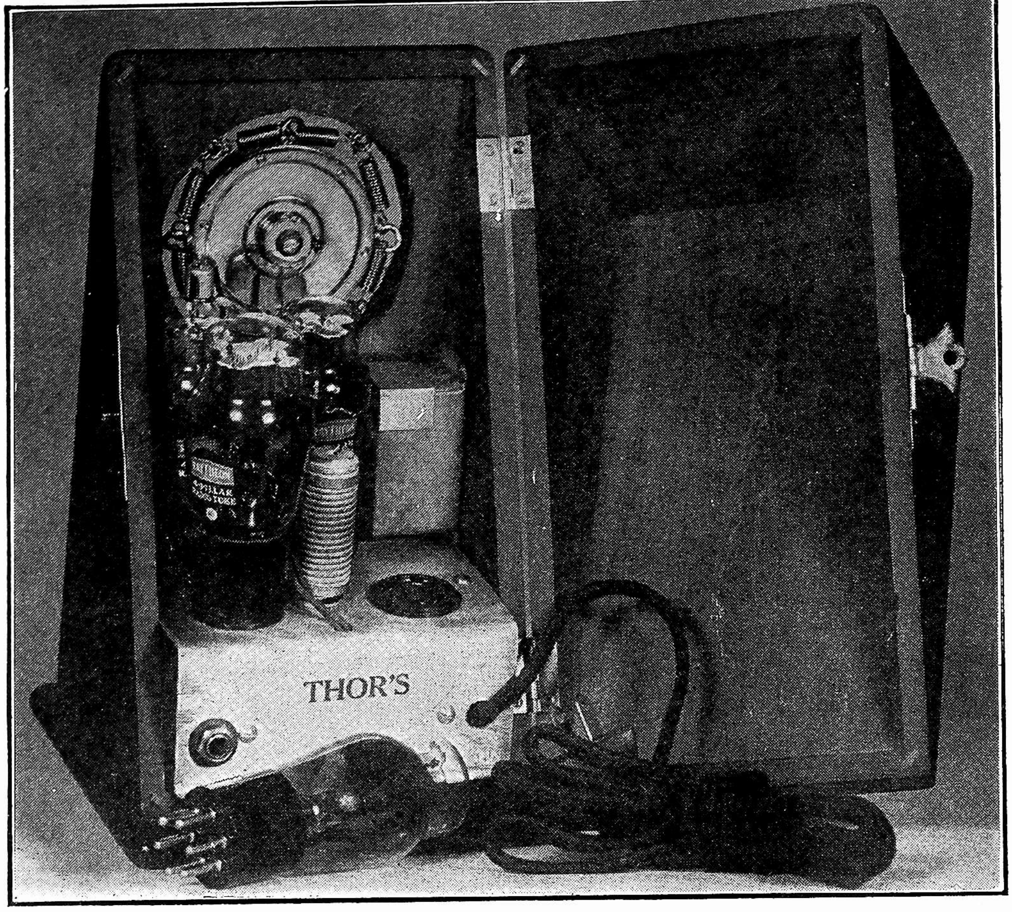
Electrolytics in One Block

Half-watt resistors are used wherever possible and electrolytic condensers, except for the coupling and blocking condensers, to save space.

The 8 and 16 mfd. condensers are put into one container and mounted on top

LIST OF PARTS

Microphone input transformer.
250,000 ohm potentiometer with switch chassis.
Four sockets
Dual 8 and 16 mfd. 175-volt electrolytic.
10 mfd. 25-volt electrolytic.
Three 2 mfd. 50-volt electrolytics.
Two .5 mfd. 100-volt electrolytics.
Two .02 foil condensers 200-volt.
.006 foil cendenser 150-volt.
190-ohm B choke.
130-ohm 25-watt resistor.
300-ohm 5-watt resistor.
9000-ohm 1 watt.
750-ohm ½-watt.
75,000-ohm ½-watt.
40,000-ohm ½-watt.
250,000-ohm ½ watt.
250,000-ohm ½ watt.
100,000-ohm ½-watt.
Two pup jacks.
Field jacks.
Line cord.
Screen grid cap.



of the chassis next to the 25Z5 rectifier. The filament resistor is also mounted on top to allow for complete air circulation and heat dissipation.

The type 77 pentode is used as a microphone amplifier with about 2 volts bias and 60 volts on the screen. Two 43 tubes are used in parallel as the output stage.

Fleming Gets Prize, As Does Barkhausen

Chicago.

At a banquet in connection with the convention of the Institute of Radio Engineers the medal of honor was awarded to Sir Ambrose Fleming, British physicist, inventor of the first vacuum tube, the two-element valve or detector. Many of those present at the banquet were not even born when Sir Ambrose, then James A. Fleming, made the invention.

Prof. J. Heinrich Barkhausen, of Germany, was awarded the Morris Liebmann Memorial Prize, of $500, for his short-wave work. His Barkhausen oscillator for ultra frequencies is well known. Consuls accepted the prizes for the absent scientists.

Guizar and Barlow Heard in Foreign Music

Tito Guizar, romantic Mexican tenor, who has been featured on several popular CBS programs during the past two years, is heard in a new series of recitals accompanied by Howard Barlow and a full concert orchestra, Mondays at 9:45 p.m. E.D.S.T., over the WABC-Columbia network. Guizar will draw from his extensive repertoire of popular Spanish, French and Italian concert songs and folk melodies during the series, and will occasionally vary the presentation with guitar-accompanied songs. The young Mexican will continue his weekly Sunday programs as soloist with the Gauchos at 9:00 p.m. and his guitar-accompanied recitals at 5:45 p.m., E.D.S.T., on Saturdays.

Deputy Sheriff Obliges

It was a red letter day in the history of Wading River, L. I., when Walter Lippmann engaged in trans-Atlantic radio discussion with John Maynard Keynes, British economist, on the eve of the London Conference.

Lippmann spoke from the study of his summer home in Wading River and scores of neighbors gathered on the veranda where a radio set had been erected. In the local Congregational Church another loudspeaker was switched on at the conclusion of the service and the congregation remained for the broadcast. Non-members also dropped in. The deputy sheriff of the township personally took charge of the highways, diverting all traffic from the vicinity of Lippmann's home for the duration of the broadcast.

Usher Bids for Fame

If Bill Paisely's "Dreams," a new fox trot ballad, wins Tin Pan Alley acclaim, a young theater usher may get a chance to establish himself as a lyric writer of unusual ability. The composer of the words to "Dreams" is now an obscure member of the staff of Proctor's RKO Theatre in New York. The lyricist is Al D'Abruzzo, or Buddy Alda, as he calls himself professionally. He was brought to Paisely's attention by an acquaintance who heard D'Abruzzo sing at the theatre. There he is known as the "Singing Usher" because he occasionally sings solos accompanied by the organ.

Paisely is a member of the NBC Music Library staff and is composer of many tunes, including "Time To Go," recently featured at Radio City Music Hall.

Talkie Film for Television Tried in West

San Francisco.

The talking pictures may revolutionize radio broadcasting.

If the innovation of Clifton R. Skinner, young San Francisco motion picture inventor, proves a success, a continuous 24-hour program may be broadcast from 3,000-foot roll of ordinary "talkie" film.

The roll is not larger in diameter than the largest 15-minute electrical transcription disc.

Or, under a different adaptation of the same idea, recorded programs may be edited, cut down, or pieced together from lengths of film. For this, a narrow film, especially cut and perforated by Skinner, is used. This will provide economical recording with advantages heretofore unknown.

The idea of putting the "talkie" method of reproduction to radio use was devised and elaborated by Skinner after several months' effort, and was given its first actual broadcast trial over KFRC.

Claims Advantages

Like some other inventions that were not so much new inventions as they were the application of something already at hand to a use hitherto unthought of, Skinner's innovation puts to use standard motion picture equipment, with a few simple, but important, changes.

Skinner claims the idea of broadcasting from a voice "movie" has many advantages over the record method. First and foremost, voice and music can be reproduced more clearly on a film than on a rubber disc. And it can be done more economically, he says.

"The fact that programs of any length, up to an entire day's broadcast, can be contained on a single roll of film should be a strong factor in winning some radio stations' approval," Skinner added. "The film could be stopped at any time for local announcements, and the method would eliminate the bother of changing records every few minutes.

Stations Have Choice

"Other stations will appreciate the idea of editing and preparing their own programs of any desired length from recorded material on hand. Prospective sponsor will be able to select a well-rounded program suited to their tastes."

Skinner has limited his present experiments to the regular portable motion picture equipment, with a few alterations. But he has specifications prepared for reproducing equipment specially prepared for radio stations, more compact and convenient than the larger theatre machines.

Skinner explains his method in two sentences:

"We feed the output of a standard projector into the voice input equipment in the radio studio. That output is the variable reaction of a photo-electric cell on the modulation of the voice track."

On the side of the film is a "sound track" with a mass of irregular lines corresponding to the modulation of the voice or music. The light passes through the film and registers these sounds on a photoelectric cell which in turn transmits them to a loud speaker.

Skinner says as many as 20 sound tracks can be put on each film, throughout the use of a machine that jumps from one track to another when one is "played out." It is that machine that will permit continuous 24-hour broadcasting without a change of film. For the narrow film to be used when it is desired to edit programs, a single track is necessary.

2-VOLT PENTAGRID T

THE 1A6 IS A NEW COMBINATIO ELECTRON

The RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., have recently released to equipment manufacturers a new pentagrid converter tube, the 1A6.

It is a 2-volt, low-filament-current type of tube, designed so that it can perform simultaneously the functions of mixer (first detector) and oscillator in superheterodyne circuits of the battery-operated type. This new tube has the desirable feature from a circuit design standpoint of permitting independent control for each function.

Because the 1A6 combines efficiently in one bulb the functions of mixer and oscillator, it offers new facilities in the design of compact battery-operated receivers.

THE 1A6 is a multi-electrode type of vacuum tube designed primarily to perform simultaneously the function of a mixer tube and of an oscillator tube in superheterodyne circuits. Through its use, the independent control of each function is made possible within a single tube. The 1A6 is designed especially for use in battery-operated receivers. In such service, this tube replaces the two tubes required in conventional circuits and gives improved performance.

The action of this tube in converting a radio frequency to an intermediate frequency depends on independent control of the electron stream (1) by three electrodes (including the filament) connected in an oscillator circuit and (2) by a fourth electrode (a grid, to which the radio input is applied. As a result of this arrangement, it is apparent that the simultaneous control by these two groups of electrodes will produce variations in the electron stream between cathode and plate. Since the electron stream is the only connecting link between these two control-factors, this converter system may be said to be "electron coupled."

Frequency-Converter Considerations

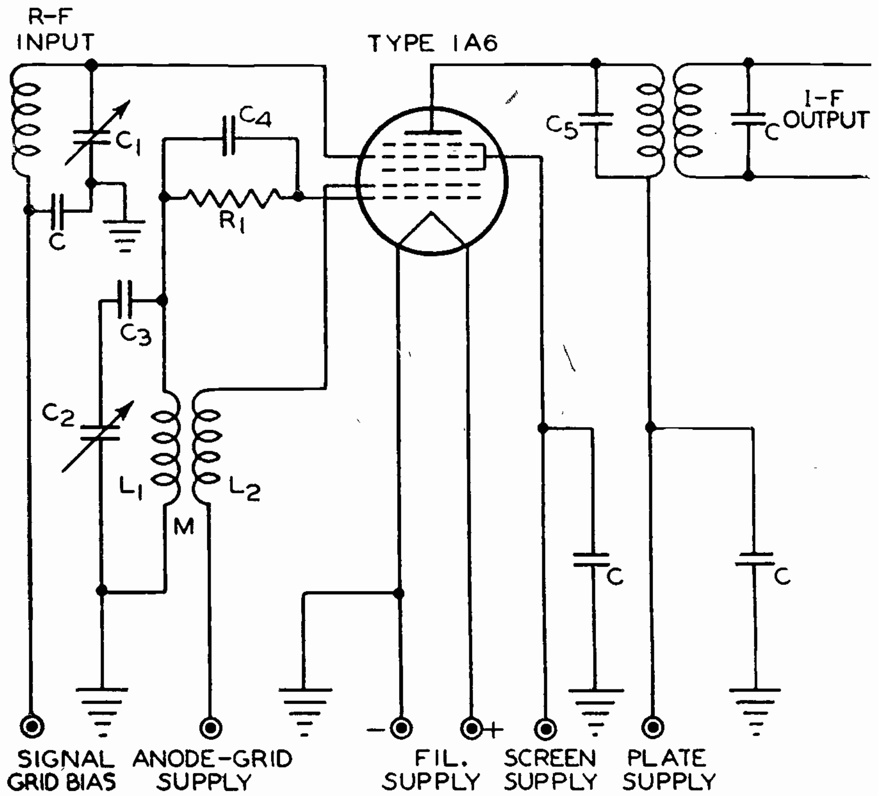
In a superheterodyne receiver the tubes and circuits used to generate the local frequency and to mix it with the incoming radio signal to produce an intermediate frequency may be called a frequency-conversion device.

The usual methods employ a mixer (first detector) tube in which the radio signal and local frequency are applied to the same grid. The local frequency may be generated by a separate tube or within the mixer tube. These methods generally depend on coupling the oscillator and mixer circuits by either capacitive or inductive means.

Another method of interest to circuit designers depends on electron coupling instead of reactive coupling. This arrangement offers advantages in eliminating undesired intercoupling effects between signal, oscillator, and mixer circuit and in reduction of local-frequency radiation. Furthermore, not only simpler circuits can be utilized, but also greater oscillator stability can be obtained because the oscillator operates under conditions essentially no load. A simple electron-coupled device may be imagined in which the space current of the mixer tube is modulated by variation in cathode emission. Conceivably, the cathode current might be modulated by variation in cathode temperature produced by filament-current variation. Practically, however, this same effect can be accomplished by placing a grid and a supplementary anode-grid between the cathode and the control-grid and by using these electrodes in conjunction with the cathode to accomplish the modulation of the cathode current.

With this latter arrangement, the cathode and the first two grids may be regarded theoretically as a composite cathode which supplies a modulated electron-stream. This modulated cathode-stream

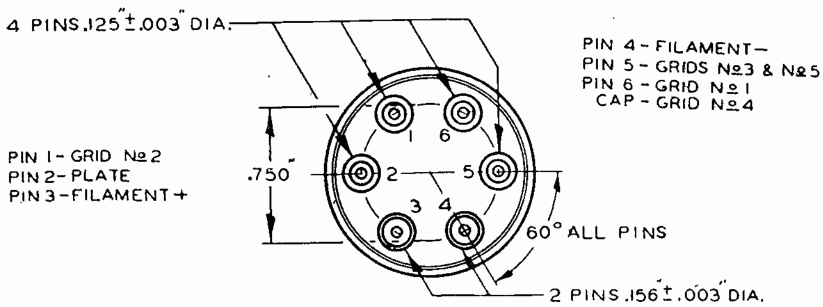
Autodyne Mixer of 60 ma T

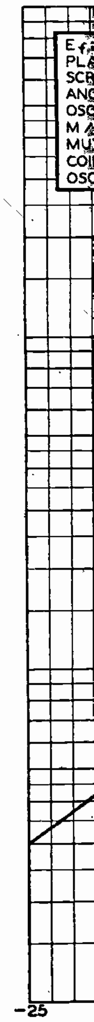


C = 0.1 µf.
C_1 = } C_2 = } GANGED VARIABLE CONDENSERS
C_3 = PADDING CONDENSER
C_4 = GRID CONDENSER OF 200 µµf.
L_1 = OSCILLATOR GRID INDUCTANCE } COUPLED
L_2 = OSCILLATOR PLATE INDUCTANCE }
M = MUTUAL INDUCTANCE OF L_1 AND L_2
R_1 = OSCILLATOR GRID LEAK

NOTE-1
ANODE-GRID SUPPLY MAY BE OBTAINED FROM PLATE SUPPLY TAP THROUGH VOLTAGE-DROPPING RESISTOR OF 20000 OHMS SHUNTED BY BY-PASS CONDENSER OF 0.1µf.

NOTE-2
VOLTAGE APPLIED TO ANODE-GRID (GRID No. 2) SHOULD BE HIGHER THAN THAT ON SCREEN (GRID No. 3 & No. 5).



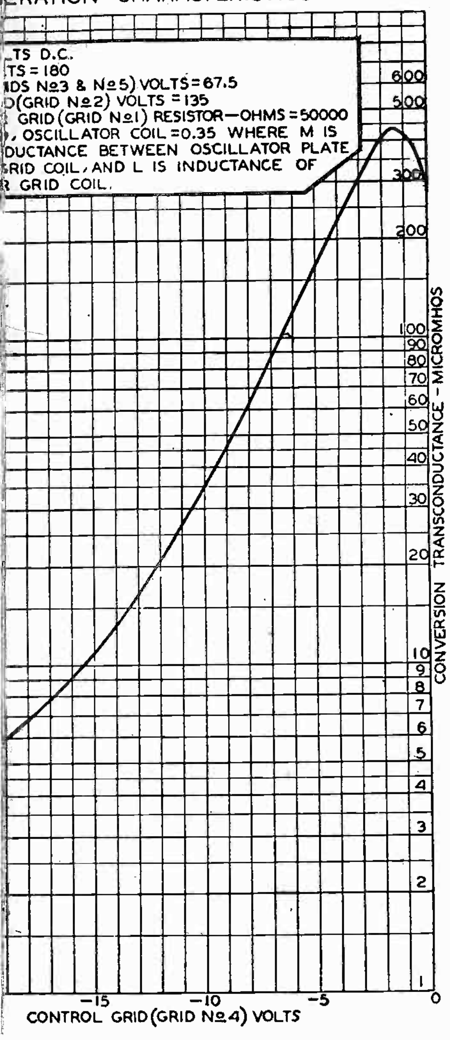


BE FOR BATTERY SETS

OSCILLATOR-MODULATOR WITH COUPLING

ype Filament

ERATION CHARACTERISTICS



er left is the circuit diagram of the new 1A6 pentagrid er tube. C4 is the grid con- C3 the padding condenser. er left is the bottom view of cket. The pins are coded 3, 4, 5, 6) according to the code. The transconductance for grid voltage variation voltages constant) is given at right.

may be further controlled and utilized by means of the addition of other grids and a plate. For example, a control-grid placed between the composite cathode and the plate will provide for the introduction of the radio signal. Additional grids placed either side of the control-grid will shield the control-grid electrostatically from the other electrodes, and increase the output impedance of the tube—a desirable characteristic from a gain standpoint. Of these two grids, the one (No. 3) nearest the cathode serves also to reduce the local-frequency radiation.

Installation

This design just considered is incorporated in the 1A6 to make available for battery-operated receivers a tube which combines efficiently in one bulb all the functions of a frequency converter.

The base pins of the 1A6 require the use of a standard six-contact socket, which should be installed to operate the tube in a vertical position. Base connections and external dimensions of the 1A6 are given. The No. 4 grid connection is made to the cap on top of the tube.

The coated filament of the 1A6 may be operated conveniently from dry-cells from a single lead storage-cell, or from an air-cell battery. For dry-cell operation, a filament rheostat may be used together with a permanently installed voltmeter to insure the proper filament voltage. For operation from a 2-volt lead storage-cell, the 1A* requires no filament resistor. Operation with an air-cell battery requires a fixed resistor in the filament circuit. This resistor should have a value such that with a new air-cell battery, the voltage applied across the filament terminals will not initially exceed 2.15 volts. Series operation of the filament of the 1A6 with those of other two-volt battery types is not recommended.

Complete shielding of the 1A6 is generally necessary to prevent intercoupling between its circuit and those of other stages.

APPLICATION

For converting the radio-frequency input to an intermediate frequency, the 1A6 is recommended for use in battery-operated superheterodyne receivers.

The feature that independent control of mixer and oscillator functions is made possible in a single tube with high gain is of practical advantage to the set designer.

As a frequency converter in superheterodyne circuits, the 1A6 can supply the local oscillator frequency and at the same time mix it with the radio-input frequency to provide the desired intermediate frequency. For this service, design information is given under "Rating and Characteristics." It important to note that the anode-gride voltage and the plate voltage must each be higher than the screen voltage.

For the oscillator circuit, the coils may be constructed according to conventional design, since the tube is not particularly critical. The voltage applied to the anode-grid (No. 2) should not exceed the maximum value of 135 volts, but should always be higher than the screen (grids No. 3 and No. 5) voltage. The anode-grid voltage may be obtained from a suitable tap on the B-battery or from the plate-supply tap through a voltage-dropping resistor of 20,000 ohms shunted by a by-pass condenser of 0.1 uf. The size of the resistor in the grid circuit of the oscillator is not critical but requires design adjustment, depending upon the values of the anode-grid voltage and of the screen voltage. Adjustment of the circuit should be such that the cathode current is approximately 6 milliamperes. Under no condition of adjustment should the cathode current exceed a recommended maximum value of 9 milliamperes.

Plate Circuit Condenser

The bias voltage applied to grid No. 4 can be varied over relatively wide limits to control the translation gain of the tube. For example, with 67.5 volts on the screen (No. 3 and No. 5) the bias voltage may be varied from —3 to plate current cut-off (approximately —25 volts). With lower screen voltages, the cut-off point is proportionally less. The extended cut-off feature of the 1A6 in combination with the similar characteristics of super-control tubes can be utilized advantageously to adjust receiver sensitivity.

Since the capacity between grid No. 4 and plate is in a parallel path with the capacity and inductance of the plate load, it is important to use a load capacity of sufficient size to limit the magnitude of the r-f voltage built up across the load. If this is not done r-f voltage feedback will occur between plate and grid No. 4 to produce degenerative effects. For this reason the size of the load condenser in the plate circuit should be not less than 50 mmfd.

Converter circuits employing the 1A6 may easily be designed to have a translation gain of approximately 40. A typical circuit is shown on Drawing No. 92S-4276. This circuit provides exceptionally uniform oscillator output over entire grid-bias range.

TENTATIVE RATING AND CHARACTERISTICS OF THE 1A6

Filament Voltage (D. C.)	2.0 Volts
Filament Current	0.060 Ampere
Direct Interelectrode Capacitances (approx.):	
Grid No. 4 to Plate	0.25*
Grid No. 4 to Grid No. 2	0.2*
Grid No. 4 to Grid No. 1	0.1*
Grid No. 1 to Grid No. 2	0.8
Grid No. 4 to all other electrodes trodes (R-F Input)	10.5
Grid No. 2 to all other electrodes (Osc. Output)	6
Grid No. 1 to all other electrodes (Osc. Input)	5
Plate to all other electrodes (Mixer Output)	9

*With shield-can.

Overall Length	4-9/32" to 4-17/32"
Maximum Diameter	1-9/16"
Bulb	ST-12
Cap	Small Metal
Base (Refer to Drawing No. 92S-4275)	Small 6-Pin

Converter Service

Plate Voltage	180	max.	Volts
Screen Voltage (Grids No. 3 & No. 5)	67.5	max.	Volts
Anode-Grid (Grid No. 2)	135	max.	Volts
Control-Grid (Grid No. 4)	—3	min.	Volts
Total Cathode Current	9	max.	Milliamperes

Typical Operation:

Filament Voltage	2.0	2.0	Volts
Plate Voltage	135	180	Volts
Screen Voltage (Grids (Grids No. 3 & No. 5.	67.5	67.5	Volts
Anode-Grid (Grid No. 2)	135	135	Volts
Control-Grid (Grid No. 4)	—3	—3	Volts
Oscillator-Grid (Grid No. 1) Resistor	50,000	50,000	Ohms
Plate Current	1.2	1.3	Milliamperes
Screen Current	2.5	2.4	Milliamperes
Anode-Grid Current	2.3	2.3	Milliamperes
Oscillator-Grid Current	0.2	0.2	Milliamperes
Total Cathode Current	6.2	6.2	Milliamperes
Plate Resistance	0.4	0.5	Megohm
Conversion Conductance**	275	300	Micromhos
Conversion Conductance at—22.5 volts on grid No. 4	4	4	Micromhos

**Conversion Conductance is defined as the ratio of the intermediate-frequency component of the mixer output current to the radio-frequency signal voltage applied to grid No. 4.

Determination of Non-Standard Voltages for Tetrodes and Pentodes

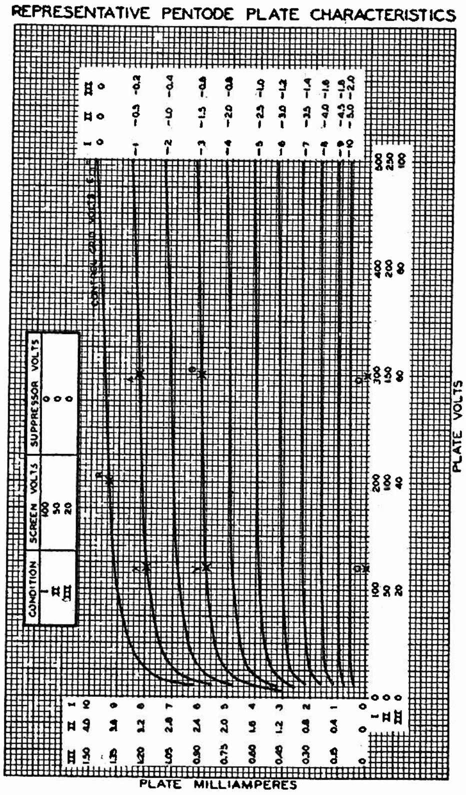


FIG. 1

Typical family of plate characteristics. Three voltage scales and three current scales are shown for a representative pentode. The shape of the curve remains the same, provided all the voltages (other than filament or heater) are changed proportionately.

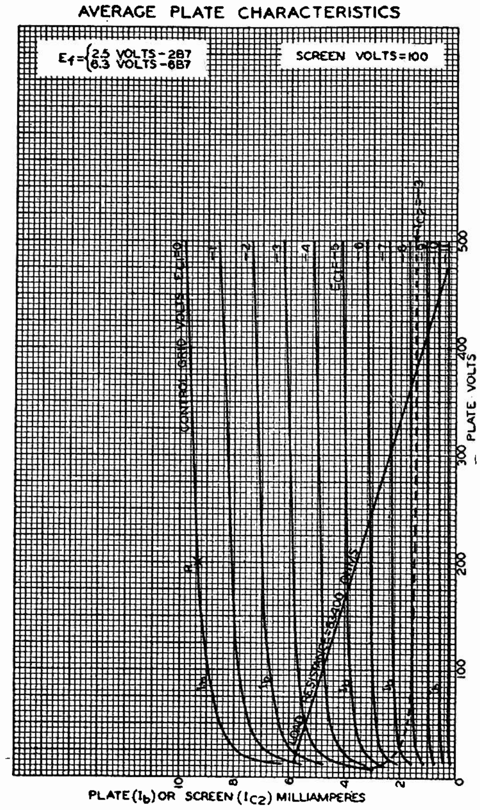


FIG. 2

Here a particular tube is selected, the 2B7 (or 6B7), and a family of plate characteristic curves given. A conversion factor (Fe) is used as multiplier to establish a new voltage scale for any desired set of voltage conditions.

The following technical discussion on a method for the conversion of a tetrode or pentode plate family outlines a means of obtaining from a representative plate family for each tube type operating conditions and performance for any other voltage conditions within the rating of the tube.

The method is simple in its application. It requires for each tube type but two sets of curves; one, giving a representative plate family and the other, the required conversion factors.

RCA Radiotron Co., Inc., and E. T. Cunningham, Inc., who issued the paper, propose to supplement future curve data on tetrodes and pentodes with curves of conversion factors.

IN present-day radio receivers, plate voltages ranging from 50 volts upwards are employed. Commonly employed design methods require a family of plate characteristics at each screen voltage of interest. To cover the entire range of voltages, a large number of characteristic families is needed, unless a method of calculation is used which allows any typical family of curves to be converted to any desired voltage conditions. Such a method of calculation is described.

The potential distribution within a tetrode or a pentode of a given physical structure depends upon the voltages applied to the various electrodes. Multiplying, or dividing, all the electrode voltages by the same factor will not change the relative distribution of the potentials within the tube, provided that no secondary emission occurs.

The electrode currents in tetrodes and pentodes depend upon the potential distribution between the cathode and plate. Since the relative distribution of potential within the tubes does not change when all the electrode voltages are changed proportionately, the ratio of the several electrode currents to each other does not change.

Ratios Preserved

This condition is illustrated in Fig. 1 by a typical family of plate characteristics. Three voltage scales and three current scales are shown in the diagram. Regardless of the magnitude of the voltages applied to the electrodes of the tube, the shape of the curves remains the same, provided that all the voltages are changed proportionately. That is, when the plate voltage is made one-half, the screen voltage and grid voltages must be made one-half as well.

Since the shape of the curves does not change when all the voltages are changed in the same proportion, ratios of current values do not change. For example, the ratios OA/OB and OX/OY do not change. Consequently, by establishing a new current scale for the new voltage conditions, a new family of plate characteristics is provided.

Therefore, if the electrode currents and other pertinent facts are known for one set of voltage conditions, it is possible to establish the current scale for any other set of voltage conditions simply by determining the current at a reference point (R in Fig. 1) for the new voltage conditions.

Convenient Values

In Fig. 2 is shown a family of plate characteristic curves for a typical pentode, the 2B7. To establish a new voltage scale for any desired set of voltage conditions, it is merely necessary to multiply all the voltages in the given family of curves by the appropriate value of voltage conversion-factor (F_e).

The current scale for the desired set of voltage conditions is established from the current at the reference point (R) on the original family of curves and from a current conversion-curve.

The most convenient value of plate current selected as a reference point on the given family of plate characteristics is one which is due to a combination of electrode voltages having a fixed ratio to each other. The selection of such a point simplifies the determination of the current conversion-curve.

At the point R (Figs. 1 and 2) the screen voltage bears the following relationships to the other electrode voltages:

Screen volts: plate volts :: 100 : 200.
Screen volts: grid volts :: 100 : 0.
Screen volts: suppressor volts :: 100 : 0.

The current conversion-curve is then determined experimentally for a similar set of conditions. That is, a curve of plate current versus screen voltage is taken for the conditions. Bias volts = 0, suppressor volts = 0, and plate volts = twice the screen volts. This curve is shown in Fig. 3.

Reference Point

Since the ratio of the several electrode currents to each other remains constant for all proportionate voltage changes, the current scale for any new voltage conditions can be established from a single value of plate current. This single value of plate current at the desired screen voltage is taken from the current-conversion curve in Fig. 3. Its location as a reference point on the new family of plate characteristics is determined by the conditions under which the current conversion-curve was taken.

For convenience, it is desirable to establish a curve of current conversion-factor (F_i) which gives the value by which all the electrode currents shown in the original family of plate characteristics must be multiplied to determine the currents at any other screen voltage. Such a curve is shown in Fig. 4. It is determined by plotting values of the ratio of the plate current at the reference point R in Fig. 2 to the value of the plate current (taken from the current conversion-curve in Fig. 3) at a similar point for any other screen voltage.

The voltage conversion-factor (F_e) corresponding to different screen voltages is shown in Fig. 4. To convert the original family of plate characteristics to any other screen voltage, all voltages in Fig. 1 are multiplied by F_e. An additional curve of resistance conversion-factor (F_p) versus screen voltage is also shown. This curve is determined by plotting the ratio of F_e to F_i at the various screen voltages.

Grid Voltage Limitations

Heater-Cathode types of tubes usually

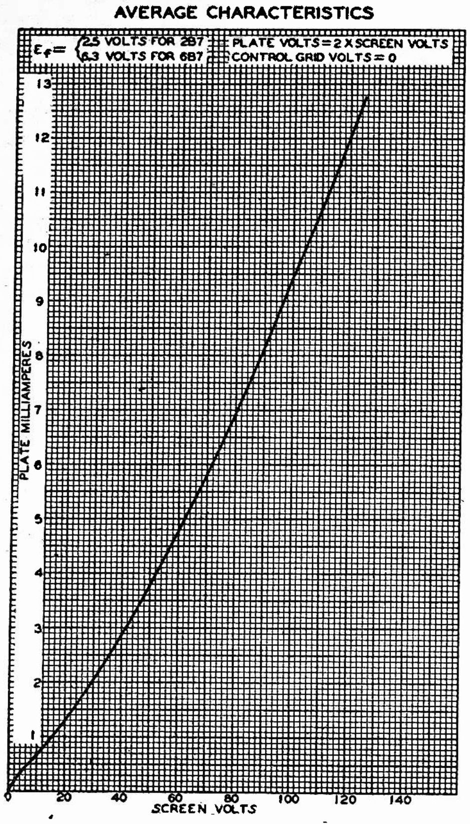


FIG. 3

Since it is desirable to establish the current values for a new set of conditions, a conversion factor (Fi) is used. This gives the value by which all the electrode currents shown in the original family must be multiplied.

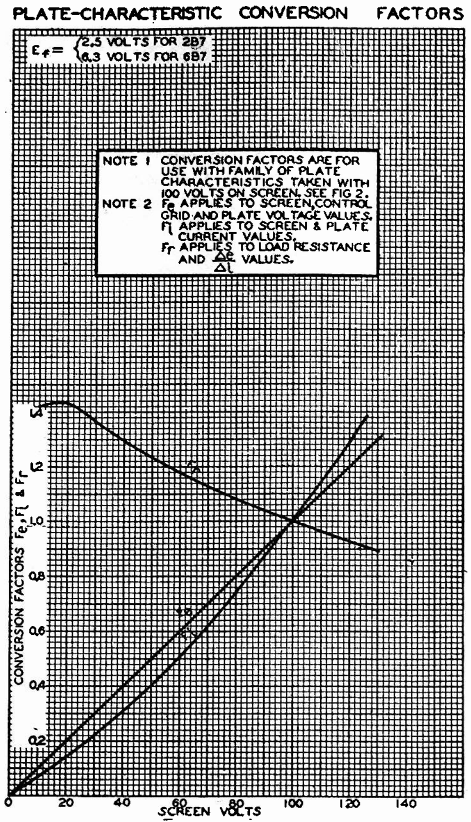


FIG. 4

The conversion-factor curve (Fi) for current. This is determined by plotting values of the ratio of the plate current at the reference point (R) to the value of the plate current (see Fig. 3) at a similar point for any other screen voltage.

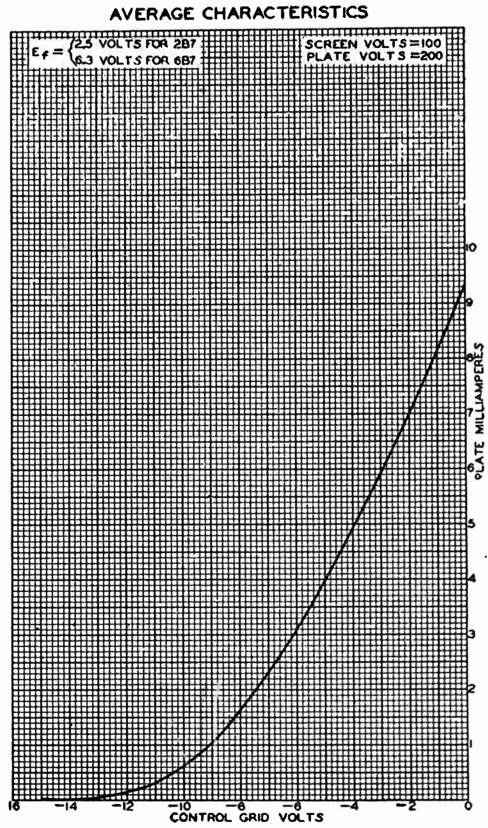


FIG. 5

The characteristic curve of the 2B7 or 6B7, relating plate current and control grid volts. The plate voltage is 200 volts, the screen voltage 100 volts. It can be seen the plate current "cuts off" at around 14 volts negative bias.

draw grid current at grid-voltage values less negative than —0.8 volts. Therefore, for satisfactory operation of a tube under any voltage conditions, the instantaneous grid voltage should never reach a less negative value than —0.8 volt. That is, the useful range of operation along a load line is limited to grid voltages more negative than —0.8 volts.

If the original family of characteristics is to be converted to lower voltage conditions, the grid voltages are reduced from the original values. The least negative value of instantaneous grid voltage also will be reduced proportionately with the other voltages. For example, it is desired to convert the voltage scale downward to one-fifth of its original value ($F_e = 0.2$). Then, the least negative value of the instantaneous grid voltage on the original characteristics must be —4 volts or more. Otherwise, upon conversion (0.2 x —4 = —0.8 volts) the instantaneous grid voltage would swing to a point at which grid current is drawn. It is well to check the value of grid voltage for grid current cut-off for each tube type before the conversion is made.

Therefore, the minimum value of instantaneous grid voltage which can be used in converting to any set of voltage conditions is equal to the limiting value of grid voltage for grid current divided by the desired value of F_e.

Load Line Limitations

In locating a suitable load line, the first selection of plate-supply voltage is made arbitrarily. For example, it is assumed that the plate-supply voltage is 500 volts on the original characteristics, and that it is desired to convert downward to a plate-supply voltage of 100 volts. F_e then is 100/500 or 0.2. The limiting value of grid voltage on the original family is, therefore, —0.8/0.2 = —4 volts. Consequently, the section of the characteristics in which load lines can be placed lies below the —4 volt grid-voltage line.

Higher assumed values of plate-supply voltage for the original characteristics will naturally give smaller value of F_e and more negative limiting values of instantaneous grid voltage.

Consequently, the section of the original family of plate characteristics which is suitable for the location of load lines lies below the limiting value of instantaneous grid voltage for a given value of F_e.

In cases where an electrode other than the cathode is a source of electronic emission, the ratio of the several electrode currents to each other will not remain constant at all proportionate electrode voltages. Consequently, the application of this method of calculation is limited to voltage conditions which do not cause secondary emission. Since secondary emission effects are negligible in pentodes, the entire range of characteristics may be used for conversion. In the case of the tetrodes, the range of conversion is limited to plate voltages somewhat higher than the screen voltage.

Application of Method

Since the voltage conditions of Fig. 1 may be converted to any other desired condition simply by multiplying the scales by appropriate values of conversion-factors, optimum operating conditions determined on the original family of characteristics can be converted to the desired conditions.

Suppose that it is desired to determine the operating conditions for the pentode section of the 2B7 as a resistance-coupled audio-frequency amplifier with a plate supply of 100 volts. A desirable load line (83,440 ohms) is placed on the family of plate characteristics shown in Fig. 2. The conditions for operation at the voltages shown for the given family of plate characteristics are then determined in the usual way and the values noted. The values follow:

Plate-supply volts = 500.
Grid volts = —6.
Screen volts = 100.
Load resistor (ohms) = 83,400.
Plate milliamperes = 3.1.
Screen milliamperes = 0.78*.
Plate volts = 240.
Peak signal volts = 2*.
Peak output volts = 128 approx.
Distortion = 3.5% approx. (mainly 2nd har.).
Voltage amplification = 128/2 = 64.
Self-bias resistor (ohms) = 1550.

*The least negative instantaneous value of grid voltage with this signal voltage is —6 + 2 = —4 volts. With $F_e = 0.2$, this value of grid voltage is satisfactory since the least negative value after conversion is —0.8 volts..

**The value of screen current for —6 volts bias is not shown on the curve in Fig. 2. However, its value is readily calculated since the ratio of plate current to screen current at any bias voltage is constant for a given plate voltage. At 240 volts plate and —3 volts bias, the ratio of plate current to screen current equals 5.94/1.50 = 3.96. The ratio of the plate current to the screen current at —6 volts bias is the same. Since the plate current at —6 volts bias is 3.1 milliamperes, the

(Continued on next page)

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RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

AFTER HAVING TRIED the 2B7 as a detector-amplifier, with a driver stage next, and push-pull output, and also without the driver, so that the 2B7 feeds a single output tube, I find that each time there is a steady, high-pitched audio note, and this practically ruins reception. Kindly advise promptly what remedy to apply.—J.M.H.

A high-gain audio circuit is likely to oscillate at such an audio frequency when this tube is used, and there are several remedies, but the simplest is to put a fixed condenser across the line somewhere. It may be across the load resistor of the diode rectifier in this tube, or from plate of the pentode of this tube to ground, or across an audio leak or plate load in the 56 stage. Try different positions, also different capacities from 0.0005 mfd. up, using as low a capacity as is consistent with curing the trouble. It has been found in commercial practice that 0.001 mfd. across the load resistor of the diode will cure the trouble. While this may seem to be a large value, so as to attenuate high audio frequencies, it should be remembered that the very trouble sought to be cured is one of excessive over-accentuation of amplification in the high audio frequency realm, resulting in oscillation at a fixed frequency in that region, and therefore the seemingly large capacity is nevertheless desirable.

* * *

IS THRE ANY ADVANTAGE in using the 5Z3 instead of the present 280 rectifier in my set? I would gladly make the change if you can point out any advantage.—L.W.

You do not give particulars about your set, but if there is a little hum in it at present, even a barely discernible note when no station is tuned in, you can reduce the hum materially by doubling the amount of capacity next to the rectifier, and using the 5Z3 instead of the 280. The 5Z3 hasn't anything particular to do with the hum, but it does stand about twice as much current drain as the 280, and the extra condenser will put a high-current starting drain on the rectifier tube, besides raising the B voltage a little, the latter a continuous contribution. It may be that the amplification in your set also will be noticeably increased in consequence. A present set using a 280, with up to 8 mfd. next to the rectifier (filament to B minus), may have the capacity doubled, and if the newer tube is substituted it will stand the drain nicely, which the 280 might not, because of the high demand on it at turning on the set.

* * *

THE FILTER IN MY SET is of the typical circuit (pi-filter), but I find there is ineradicable hum in the receiver. I have tried a center-tapped B choke, with condensers from extremes and tap to B minus, but using the tap only increases the hum. While I know that you have given sound remedies for hum reduction in answer to others' questions in recent months, nevertheless nothing printed seems to fit my case and I beseech your valuable advice.—H.R.

The typical filter is preferable where the choke coile is on one winding, that is, a condenser is put from one extreme to B minus, and from the other extreme to B minus; or, if the choke is in the negative leg, the first condenser, next to the rectifier, is from filament to B minus, and the other from opposite end of the choke to ground. There is an advantage in some instances in using the midsection filtration, but this does not apply if the choke is on a single core, and only if the two chokes are separate. The reason is that the mutual inductance of the two legs on one core has the effect of making the midsection condenser effect that of being across the net inductance, instead of across the line. However, you will find considerable reduction in hum if you will put a resistor between the present B plus feed and the radio frequency tubes that it feeds, and bypass it at the coil end with 8 mfd. or similar capacity. If a detector and driver audio stage are also fed with maximum B voltage in the set, use the lower voltage as obtained from the other end of the newly-inserted resistor. The value of the resistor is not critical but will depend on the present current, and in general values from around 5,000 to 15,000 ohms are suggested, and of course the resistor should be larger than the 1-watt capacity. Around 5 watts is the suggested rating, although for sets with two or three tubes thus affected, 2 watts would do.

* * *

I AM ANXIOUS TO BUILD a battery-operated receiver, using electron coupling in the mixer of the superheterodyne, but would desire to confine this work to one tube, so will you suggest the proper tube?—P. W.

Since receipt of your inquiry a battery type pentagrid tube has been announced, and you will find the details in this issue. Also, the circuit is given. This tube fills a need, as you intimate, particularly as the a-c and 6-volt equivalents, the 2A7 and the 6A7, have proved so successful in actual operation. It isn't always true that a tube representing a departure from previous methods proves readily useful in actual circuits, since experience has to dictate the best way to operate the tube. But in this instance, as is true in regard to nearly all the tubes announced during the past year, considerable experience preceded the announcement of the tube, and results were superb. An exception is the 2B7, which requires careful choice of load constants and voltages, and experimenters are finding that slight departure from what the tube manufacturers recommended improves results, e. g., use of a 100,000-ohm plate load, instead of 250,000 ohms, and of a low screen voltage in audio amplification, around 20 to 25 volts.

* * *

IN USING MY newly-purchased short-wave set I hear what I assume to be commercial stations, although the set is tuned to some frequency or frequencies in the amateur band. Is it a fact that there are commercial stations in the amateur bands, and is it permissible? I thought the amateur bands were for amateurs.—T. H.

Yes, there are commercial stations operating in the amateur bands, particularly the 40-meter band, where their location is of doubtful legality. The question is

Non-Standard Voltage Selections

(*Continued from preceding page*)
screen current equals 3.1/3.96 = 0.78 milliamperes.

The Final Figures

Since the desired conditions call for a plate supply of 100 volts, the voltage conversion-factor (F_e) equals 100/500 = 0.2. All voltages as determined above are multiplied by this factor to obtain the new voltages.

Plate supply volts = 100.
Grid volts = —1.2.
Screen volts = 20.
Plate volts = 48.
Peak signal volts = 0.4.
Peak output volts = 25.6.

The voltage amplification will be the same as that for the original conditions, since the ratio of voltages does not change. Likewise, the percentage distortion is unchanged.

The current conversion-factor (F_i) is taken from Fig. 3 for the new screen voltage of 20 volts. The new values of currents are found by multiplying the original current scale by F_i = 0.14. Thus,

Plate milliamperes = 0.434.
Screen milliamperes = 0.11.

The resistance conversion-factor (F_r) equals F_e/F_i = 1.43, or its value can be taken directly from the curve in Fig. 3. The new value of load resistor is determined by multiplying the original value by F_r. The new value of self-biasing resistor is determined in the same way.

Load resistor (ohms) = 119,000.
Self-bias resistor (ohms) = 2220.

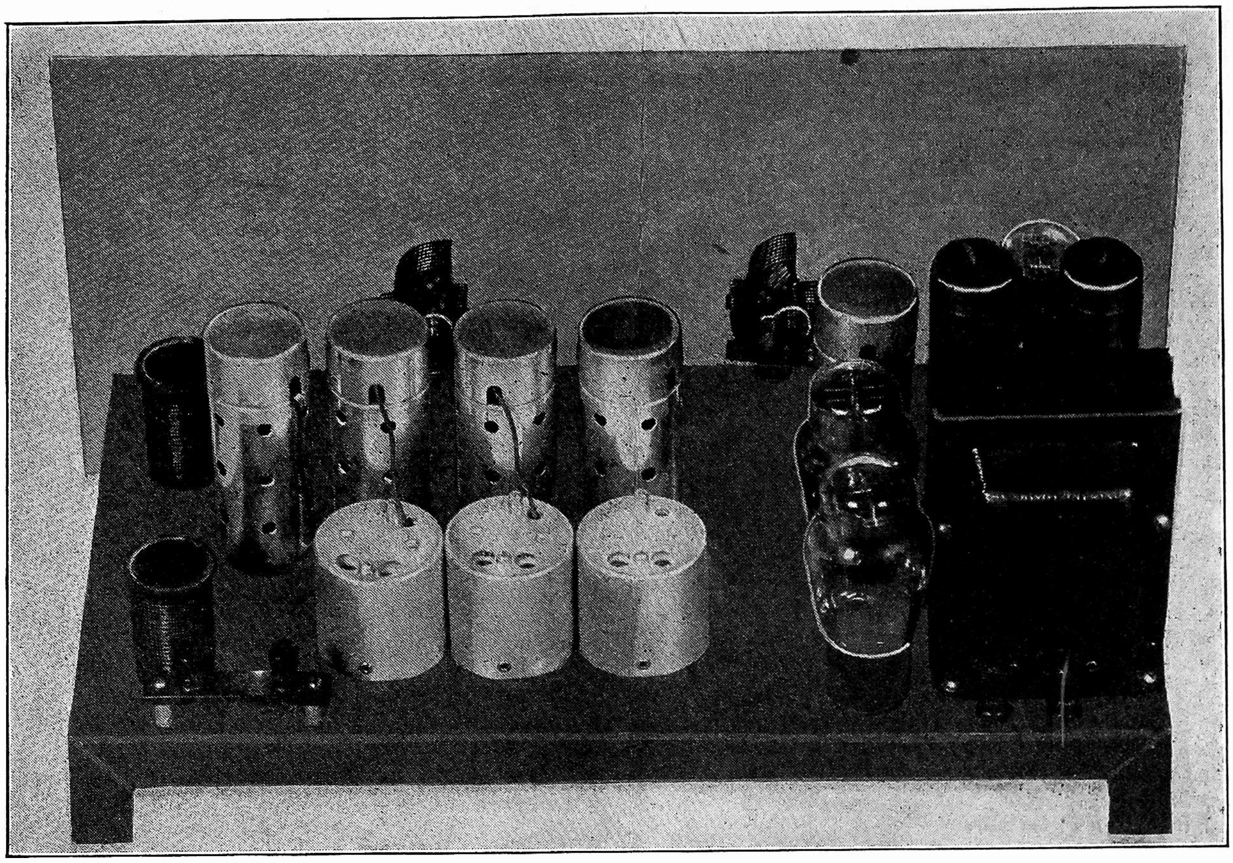
Recommendations

It is not advisable to extend the family of plate characteristics by extrapolation to higher values than those shown on published curves, since the plate-current change in pentodes is not uniform with respect to plate voltage beyond certain values of plate voltage.

In some cases, it will be desirable to interpolate current curves at additional grid voltages on the original family of plate characteristics in order to analyze more accurately the operation of the tube. This can readily be accomplished with aid of the curve shown in Fig. 5. The spacing of the curves (Fig. 1) at any plate voltage is uniform with respect to that at any other plate voltage, provided that no secondary emission takes place. In other words the ratio OA/OB equals the ratio OX/OY (Fig. 1). Stating this relationship in words, the ratio of the plate currents at two given bias voltages and at the same plate voltage equals the ratio of the plate currents at any other plate voltage for the same two bias voltages. The same relationship holds approximately true for screen currents. Consequently, it is possible to draw in any additional current curves which may be needed on the original family of plate characteristics.

Accuracy of Method

Actual laboratory tests have substantiated the results obtained with this method of calculation. Discrepancies between calculated values and values determined experimentally are equal to, or less than, the unavoidable drafting errors of Fig. 1. This method of calculation is, therefore, entirely satisfactory for general design purposes.



Layout of parts in a short-wave superheterodyne from which the builder could get no results. The intermediate coils are too close together, and there are other defects in the layout. The same type of circuit may be arranged properly to work well, as illustrated in last week's issue (front cover, July 8th).

likely to come to a head when the Madrid conference recommendations are considered by the Senate. Although the topic is not directly in line with the Madrid report, confinement of amateur privileges to continental use is one of the direct considerations, and no doubt the other subject will be broached, along with other problems nettling amateurs. There is too much congestion in the principal amateur bands by amateur themselves (though unavoidable, at present), without interference added by commercial stations.

* * *

I HAVE AN ASSORTMENT of small honeycomb coils, and I haven't the faintest idea what their inductance is. May I not use an oscillator, one coil at a time in it, and determine the inductance approximately? All I know about the condenser is its maximum capacity, which is 0.00035 mfd. (commercial rating).—I.F.

Yes, you can arrive at a fair approximation. Take the maximum capacity, representing 350 mmfd., and the circuit strays and various minima as 40 mmfd., or, for convenience, say a total of 400 mmfd. Determine what frequency is generated at maximum capacity setting of the condenser and compute the inductance. If you are not able to make the computation, consult a tri-relationship chart, which gives the relationship between capacity, inductance and frequency. One such chart is commercially produced on a highly accurate scale and costs 25 cents. It covers all the frequencies in which you would be interested, from audio frequency to virtually ultra frequency.

* * *

WHY ARE THE ULTRA frequencies referred to as quasi-optical waves, since in point of comparison the frequencies are so far removed from those of optics that the expression is ridiculous?—T. S.

The quasi-optical waves are so-called not because of their frequency closeness to the waves of light but because their behavior is considerably like that of light waves. Reception is in general limited to the angular distance marked by the horizon.

IN THE CONSTRUCTION of an oscillator to cover the broadcast band with one coil and a low frequency intermediate band with another coil, will a dial calibration in frequencies for one apply to the other, if a suitable harmonic is selected, such as the tenth?—H. D.

No, unless you are willing to tolerate considerable in accuracy, that is, around 4 or 5 per cent. off in some spots. The difference in constants results in a slightly different curve, the percentage frequency difference of which becomes as high as stated. If, however, you could arrange to have each coil trimmed separately with a capacity, and the right capacity cut in for each coil, good coincidence on the dial could be attained.

* * *

IN THE SHORT-WAVE set that I built I find there is considerable oscillation in the intermediate amplifier, and I can not stop it without killing the signal. I have the i-f coils close together, as shown by the photograph enclosed. Also, I do not get any signals whatever.—H.Z.

The i-f coils are too close together and should be separated. The plug-in coil sockets are separated enough as they are. When inductive coupling is very close between stage coils in any amplifier it is a common experience that oscillation and the signal stop together, the situation is that bad. In addition, if you want to filter the intermediate channel in any way, resistors of around 25,000 ohms in the screen leads, bypassed by 0.1 mfd., will help, but would not be necessary if there is no oscillation in the amplifier. If similar plug-in coils are used, a small variable condenser is needed across the modulator tuning condenser, to establish the necessary frequency difference.

TUBE EXPORTS INCREASE

The Arcturus Radio Tube Company reports export sales in dollars and cents volume for the month of May 25% ahead of the corresponding month last year.

56 Developed for Assured Oscillation

The Arcturus Radio Tube Company, Newark, N. J., announces an improvement in the type 56 tube which renders it particularly efficient as an oscillator. The company in a statement said:

"Designed primarily to operate as a detector and amplifier, the type 56 had limitations for use as an oscillator at the higher frequencies under reduced line voltages in superheterodyne sets, particularly in short and long wave receiver combinations.

"The original type 56 was apt to fail to oscillate at high frequencies if the line voltage was reduced below 100 volts. It was also found that many makes of this tube would not oscillate even at 105 volts, yet the static and dynamic characteristics with rated voltages applied to the tube were apparently no different than for tubes which would operate at 100 volts or below.

"Arcturus engineers developed a type 56 tube that would readily oscillate at high frequencies even though the line voltage supplied to the receiver dropped to 85 volts."

Supertone's New Set for Car is All-Electric

Supertone Products Corporation, 35 Hooper Street, Brooklyn, N. Y., has a five-tube all-electric auto set, using a motor generator. It is called the Carjen and uses two 78's, one 6A7, one 6B7 and one 41, said Jacob P. Lieberman, president. It is compact and inexpensive.

"The demand today," said President Lieberman, "is obviously for electrified car sets, and we found that an extra tube did so much more that we included it, rather than follow the conventional four-tube design."

Station Sparks

By Alice Remsen

Spanish Idyll

For Casa Loma Orchestra

WABC—Sunday, 6:30 p. m.; Tuesday, Thursday and Friday, midnight; Saturday, 7:30 p. m.

The candles burned in the loft room,
Casting a misty glow through the gloom,
Striking the scarlet curtain's fold
As the spilled wine from a cup of gold.

There at the table a maiden fair,
With priceless pearls wov'n through her hair,
Sat by the side of a Spanish don—
A bold grandee whom she smilded upon.

She wore a gown of velvet and lace,
A mantilla framed her lovely face;
A pomegranate had stained her lips,
Her cheeks were pink as her finger tips.

The bold grandee knelt down at her feet,
And kissed the hand of his lady sweet;
Eternal devotion to her he swore,
As he led her out through the open door.

The maiden tossed him a smiling glance,
Her red heels clicked in the swaying dance—
The music played a melodious strain—
And romance was born on that night in Spain. —A. R.

* * *

And if you listen in to the lovely music of Glen Gray's Casa Loma Orchestra, playing at the beautiful Glen Island Casino, you, too, will feel the call of romance, moonlight and the dance. This lad has, without a doubt, one of the most attractive dance combinations on the air today. Listen in—you'll like him!

* * *

The Radio Rialto

Johnny Woods Arrives

The last Chevrolet program with Jack Benny went off in a blaze of glory, and I was very glad this hardened scribe heard it, for on it was discovered a new radio personality in Johnny Woods, who impersonated many radio stars of importance, his best being Rudy Vallee, Ed Wynn, and Walter Winchell, the latter being a gem of the first water; knowing Walter well, I can assure you Johnny's impersonation of Mrs. Winchell's bad boy was absolutely perfect; it seems to be that this young fellow—he is only nineteen—should go far in radio and vaudeville.

He Holds His Audience

Listened in again to the Voice of Experience, who, as you probably know, is now broadcasting commercially over WABC and network five times weekly at 11:00 a. m.; must say that this man manages to hold the interest of a listener throughout his program; there is something very fascinating in the way he handles the human interest problems which come his way; he has a philosophical slant on life, and what is more, is able to apply his own views in the solving of other peoples troubles. . . . Have you ever listened in to Vic and Sade, a comedy skit with Van Harvey and Bernadine Flynn, coming through WJZ and network, every weekday at 1:00 p. m. from the NBC Chicago Studios? This is one of the most natural domestic programs I've heard. The dialogue is not what you might call clever, but it's good; the other morning they talked about garbage pails and the moon, and it handed me several snickers—which is going some, believe me, for I listen to plenty of radio and get fed up with most of it. Take a listen to them. . . . Probably by the time this reaches print you'll know that Taylor Holmes, well-known stage and picture star, has been selected to star on the Texaco program while Ed Wynn is away vacationing. Mr. Holmes will do his famous stuttering character, representing Ed Wynn's much malingned "uncle"; it is an excellent idea for one of Wynn's radio family to carry on during his absence, and Taylor Holmes does it to perfection.

"Myrt and Marge" Sail

Myrtle Vail, author and lead of "Myrt and Marge," Bobby Brown, director of the series, and Mrs. Brown will sail for South America on the S.S. Southern Prince from New York on July 15th to gather local color for the "Myrt and Marge" episodes of the Fall and Winter series, so evidently the sponsor has reconsidered his decision, for which all fans of that popular period will give a vote of thanks. . . . A new half-hour sustaining program, entitled "Presenting Mark Warnow," will feature that versatile Columbia conductor and his orchestra, together with guest soloists. Ted Husing will be the announcer. Each Thursday at 9:15 p. m. EDST. . . . At last Nat Shilkret is reailzing one of his greatest ambitions; he will be a glove-trotter this summer, visiting such places as Egypt, Italy, Spain, France, Denmark, Norway, Sweden, Holland, Scotland, England, Ireland, Wales, Belgium, Germany and other countries. This will be the first vacation that Nat has taken in eighteen years. During his absence his brother Jack will take over the baton to direct the Shilkret Orchestra on the "Evening in Paris" presentation. . . . Another new half-hour sustaining program emanating from the studios of station WHK, Cleveland, will be heard over WABC and the Columbia network, each Tuesday afternoon from 3:45 to 4:15 p. m., EDST. "Memories Garden" is the title. The featured artists will be Emanuel Rosenberg, tenor; Vincent H. Percy, organist; and Carl Everson, poetry reader.

Don Carney In New Series

Don Carney is being starred in a new series of programs over WABC each Tuesday night at 9:00 p. m., sponsored by the Poland Springs Corporation of Maine. Each episode is complete in itself, and concerns the history of Poland Springs; produced by the McCann-Erickson Company under the direction of Frank McMahon, Tim Sullivan and Dorothy Barstow; Josef Bonime directs the orchestra. . . . Mann Holiner, the clever writer who is associated with the Federal Advertising Agency, is expecting to leave for London to assist Lew Leslie in the production of the London "Blackbird" show, of which Mann is the author.

Honoring Our President

The latest news of the Ed Wynn chain is that it will be called WFDR in honor of President Roosevelt, who will open the first chain of fourteen stations along the Eastern seaboard. The first month of operation will be confined to sustaining programs, then forty more stations will join the network and commercial broadcasting will begin. It maybe that my old friends of WLW, Cincinnati, will be doing some work over the new chain, as that great station may sign up with the Wynn outfit, at least for part time. . . . Helen Nugent is out in Cincinnati, broadcasting from WLW. . . . So is Thelma Kessler. . . . Jim Harkins and Hal Neiman have teamed for radio and are doing a blackface act which is a scream. If you see them billed anywhere be sure to listen in, for they are funny. . . . And now, as it's summer time, and vacations are in order, I'm going to take a little holiday by not writing quite as much as usual. Have a little correspondence to take care of, so here goes.

* * *

ANSWERS TO CORRESPONDENTS

J. F., Cedar Grove, N. J.—If you would like to hear Jane Pickens doing solo work listen in on Tuesdays at 4:30 p. m. WEAF.

* * *

H. M. Lyall.—The last report I got on the Mills Brothers was that they were in Piqua, Ohio, waiting for Brother John to recover from his illness. . . . I passed your regards on to Floyd Neale! he is still at WOR. Sorry you do not like the poetry, but lots of people do.

* * *

E. V. D., New York.—Maria Cardinale is taking a well-earned vacation and will return to the air in the Fall.

* * *

Nettie Gordon, N. J.—Tommy Weir is not broadcasting at present and I do not know what his plans are. The last I heard he was playing some vaudeville dates.

Studio Notes

A THOUGHT FOR THE WEEK

RADIO manufacturers are preparing for a big season in their field. The mere fact that one concern alone has already enrolled 500 additional factory workers is evidence that conviction is joining hope in the fight for greater sales. There looms in sight a new radio year that will stand out clearly in the light of added interest and renewal of buying desire and power.

Annette Hanshaw, singing star of the Maxwell House Showboat, must be added to the roster of luminaries who are serious amateurs of art. She is a graduate of the National Academy of Design and the recipient of honors in drawing. Annette designs and supervises the cutting of most of her clothes when radio's demands on her time permit.

* * *

Victor Arden, member of the piano team of Ohman and Arden, has played the tune, "Underneath a Japanese Moon" countless times in the theatres and on the radio. He didn't know until recently during the American Album of Familiar Music program, that Gustave Haenschen, the director of the program, had composed the number. Arden has played for Haenschen for years.

* * *

Although some thirty instruments are heard during the "Mountain Music" broadcast from the NBC in New York on Sunday nights, there are only five musicians in the studio. William Wirges, pianist and conductor, is director of the program. Frank Novak, the one-man orchestra, plays more than a dozen instruments. Frank Chase, member of NBC production staff, surprises his associates by appearing as the hill-billy master of ceremonies.

* * *

B. A. Rolfe has broken a precedent. Seldom heard over the air, "B. A." spoke on his Saturday night program in a skit featuring Frank Luther, leader of the Men About Town trio.

Industry Formulating Its Recovery Code

Rapid progress is being made toward formulating a code of fair practice for the radio industry and its separate divisions, for presentation to the National Industrial Recovery Administration at Washington. All Radio Manufacturers Association members will have ample opportunity for consideration and full discussion of the proposed radio code before its submission to the Government.

Special provisions covering interests of each group of manufacturers, it is contemplated, will be incorporated, with general provision of the national code applying to all radio manufacturers.

Following a meeting in New York of the executive committee of the tube division, to consider special code proposals relating to the tube industry, there were meetings at the Hotel Statler in Buffalo of the executive committee of the parts, cabinet and accessory, and the amplifier and sound equipment divisions. This was followed by a meeting of the general RMA Industrial Recovery Committee under Chairman McCanne.

Television Demonstration Enjoyed by Psychologists

Members of the Western Psychological Association, gathered at their annual meeting at the University of Southern California, enjoyed a television demonstration staged by the Don Lee television station W6XS, in Los Angeles, under supervision of Harry R. Lubcke, director of television for the network.

The 200 assembled psychologists saw unreeled before them, on a receiver screen, motion picture film showing Prof. E. W. Scripture, and Dr. Milton Metfessel engaged in an experiment to measure the rate of breathing under emotional stress. The film was made in Vienna.

The film was picked up with satisfactory clarity by the group on the college campus, on a receiver of the E. B. Dunn Co., of Los Angeles.

Professor Scripture, head of the Psychology Department at the University of Southern California, expressed himself as impressed by the demonstration.

ARCTURUS WINS ROYALTY SUIT

Radio Corporation of America lost a suit against Arcturus Radio Tube Company to recover $33,000 in disputed royalties in New Jersey Supreme Court.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, Radio World, 145 *West 45th Street, New York, N. Y.*

Floyd C. Bonnell, 225 W. Mechanic Street, Princeton, Ill.
Knise Radio Service, 5 Franklin Street, Santa Cruz, Calif.
G. Pasquale, 100 N. Main St., Wellsville, N. Y.
C. J. Hucabee, 702 United Fruit Company Bldg., New Orleans, La.
Bill S. Wedel, 305 6th St., Huntington Beach, Calif.
C. W. Lusk, R. 2, Box 138, W. Monroe, Louisiana.
Ray C. Walker, Amateur Radio, 418 West Court St., Beatrice, Nebr.
E. L. Horne, Furniture, Batesboro, S. C.
F. C. Davis, 41 Winter St., Portland, Maine.
M. De Oliveira, P. O. Box 296, Middletown, N. Y.
Leland Means, Topsfield, Mass.
M. Storkan, Y. M. C. A., Lincoln, Nebr.
Robert Woods, Perry Ave., Norwalk, Conn.
Gerald J. Murphy, C.P.A., New Orleans, La., 703 Napoleon Ave.
Wm. T. Risdon, 128 Harrison Ave., Morrisville, Pa.
N. Peterson, Radiotrician, P. O. Box 182, Riverside, Calif.
M. C. Young, Box 543, Bluefield, W. Va.
Thos. Morgan, 903 Main St., Southbridge, Mass.

TRADIOGRAMS

By J. Murray Barron

What is claimed to be the largest public address system in the world has been erected at Long Beach, L. I., by the Audible Advertising, Inc., of 597 Fifth Avenue, New York City. From twelve especially built loudspeakers, the latest in dance music, popular songs, beach exercise, news events and advertising will be imparted to boardwalk strollers. The system will run along a mile and a quarter.

* * *

Frank Grimes, formerly at the 85 Cortlandt Street store of Try-Mo Radio Corp., N. Y. City, has taken charge of the transmitting department at the 179 Greenwich Street store, corner of Dey Street. At the Greenwich Street store a bargain basement has been opened, catering to the experimenter and serviceman.

* * *

That the automobile radio receiver is a popular item nowadays is demonstrated daily at almost any well-located radio retail store. Servicemen and others are overlooking a very excellent idea unless they cash in during the next six weeks when such sales are possibly the largest. The general plan is simple enough after the source of supply is located. There are several good makes not listed among what is generally considered nationally-known radio receivers. The idea is to have one installed in a car for demonstration, or located at some convenient place in the neighborhood where it may be seen and heard. There is plenty of business for a live fellow who will go after it and not wait for it to drift in.

* * *

An idea with great possibilities that right now is bringing in some business without very much effort is an amplifier for the "hard of hearing." In New York City a man has built up a healthy business selling an amplifier of this type with microphone and headphones to business men for use in their offices. The unit is very efficient and can be had for out-of-town business, or the circuit and parts may be bought and amplifier built up from the kit. Those interested may have full information by addressing the Trade Editor.

* * *

A good point to bear in mind when buying a kit or wired short-wave receiver, is that the circuit is a very essential part of the whole outfit. Just a number of tubes and any circuit will not necessarily produce satisfactory results. In fact they may prove quite disappointing. On the other hand, a well-designed and tested circuit with minimum amount of tubes may give one many thrills and more consistent performance. It is well thoroughly to understand just what is claimed for the kit or outfit. Naturally it is quite difficult for a dealer to guarantee the mechanical ability of the home constructor, but if the diagrams are correct and the values followed and common sense used it is not unreasonable for the builder to expect to approximate the claims of the dealer in performance. Some three-tube short-wave receivers will give the fan more than enough thrills to warrant him adding this form of entertainment to his list of amusements. To avoid unnecessary disappointment and loss of faith in a hobby that is surely worthwhile one should avoid sets for which outlandish and exaggerated claims are made.

* * *

The July issue of "Radio" is the first under the new title "Radio Short-Wave and Experimental." With the merging of "Modern Radio" and "Radio" the public is assured of even a greater effort to serve their interests. With this assurance goes knowledge and a history in the radio industry dating back to 1917, so the readers of both publications should feel doubly proud that they can now enjoy the best of the two under one cover.

Philco Seeks to Band 25,000 Service Men

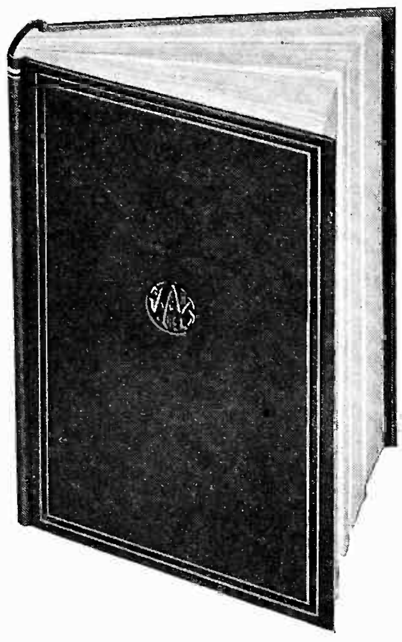
A radio servicemen's association is being organized under the name of Philco Manufacturers Service. It aims to combine the 25,000 best servicemen in the country into a single cooperative association.

Philco distributors are active in the organization of local units of this organization, although members will be picked from dealers of all kinds, whether selling Philco products or not, and from independent servicemen throughout their territories. Membership certificates in the Radio Manufacturers Service will be sent to each member as enrolled, accompanied by a chart of definite fixed charges for all types of service jobs. All service calls which come into Philco dealers will be turned over to members of the Radio Manufacturers Service while an extensive advertising program under Philco supervision will stimulate interest in radio repairs and maintenance and bring business into the members' shops.

Members of the Radio Manufacturers Service will receive regular bulletins on service work, technical information on new tubes and new models. All work performed by members will carry a ninety-day guarantee—a step which will do much to create public confidence in the ability and stability of this new organization. Philco distributors throughout the country are at present engaged in getting this organization under way, although, as it has already been explained, this is an organization of all good servicemen and is not in any sense limited to Philco specialists.

RADIO EXPORTS INCREASE

Increase in exports of American radio during April is reported by the Electrical Division of the Department of Commerce. The April exports were $1,510,897, compared with $1,397,861 for March. There was a reduction, however, as compared with exports in April, 1932, which were $1,875,716.



MORECROFT'S "ELECTRON TUBES and THEIR APPLICATIONS"

(A NEW BOOK)

HERE is a new book by John H. Morecroft, consulting engineer, professor of Electrical Engineering, Columbia University, N. Y. City, a book many had been hoping he would write. It is a practical authoritative book on tubes and their manifold applications. Those acquainted with his previous books will not be disappointed for he has written the sort of book which every technician, engineer, experimenter, and student will find of incalculable value and inspiration. The whole story of tubes is here—written in clear, direct and forceful English.

The first part of the book discusses a general treatment of the subject of extracting electrons from metals and methods of utilizing them. The succeeding chapters deal with the characteristics and applications of all types of commercial tubes. Written in a simple and direct manner, this book will be of great service to the engineer who is at present working in the profession and whose achievements must depend upon his ability to improve processes and products—and from the many applications covered in the book he is almost sure to find tasks in his own field for which they will efficiently serve. 578 pages, 6 x 9 inches. Order Cat. MET @ $4. Remit with order and we pay postage. Order C.O.D. and you pay postage.

MORECROFT'S "PRINCIPLES OF RADIO COMMUNICATION"

(A NEW EDITION)

Prof. Morecroft's "Principles" is one of the standard books on radio for those who have mathematical training and are somewhat advanced in radio. First published in 1921, it is now, in its 1933 edition, fully up-to-date. New material has been added on amplification, shielding, electrolytic condensers, crystal oscillators with calibration of their harmonics and other topics. 1084 pages, 6 x 9 inches. Order Cat. MPR @ $7.50. Remit with order and we pay postage. Order C.O.D. and you pay postage.

MORECROFT'S "ELEMENTS OF RADIO COMMUNICATION"

(RECENT EDITION)

This is an adequate and comprehensive book on radio, stressing particularly the field of broadcast receiver design. The subject is developed in a natural and conventional manner and the mathematical treatment does not range beyond the field of advanced algebra. It is an excellent book for beginners.

CONTENTS

Simple Laws of Electric Circuits; Laws Particularly Useful in Radio Communication; General Idea of Radio Communications; The Vacuum Tube and Its Use; Radio Telegraphy; Radio Telephony; Receiving Sets; Problems.

269 Pages 6 x 9 Cat. MEL, $3.00

Technical Books JUST OUT!

"THE INDUCTANCE AUTHORITY"

By EDWARD M. SHIEPE, B.S., M.E.E.

[A NEW BOOK]

THE ONLY BOOK OF ITS KIND IN THE WORLD, "The Inductance Authority" entirely dispenses with any and all computation for the construction of solenoid coils for tuning with variable or fixed condensers of any capacity, covering from ultra frequencies to the borderline of audio frequencies. All one has to do is to read the charts. Accuracy to 1 per cent. may be attained. It is the first time that any system dispensing with computation has achieved such very high accuracy and at the same time covered such a wide band of frequencies.

A condensed chart in the book itself gives the relationship between frequency, capacity and inductance, while a much larger chart, issued as a supplement with the book, at no extra charge, gives the same information, although covering a wider range, and the "curves" are straight lines. The condensed chart is in the book so that when one has the book with him away from home or laboratory he still has sufficient information for everyday work, while the supplement, 18 x 20 inches, is preferable for the most exacting demands of accuracy and wide frequency coverage.

From the tri-relationship chart (either one), the required inductance value is read, since frequency and capacity are known by the consultant. The size and insulation of wire, as well as the diameter of the tubing on which the coil is to be wound, are selected by the user, and by referring to turns charts for such wires the number of turns on a particular diameter for the desired inductance is ascertained.

There are thirty-eight charts, of which thirty-six cover the numbers of turns and inductive results for the various wire sizes used in commercial practice (Nos. 14 to 32), as well as the different types of covering (single silk, cotton-double silk, double cotton and enamel) and diameters of ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1¾, 2, 2¼, 2½, 2¾ and 3 inches.

Each turns chart for a given wire has a separate curve for each of the thirteen form diameters.

The two other charts are the tri-relationship one and a frequency-ratio chart, which gives the frequency ratio of tuning with any inductance when using any condenser the maximum and minimum capacities of which are known.

The book contains all the necessary information to give the final word on coil construction to service men engaged in replacement work, home experimenters, short-wave enthusiasts, amateurs, engineers, teachers, students, etc.

There are ten pages of textual discussion by Mr. Shiepe, graduate of the Massachusetts Institute of Technology and of the Polytechnic Institute of Brooklyn, in which the considerations for accuracy in attaining inductive values are set forth. These include original methods.

The curves are for close-wound inductances, but the text includes information on correction factors for use of spaced winding, as well as for inclusion of the coils in shields.

The publisher considers this the most useful and practical book so far published in the radio field, in that it dispenses with the great amount of computation otherwise necessary for obtaining inductance values, and disposes of the problem with speed that sacrifices no accuracy.

The book has a flexible fiber black cover, the page size is 9 x 12 inches and the legibility of all curves (black lines on white field) is excellent.

Order Cat. IA @ $2.00 (book and supplement). Remit with order and these will be sent postpaid to any destination. Order C.O.D. and you pay the postage.

Vol. III of RIDER'S MANUAL (A New Book)

Just out, John F. Rider's Vol. III Manual weighs nearly 11 lbs. and has 1,100 pages, all diagrams of commercial receivers, etc. (no text). Sets announced up to May 1st, 1933, are included—and complete information on every one, including resistance values. The volume is original and necessary and does not repeat data that are in Vols. I and II.

A Chronological Catalog and Index of all nationally-advertised radio receivers manufactured and sold in the United States between January, 1921 and January, 1933 are contained in Volume III. This list will be of tremendous aid in the identification of receivers for which the model number is not known.

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Complete tabulation of tube data showing electrical characteristics and constants for all of the tubes employed in radio receivers and amplifiers since 1921. Also a table of interchangeable types.

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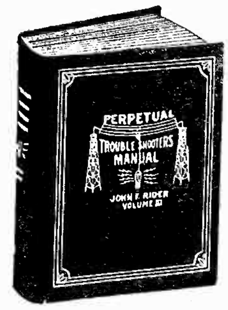

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