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The New All-Star Junior. See Pages 3 and 4.

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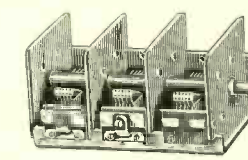

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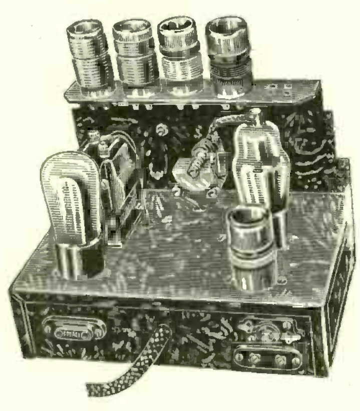

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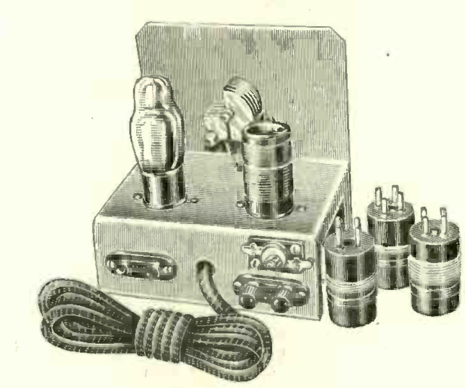

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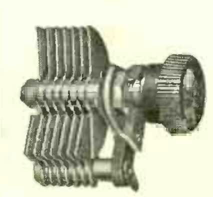

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THIRTEENTH YEAR

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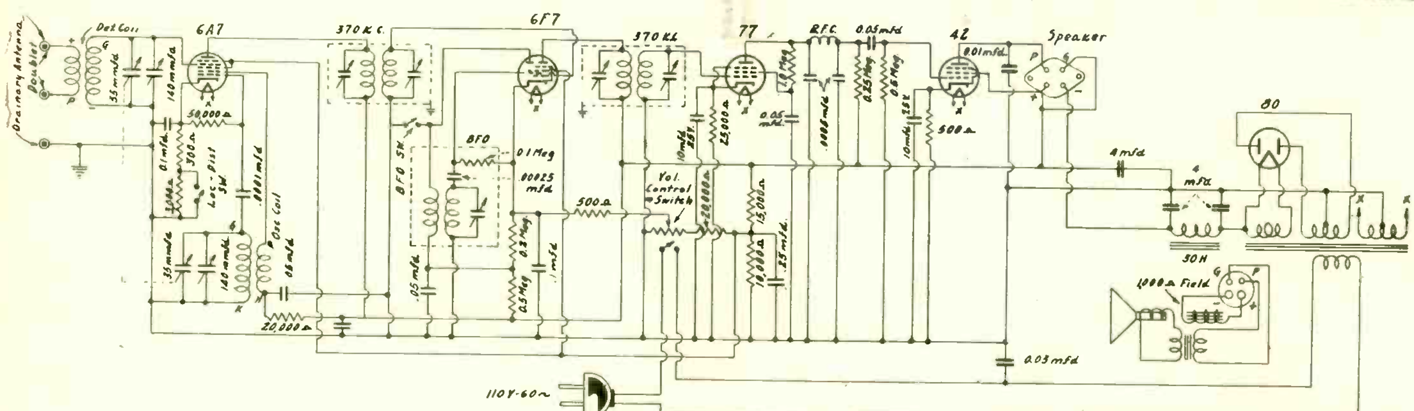
A Compact Bandspread Super

All-Wave 5-Tube Circuit Has Beat Oscillator

By L. C. Raleigh

ALL-STAR JUNIOR DEVELOPS BIG OUTPUT FROM FEW TUBES



A circuit showing a five-tube design for all-wave, bandspread and beat-oscillator performance. That quite a lot is obtainable from five tubes this circuit abundantly proves. It is the All-Star Junior.

DUE largely to the efficiency obtainable from present-day tubes, a receiver of some consequence may be built, using only five tubes, and one of these tubes is the rectifier. The diagram of this bandspread receiver is shown herewith. On the front cover is a reproduction of a photograph of the built-up receiver. *(Continued on next page)*

LIST OF PARTS

Coils

Two coils, one for antenna, one for oscillator, for each frequency band as follow:
540-1,200 kc.
1,100-2,300 kc.
2,200-4,400 kc.
3,800-8,900 kc.
7,750-16,000 kc.
15.5-30 mgc.
Input i-f transformer, 370 kc.
Output i-f transformer, 370 kc.
Beat-frequency oscillator Coil.
R-F choke, 16 millihenries.

Condensers

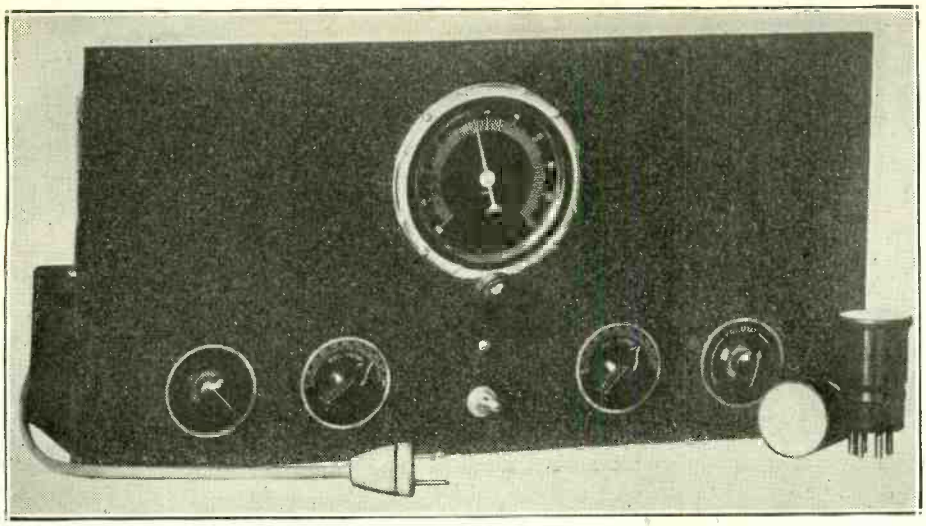
Two 140 mmfd. variable condensers.
Dual 35 mmfd. variable condensers.
Three sections, each one 4 mfd. 450 volts.
.1 mfd. 400 volt condenser.
.25 mfd. 400 volt condenser.
.05 mfd. 400 volt condenser.
.03 mfd. 400 volt condenser.
.01 mfd. 400 volt condenser.
.0005 mfd. mica condenser.
.0001 mfd. mica condenser.
10 mfd. 25 volt condenser.

Resistors

300 ohm.
3,000 ohm.
50,000 ohm.
20,000 ohm.
500 ohm.
200,000 ohm.
500,000 ohm.
25,000 ohm.
1 meg.
250,000 ohm.
10,000 ohm, 10 watt.
15,000 ohm, 10 watt.
260 to 25,000 ohm potentiometer, logarithmic taper, with a-c switch attached.

Other Requirements

Dynamic speaker, 1,000-ohm field; with output transformer built in, 24-inch a-c cable and a plug.
Three tube shields and bases.
Eight wafer sockets: two 7-prong, two 6-prong; three 4-prong and one 5-prong. (One of the "fours" is for speaker, the "five" is for oscillator coil.)
Tubes: One 6A7, one 6F7, one 77, one 42, one 80.
One rotary switch S.P. S.T.
One toggle switch S.P. S.T.
Three binding posts (two antenna, one ground).
Three grid clips.
Two bar knobs for ¼" shafts.
Nuts, bolts, soldering lugs.



Front view of the compact all-wave superheterodyne.

(*Continued from preceding page*)

This is an all-wave superheterodyne, capable of being tuned from 30 megacycles to 545 kilocycles. The volume and tone quality are satisfactory.

The tubes are used as follows:

6A7 mixer and electron-coupled oscillator.
6F7 pentode intermediate-frequency amplifier and triode beat frequency oscillator.
77 detector and amplifier.
42 power output tube.
80 full-wave rectifier.
The i-f is tuned to 370 kc.

The Bandspread Method

The bandspread method of tuning consists of the use of two tank condensers for first selection of any particular wave band within the range of the coils being used. After setting the tank condensers, the main tuning dial which operates two sections of the gang tuning condenser is used to select the desired station. The vernier reduction mechanism of this dial spreads the scale over 270 degrees of an illuminated airplane type dial. Stations may be logged for future reference with accuracy. This spreading of stations over the dial may be compared to conditions in the broadcast band familiar to the standard broadcast tuning. WGN, WOR and WLW are bunched on three points of the usual receiver's dial. On this set, these three stations may be spread over a dozen points, and with the aid of the beat-frequency oscillator, each station may be tuned in accurately. In trans-oceanic reception, stations in several countries may be within a wave band of two or three meters. The bandspreading device separates these stations.

The range of 30 mgc to 545 kc, or 10 to 550 meters, is accomplished with six pair of plug-in coils.

The selection of a speaker and a baffle or housing for it partly determines the tone quality. The electrical output of the receiver is good between 70 cycles and 5,000 cycles. The larger the speaker baffle, the more efficiently the deep tones will be reproduced. A tone control is not used because it reduces the intensity of the higher audio frequencies which go to to make realistic reproduction possible. Experimenters who desire tone control may instal a 500,000-ohm rheostat in series with an 0.05 condenser across the 250,000 ohm detector plate resistor and suppress the higher audio frequencies.

Speaker Field Filter

Standard 110- to 120-volt, 60-cycle a.c. is the only suitable source of power. The set is designed with low current consuming 6.3 volt tubes; hence it draws less than 60 watts from the electric system. A standard type 80 rectifier tube in a well-filtered B supply, using dry electrolytic filter condensers and the 1,000 ohm field of the dynamic speaker as part of the filter, delivers hum-free power to the tubes. A line filter condenser in the transformer primary prevents some outside interference from entering the receiver due to the antenna effect of the a-c cable and the line itself.

Good quality tubes are essential. Select the brand with which you are most familiar. The set does not require matched or specially selected tubes so long as the tubes actually used are in good condition.

The dynamic speaker must have 1,000 ohms field resistance (within 10% is satisfactory). It must be equipped with an output transformer which will match the 7,000-ohm recommended output load of the 42 power tube. A four-prong plug, its size equivalent to the base and pin arrangement of a type 80 tube, is required to connect the speaker to the output socket on the back of the chassis.

The aerial may be a plain wire 40 to 80 feet long and from 10 to 40 feet above ground or metal roofing. It should consist of one piece of good copper aerial wire well insulated with glass or porcelain. A connection to the earth through a water pipe or buried metal plate is required with this type of aerial. In locations where interference is encountered, the doublet aerial system of two equal lengths of aerial pickup wire should be connected to a twisted pair transmission wire lead-in and connected to the set without a ground wire. Special transformer coupled doublet antenna systems will operate well with this set.

Beat Frequency Oscillator

Anyone familiar with a soldering iron, screw driver, and pliers can assemble the set in a few hours.

Two features which assure the builder of better performance from the set are the beat-frequency oscillator and the bandspread tuning system. The beat oscillator permits tuning in the carrier of distant stations even though no signal is being transmitted at the moment. As many Asiatic and European stations have long silent periods between announcements, this is the only method by which the listener can detect the presence of the station's carrier wave. The bandspread tuning system spaces stations over the main tuning dial and permits accurate logging of the congested channels. Often ten or twelve stations will be on, say, the 49-meter band simultaneously. No ordinary short-wave set can possibly select a particular station in this important international channel and log its position accurately. With the bandspread method of tuning every signal has a definite spot on the dial scale.

The circuit employs a 6A7 tube as a combination oscillator and mixer. A 6F7 pentode-triode functions as an i-f amplifier on a frequency of 370 kc. The triode part of the 6F7 is connected as a beat-frequency oscillator with a control switch on the front panel. A 77 pentode detector is resistance coupled to a type 42 pentode power tube. A standard 80 rectifier tube is used in the well filtered power pack of the B supply. The circuit calls for a dynamic speaker with an inductive hum-bucking field shunt, and a transformer to match the speaker's voice coil to the type 42 tube.

Constructional Steps

The assembly of this circuit, called the All-Star Junior, has been simplified. The parts are mounted on the chassis deck as the assembly progresses, the front panel being mounted last as a precaution against marring the finish or breaking the glass window of the airplane type tuning dial. The first step is to mount the wafer type sockets with 6 32 ½ inch bolts and lock washers. The power transformer and choke are mounted next. With these parts in place the preliminary wiring may be installed. The second series of assembly operations involves the controls which appear on the front of the panel. From left to right these are: the local distance switch, the Hammarlund oscillator tank condenser, the beat-frequency toggle switch, the Hammarlund detector tank condenser, and the logarithmic-tapered 25,000 ohm potentiometer and power switch combined.

The 6A7, 6F7, and 77 tubes must be shielded. Shields with mounting bases punched for 1½" centers were used on the laboratory models and proved successful in suppressing all oscillation resulting from coupling between tubes.

Six pair of coils are recommended for all-wave reception. The oscillator coils have five prongs and the detector coils have four prongs.

SOCKET CONTACT RESISTANCE

Whenever tubes are used that carry heavy current or that are especially dependent on just the right filament voltage, as where the mutual conductance is high, the socket contacts must be especially good. This means low contact resistance. Tubes such as the 2A3, 82 and 83 fall into this category.

The mercury-vapor rectifiers require this condition for reasons of regulation, especially as there might be inconstancy of the high contact resistance.

Principles of Matching

Maximum Power Transfered When Load Equals Supply Impedance

By M. N. Beitman and I. Gebel

IT is of interest to know how electrical power may be transferred efficiently and with the minimum of distortion. A common example of power transfer, encountered in every loudspeaker system, is the impedance matching of the output power tube to the loudspeaker voice coil.

Consider a generator G, which may be a vacuum tube, generating an electo-motive force E, and having internal resistance R. Let further a load R_L be connected to the generator, Fig. 1. The circuit equivalent to this is where voltage E is imposed on R and R_L in series, Fig. 2. According to Ohm's Law current

$$I = \frac{E}{R + R_L} \quad \ldots\ldots\ldots\ldots (1)$$

will flow in the circuit. The power used by the load is

$$W = I^2 R_L \quad \ldots\ldots\ldots\ldots (2)$$

or on substituting (1) in (2)

$$W = \frac{E^2 R_L}{(R + R_L)^2} \quad \ldots\ldots\ldots\ldots (3)$$

differentiating this equation and setting it equal to zero to find the maximum power, we have

$$\frac{dW}{dR_L} = R - R_L = O \quad \ldots\ldots\ldots\ldots (4)$$

or

$$R = R_L \quad \ldots\ldots\ldots\ldots (5)$$

In other words the maximum power transfer occurs when the load equals the source. For a.c., in a similar manner, it can be shown that for maximum power transfer the impedance of the load should equal that of the source.

At left, a load R_L connected to a generator, G. At right, the equivalent series circuit.

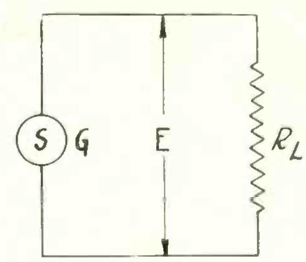


FIG. 1

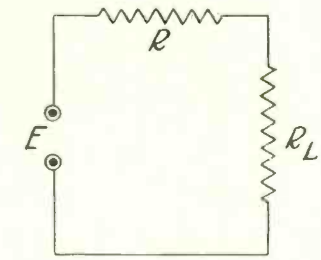


FIG. 2

The Radio Example

However, in radio practice it becomes necessary to further consider the associated distortion. Many times the efficiency of power transfer is sacrificed to keep distortion of certain types within the allowed limits. For example, pentode type power tubes are not loaded for maximum power output, but at some point where some power is lost to obtain less harmonic distortion.

The source of current is usually referred to as simply the **source**, and the load circuit is termed the **sink**. If the impedances of the source and sink do not match, i.e., do not approach each other in value, a loss of power occurs. The greatest transfer of power occurs when the sink and source are equal (5), in that case useful power equals to

$$W = \frac{E^2}{4R} \quad \ldots\ldots\ldots\ldots (6)$$

Now the power obtained with a sink R_L is expressed by

$$W = \frac{E^2 R_L}{(R + R_L)^2} \quad \ldots\ldots\ldots\ldots (7)$$

and this divided by the maximum power obtainable (6) and multiplied by 100 will give per cent. efficiency of power transfer:

$$\%\ \text{efficiency} = 100\, \frac{4RR_L}{(R + R_L)^2} \quad \ldots (8)$$

Turns Ratio Considered

Now from this formula it is evident that when the source is of a value close to that of the sink, no appreciable loss of power occurs. This same reasoning applies to alternating currents, and the very same formulas may be used if only resistance is considered or if the phase angle is small.

With alternating currents, of course. a transformer may be used to match two unequal impedances. A transformer makes the source appear to the load as if its impedance has been multiplied by the square of the turns ratio. If, for example, a power tube requiring a 5,000 ohm load is to be coupled to a voice coil having a resistance of 8 ohms, an output transformer having a turn ratio of 25 to 1 will enable the maximum power transfer to take place (25 X 25 X 8 = 5,000).

However, it is not always advisable to use a transformer where the mismatch is but slight. Some loss always takes place in the transformer, and at times this loss may be greater than the one encountered if the two impedances are connected directly. A transformer further usually shows discrimination for different frequencies, and may cause more distortion than slightly mismatched source and sink.

Where Difference Is Small

For example if a 600-ohm load (sink) is to be coupled to a 500-ohm line, a question arises whether it is advisable to use a transformer. Of course, in this case and other similar situations the answer will depend somewhat on the allowable distortion and the quality of the transformer available. Judging of hand, a transformer does not seem to be needed. On substituting the values in question in equation (7), the efficiency is found to be more than 99%. Surely this value could not be approached even with the best laboratory transformer.

But if the impedances at different frequencies are not constant, losses at some frequencies may be much larger and necessitate the use of a suitable transformer. This, although possessing a larger average loss, does not discriminate to any large extent any group of frequencies involved.

65,000,000 Tubes Sold in 1934; Year's Increase 10,000,000

By BOND GREDDES
Executive Vice-President, Radio Manufacturers Association

Generally, the radio industry in 1934 enjoyed its best business since the depression. In total volume of receiving sets, tubes and parts and accessories, and also in unit value, there were substantial increases during 1934, largely due to introduction and wide public acceptance of the new modern dual-wave and all-wave receivers.

Estimates of 1934 sales are now coming from many quarters prior to compilation of final statistics. The best information now available indicates that 1934 sales of receivers totaled at least 4,500,000, and tubes around 65,000,000. This compares with estimated 1933 sales of 3,800,000 sets and 55,600,000 tubes. Dun & Bradstreet have issued an estimate that receiver sales in 1934 will even reach 5,500,000.

The 1934 set industry was marked by a decreasing ratio in sales of midget sets and increased public demand for more extensive console sets, and there was a widened trend in sales of the larger cabinet or mantel type. Steady demand for automobile sets also continued in 1934.

Only four new receiving tubes were introduced in 1934 as compared with forty-one new tubes in 1933, a stabilizing influence for both set and tube manufacturers.

It is estimated that the average retail price of all types of home receivers rose from about $48 in 1933 to nearly $60 in 1934.

In technical advance in engineering development of receivers, 1934 was marked by expansion of the frequency range. Two years ago less than half of the set manufacturers presented models covering more than the American band while now over ninety per cent of radio lines include extended-band receivers, while seventy-five per cent of 1934 models were multiple band types.

A Small, Sensitive Relay

Useful For Photocells—Works on 2 Ma. Change

By Samuel Wein

RECENTLY articles concerning the photo cell have been appearing in these columns and it may have occurred to some of our readers that they would like to adapt this cell to perform various operations.

In this endeavor it is necessary to use a relay that is sensitive to a very small current and will operate an armature against a set of contacts that control an external circuit. These contacts might be required to control a lighting circuit, a motor circuit or other special adaptation of automatic control, that is made to work on variation in light.

In the relay to be described it has been found that the sensitivity of this device is such that the armature would be attracted toward the magnet coil when a few milliamperes flow through the coil at the minimum adjustment of the spring. The fine sensitivity of this relay renders it well able to perform the duties necessary in conjunction with a photo cell.

How to Wind the Coil

References to the sketches on the next page will reveal the constructional details of this instrument. The uppermost diagrams show two views of the completed relay while the lower figures give the details. The construction is so simple that anyone can build this device.

The most important part of this relay is the electromagnetic coil which consists of a central soft iron circular core with two fibre washers, ¾ inches in diameter, at each end. Between the two washers is found a coil of No. 32 enamelled wire to fill the space between them. It is advisable to intersperse the wire layers with some insulating material so that they may be maintained in perfect condition. Because of its many other advantages and the degree of its thinness, cellophane is useful for this purpose. For the winding a lathe would be best. However, in the absence of such a machine, a hand drill or mother's sewing machine will fill the bill. Uniform layer winding has the advantage over scatter winding in this connection in that more turns may be used for the given space available. Thus the magnet can be made more effective, since the strength of a magnet depends directly upon the number of turns. This does not mean that several thousand turns will be much better than several hundred turns, since current is also a determining factor. With the several thousand turns, the magnet's resistance goes up a great deal with a consequent reduction in current which nullifies the advantage of the greater number of turns. About 1,000 ohms resistance should prevail.

Sheet Iron Armature

The armature is the element that carries the contacts and is affected by the pull of the electromagnet. In this design the armature is made of thin sheet iron so that it is light in weight and would therefore require very little magnetic pull to operate. At its small end there is an electrical contact welded into the metal and is so located as to be in line with the stationary contacts that it is supposed to engage. These contacts should preferably be tungsten or silver.

The Control Circuit

In the construction of this arrangement the small end of the armature is drilled with a small hole into which the contact metal is inserted for a tight fit. It will thus project on both sides and form two contacts, one for either stationary contact. The large end of the armature is also provided with a small hole into which the spring is fixed. This spring should be a very light one and composed of phosphor bronze. The free end of the spring is attached to a piece of string which is wound around an adjusting bar, the tension being adjustable by means of a screw driver. In this way, the contact pressure is adjusted as is also the minimum operating current. Once this setting is made, it need not be readjusted, in the same fashion that a padding condenser is set once and for all.

The main body of the relay is made of heavy iron of the size and shape shown in the sketch. To prevent rusting, it is given a cadmium plating. Upon its smaller end is mounted a piece of bakelite which holds the stationary contacts. All these contacts are riveted to the bakelite piece and, as the sketch shows, consist of a suport and the contact screw, made adjustable to compensate for wear of the active contact surface.

The Contacts

When all these parts have been constructed it should be an easy matter to assemble them together to comprise the completed relay.

It will be noted that the control circuit of this relay consists of two stationary contacts between which there travels the moving contact of the armature. This serves to provide us with a relay that can perform two simultaneous operations—that of opening one circuit while closing another. Thus, this relay when used in conjunction with a photo cell may be adapted to any one of a number of operations.

2 Ma. Changes Swing Contact

In conclusion, it should be appreciated that this relay was designed to operate on the small currents of a photo cell and will be actuated in a change as small as 2 milliamperes. So it is not practical for heavy currents through the coil, although the terminals will stand two amperes, that is, for the controlled circuit. The constructor of this device is therefore cautioned to use discretion in the matter of the amount of current that is fed to this relay. In order to control heavier currents, it is advisable to cause the relay outlined in this article to control a heavier relay that is capable of heavier currents, though not as sensitive. This latter type of relay is readily obtainable as the ordinary type of magnetic relay sold in stores.

SUPER-CONTROL TUBES

A super-control tube is a screen grid tube of modified construction such that modulation distortion and cross-modulation is minimized.

Taxes Paid Are Up 87.7 p. c.; Reflect Large Sales Increase

Large increase in radio sales during the final quarter of 1934 are reflected in official Federal Government reports of radio excise tax collections. Such collections during November, 1934, were $462,638.47, an increase of 87.7 per cent over the taxes of $246,526.75 collected in November, 1933, while the taxes of November, 1932, were $298,577.86.

For the eleven months of 1934 ending in November, the total excise taxes collected were $2,952,000, an increase for the eleven months of about $300,000 over the entire excise taxes of the whole calendar year of 1933. December sales and taxes have been uniformly larger, occasionally double those of November, and the tax returns indicate the excellent business enjoyed by the radio industry during the past year.

Excise tax collections last November on mechanical refrigerators were $147,376.52, a decrease from the taxes of $172,541.85 collected during November 1933.

Production and Payroll Gains Are Reported

Increased seasonal production in the radio industry is reflected in the October, 1934, report of the U. S. Department of Labor, Bureau of Labor Statistics, on radio factory employment. During that month fifty-one radio and phonograph establishments reported employment of 39,335 employees and the October statistics do not include reports from a number of manufacturers previously reporting. Wage increases affecting 511 employees were reported during October by two manufacturers.

While national factory employment increased 3.8 per cent from September to October, 1934, and national payrolls increased 4.8 per cent., largely due to settlement of textile labor difficulties, there was reported increase of 1.7 per cent. in October radio factory employment.

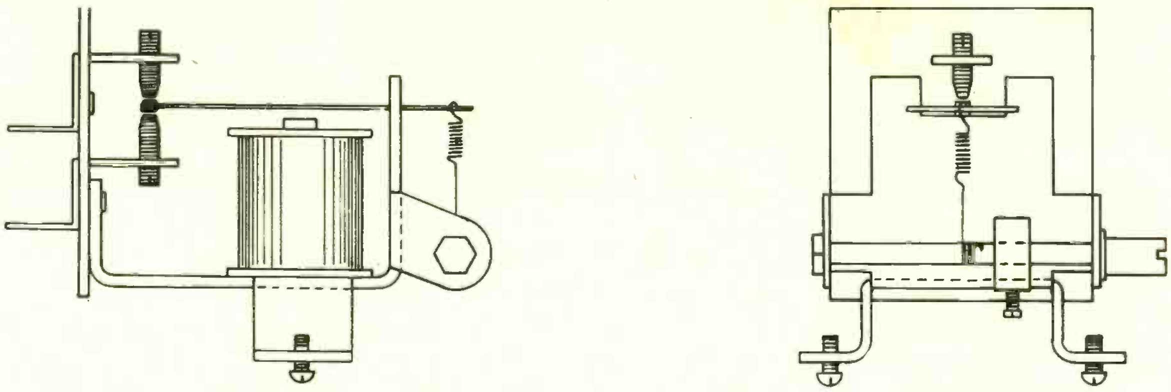
Miller Leaves Westinghouse To Join Naval Research

H. R. Miller, former Westinghouse engineer and operator at WBZA, East Springfield, Mass., recently joined the Anacostia Station of the Naval Research Laboratories. In his new position Mr. Miller is engaged in the designing and testing of ultra high frequency radio equipment.

Mr. Miller comes from South Burwich, Me., and is a graduate of the University of Maine. His experience include work at the Norfolk Navy Yard, 1917 to 1919, assistant in the Navy Department Bureau of Engineering, 1919 to 1923, Boston Navy Yard, 1923 to 1929, Westinghouse engineer in the design and manufacturing of aircraft equipment, 1929 to 1933 and associated with WBZA.

TUBE POSITIONS

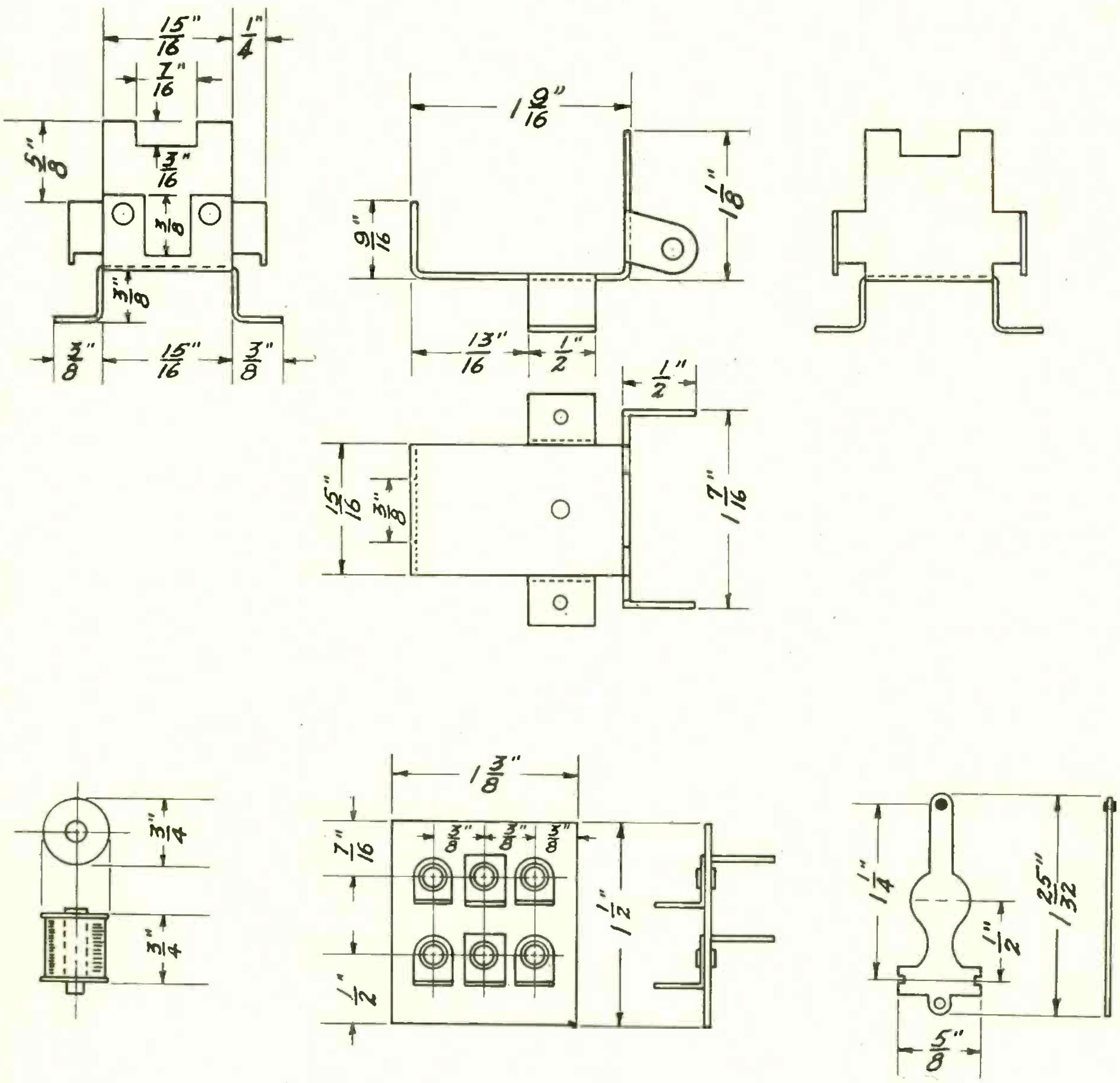
Heater type tubes may be worked in any position in a receiver. Filament type tubes should be upright.



-Side View- -Back View-

-ASSEMBLY-

Scale : Full Size



-DETAILS-

Scale : Reduced Size

This d-c electromagnetic type of relay is very useful for applications of photo-electric cells to automatic operation of devices of all sorts due to the relay's sensitivity to such small current change as 2 milliamperes.

The Ursigrams Aid Science

International Co-operation Yields Daily Measurements of Sun's Radiation, Ionosphere Height, Terrestrial Magnetism and Auroras

By M. K. Kunins

UNOBTRUSIVELY, quietly, yet constantly, there occurs a daily service offered over the air waves that few persons appreciate. Every day of the week this service is released over the far-flung area that is covered by stations NAA, Arlington, Va.; JAP, Tokyo, Japan; FLE, Eiffel Tower, Paris, and FYL, Lafayette, Bordeaux, France. The substance of the messages included in this service concerns itself with such cosmic data as: solar constant (RAD); terrestrial magnetism (MAG); sun spots (SOL); auroras (AUR), and height of Kennelly-Heaviside layer (KHL).

By the daily (including Sunday) broadcast of these data, the world is enabled to correlate these cosmic occurrences with radio so that eventually one could be able to predict the behavior of radio waves as affected by cosmic conditions. This would enable us to predict more or less accurately the ranges of radio waves for the different frequencies.

There should come a day when we will have our almanac or calendar of radio conditions just as we have our calendar and almanacs for every day of the week as far as time is concerned.

Sources of Information

The agencies involved in the accumulation and broadcasting of this material are internationally famous for such services and thus we are assured of the authenticity of this information. As far as the United States is concerned, the solar constant values are accumulated by the Astrophysical Observatory of the Smithsonian Institution, the terrestrial magnetism measurements are made by the U. S. Coast and Geodetic Survey, the sun spots are observed by the Mount Wilson Observatory and the U. S. Naval Observatory, the aurora data are compiled by the Alaska Agricultural College and School of Mines from its auroral observatory at College, Alaska, and the Kennelly-Heaviside layer data are secured by the U. S. Bureau of Standards.

The far-flung service was initiated upon the suggestion of the International Scientific Radio Union whose French name—Union Radio Scientifique Internationale—forms the basis of the name of these messages, URSIgrams. This organization receives the results of the work of the agencies indicated above to be transmitted over the radio stations mentioned at the beginning of this article. In the United States, the U. S. Army radio stations collect these data daily and transmit them to URSI from where it reaches NAA to be broadcast over the air.

Science Service Aids

Cooperating with the American section of the International Scientific Radio Union, Science Service collects these daily data and utilizes the information for weekly publishing in mimeograph form to be distributed to those interested by mail. Upon special request, Science Service will also transmit the cosmic data telegraphically over commercial channels, tolls collect. If desired, the numerals will be rendered into the following syllable code to reduce tolls:

Code:	1	2	3	4	5	6	7	8	9	0	X
	ba	de	fi	go	ku	am	en	ip	ot	ux	vy

Thus to send, URSI RAD 79333 MAG 1535X SCIENSERVC, we send: URSI RAD ENOTFIFIFI MAG BAKUFIKUVY SCIENSERVC.

Those interested in correlating the cosmic data with other phenomena and in studying the literature upon the fields affected by the cosmic data reported will be placed in communication with competent authorities upon application to Science Service, Washington, D. C. This daily effort on the part of the agencies mentioned above is not at all appreciated by the average radio fan and it is accordingly of some value to devote this space to an exposition of the manner in which this work is accomplished.

The radio transmission of ursigrams was pioneered by the French in 1928 by the Postes Radiotelegraphiques Francais under the auspices of the Comite Francais de Radiotelegraphique Scientifique. These messages are transmitted via the French stations FLE and FYL according to the following schedule:

Station	*Location*	*Frequency*	*Time*
FLE	Eiffel Tower, Paris	207.5 kc	11:20 GMT
FYL	Lafayette, Bordeaux	15.9 kc	20:30 GMT
	Issy-les-Moulineaux (near Paris)	922.5 kc	20:30 GMT

Attracts the Americans

The messages are in plain French language and not in coded telegraph. They include information on the following:

(a)—Steadiness or disturbance of earth's magnetic field.

(b)—Steadiness or disturbance of atmosphere's electric field.

(c)—Apparent activity of solar surface, as regards both sun spots and faculae.

The data from which these ursigrams are composed are supplied by the Physical Institute of the Globe of Paris, The National Meteorological Office, the Astronomical Observatory at Meudon (near Paris), and the Val Joyeuz Observatory, near Versailles.

These French cosmic data broadcasts were being copied and used by some American radio observers. The U. S. Navy communications office had been copying them daily whenever reception conditions rendered it possible and Science Service reprinted in its weekly announcement these copied transmissions.

When American radio engineers were first informed concerning these French broadcasts, Dr. A. E. Kennelly of Harvard, as a representative of the committee on cooperation of the American section of the International Radio Union, distributed the information to those interested. This led to an informal meeting of scientists at the National Academy of Sciences, Washington, D. C., in April, 1929, when it was decided that a daily cosmic data message to be broadcast from an American government radio station would be desirable.

This led to the appointment of a special joint committee of the URSI and American Geophysical Union on the subject, which outlined the project and asked the cooperation of Science Service in the collection of the daily cosmic data messages. As a result of this meeting a regular service of American ursigrams was begun August 1st, 1930, over NAA, which included solar constants and magnetic and sun-spot values. Kennelly-Heaviside layer heights were included after June, 1931. Aurora data were added during the fall of that year.

Code Used Here

These American ursigrams are transmitted in International Morse code daily, including Sunday, from the Navy radio station NAA at Arlington, Va., at 22:30 GMT (5:30 p.m. EST) on the frequencies of 9,050 and 4,525 kilocycles, and are readily receivable in most sections of the country. If not heard reliably in your section, it is advisable to get in touch with Science Service for their weekly mimeographed sheet.

Now that we know when and where to listen for these signals, it is necessary that we be able to decipher the message since it is sent in coded telegraph code. The letters URSI are the distinguishing sign at the beginning of the cosmic data message. Each class of data is coded separately and preceded by an identifying word: RAD for solar constant, MAG for terrestrial magnetism, SOL for sun-spots, AUR for auroras, and KHL for the Kennelly-Heaviside layer heights. The data are expressed in the terms of numbers that occur in groups of five, similar to the method used in the transmission of meteorological information. When extraordinary phenomena are observed, plain English is used in their description. The message is then signed with the cable address of Science Service, SCIENSERVC.

Meanings of Numbers

The meanings of the various numbers in their groups are indicated as follows:

RAD (Solar constant)

First figure indicates day of week:
1 Sunday
2 Monday
3 Tuesday
4 Wednesday
5 Thursday
6 Friday
7 Saturday.

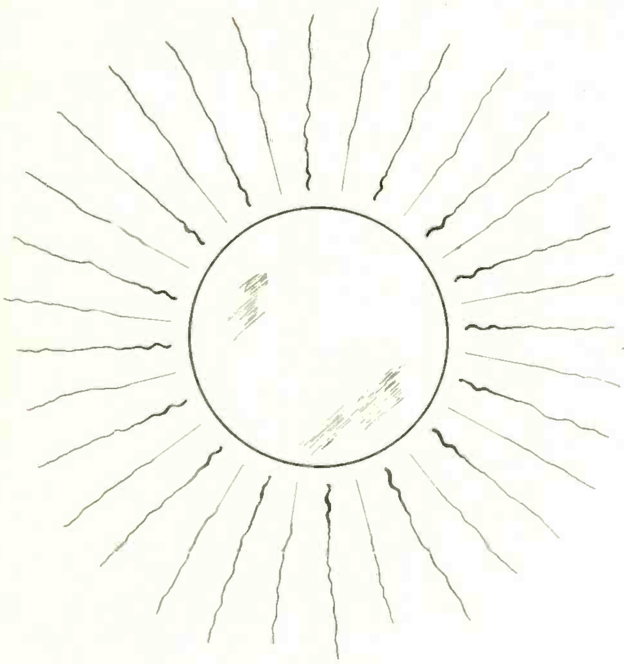
Second, third and fourth figures indicate decimal fractional part of solar constant.
(Add 1.000 to value given.)
When 933 is transmitted, the solar constant would be 1.933 calories.
The solar constant is defined as the total intensity of solar radiation outside the earth's atmosphere at the earth's mean distance from the sun and is expressed in terms of calories per square centimeter per minute.

Fifth figure indicates whether constant is:
3 Satisfactory.
5 Not quite satisfactory.
7 Unsatisfactory.

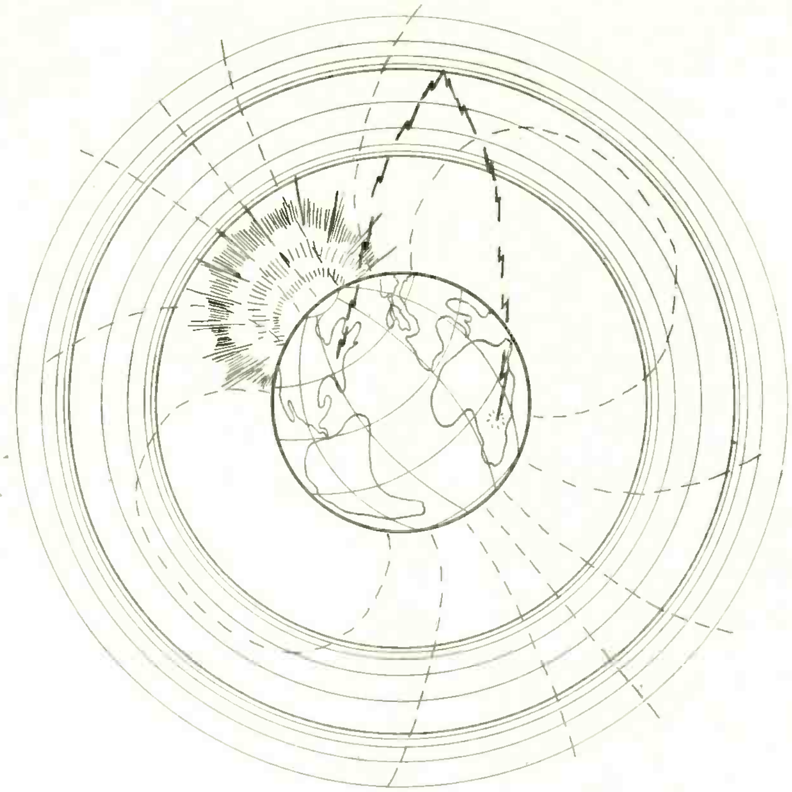
As an example, the meaning of RAD 79333 would be solar constant on Saturday was 1.933 calories which is considered satisfactory. Solar constant data are supplied by the Astrophysical Observatory of the Smithsonian Institution and are the averaged values of the determinations of that organization's observers at Montezuma, Chile.

MAG (Terrestrial magnetism)

Measuring Rod Directed at Universe



The sun is the source of all radiation in our world and influences practically every occurrence in it. When sun spots occur in more or less amount, our lives and the actions of all matter are affected in more or less degree.



The earth with its magnetic field, its aurora borealis and its Kennelly-Heaviside layer are very concrete manifestations of cosmic influences. Radio phenomena are affected materially by these occurrences.

First Group

First figure in first group shows day of week:

1 Sunday
2 Monday
3 Tuesday
4 Wednesday
5 Thursday
6 Friday
7 Saturday.

Second figures in first group indicates kind of day:

1 Quiet day.
2 Day of moderate disturbance.
3 Day of great disturbance.

Third figure of first group indicates:

3 Day marked by bay, a disturbance lasting only an hour or so, with departure from normal curve in one direction only.
5 Day marked by rapid pulsations.
7 Day marked by long period pusations or oscillations.
9 Day marked by irregular oscillations.
X Not used.

Fourth figure of first group indicates that second group gives times of:

3 Beginning of disturbance
5 End of disturbance
7 Beginning of disturbance, and given in third group.
X Not used.
Fifth figure is unused and sent as X.

Second Group

Indicates Greenwich Mean Time of beginning or ending of disturbance as indicated by fourth figure of the first group. (If there is a beginning and ending on same day, a third group gives time of ending).

First and second figures: Hours, preceded by zero, if less than ten.

Third and fourth figures: Minutes, preceded by zero, if less than ten.

Fifth figure: Tenths of minutes, in the case of a sudden commencement of a disturbance. Other times will be given in terms of whole minutes only and X will be fifth figure.

Third Group

If there is a beginning and ending on same day, a third group gives time of ending).

Sun Spots and Aurora

An example of these data sent in the approved code is MAG 1535X 08407 which would mean that Sunday was a day of moderate disturbance marked by bay. Disturbance ended 08:40.7 GMT. Terrestrial magnetism data are gathered from the observatory of the U. S. Coast and Geodetic survey at Tucson, Ariz. The period covered by these observations is for the 24 hours preceding 14 hours GMT of the Greenwich and local day of the week as given by the first figure of the first group.

SOL (Sun Spots)

First figure indicates day of the week:

1 Sunday
2 Monday
3 Tuesday
4 Wednesday
5 Thursday
6 Friday
7 Saturday

Second and third figures indicates number of groups of sun spots, preceded by zero if less than ten.

Fourth and fifth figures indicate total number of sun spots, preceded by zero, if less than ten.

SOL 10314 would be an example of this group and would mean that on Sunday, three groups of sun spots containing a total number of 14 spots were visible. Unusual solar phenomena are added when necessary in plain English. These sun spot data are furnished by the Mount Wilson Observatory of the Carnegie Institution of Washington located at Pasadena, California from observations made at about 16 hours GMT or as soon thereafter as the weather permits.

AUR (Aurora)

First Group

First figure of first group shows day of week:

1 Sunday
2 Monday
3 Tuesday
4 Wednesday
5 Thursday
6 Friday
7 Saturday

Second figure of first group indicates character of day:

0 No aurora
1 Faint aurora
3 Moderate aurora
5 Strong aurora
7 Brilliant aurora
9 No observations

Third and fourth figures of first group indicate the number of hours during which the aurora is present, preceded by zero if number is less than ten.

Fifth figure of first group indicates the cloudiness on scale of 0, 1, 2 . . . 9, X. 0 indicates no clouds and X indicates completely overcast sky.

(Continued on next page)

Why A. V. C. Is a Boon

One of the major refinements in radio receiver design during the past few years concerns itself with means for providing the loudspeaker with a signal that is unvarying in its loudness, in other words, one in which fading signals are minimized. This has been a vital boon to the automobile receivers and constitutes a major sales point for ordinary home receivers. Its utility is especially appreciated when one listens to a distant program that is fading very badly so that it cannot be enjoyed. This pernicious habit of a receiver of the old days was such that the signal would fade away just when the announcer of the distant station was about to reveal the call letters which prevented the fan from finding himself in the ecstacy of knowing he was listening to a far-flung corner of the earth.

The griping part of it all was that the signal usually reappeared when the announcement was finished. We were accordingly obliged to endure another siesta of patience to learn the identity of the station. Many times these occasions were such that should the station turn out to be local, a madman would be present in the house. At any rate, that feature of a radio receiver known as automatic volume control or a.v.c. was a worthwhile advancement.

Where to Connect

The usual type of a.v.c. utilizes a rectified voltage which is dependent upon the radio-frequency carrier or intermediate-frequency signal. This voltage is so connected as to affect the gain of the r-f or i-f stages so as to maintain an essentially constant input to the detector tube. A number of methods of varying the amplifier gain by means of the rectified voltage suggest themselves, the essential difference being the manner in which the voltage is applied to the various electrodes of the amplifier tubes.

As an example, the control voltage might be applied to the suppressor, plate screen of an r-f pentode. Another method that is more usually used, is the application of the rectified voltage to the grid of the r-f amplifier. This method takes the form of a resistor in the cathode lead of the detector tube. The voltage drop in this resistor is directly dependent upon the strength of the incoming signal since a greater signal will cause a greater current to flow with a consequent increase in the drop across this resistor. If that side of the resistor that is farthest from the cathode is connected to the grid of the r-f stage, the bias of this stage will be affected in such a way that the grid of this stage becomes more negative to reduce its sensitivity with an increase of strength of the incoming signal. On the other hand, a weakening of the incoming signal will serve to affect the bias in such a way as to render the r-f stage more sensitive and thus bolster up the weakness that may have been caused by fading or other means.

Blasting Avoided

In this manner, such a device smooths out the inconsistencies of a radio signal such that volume is fairly uniform, although this is not a complete cure for fading. Another benefit of such a device is apparent when the listener tunes from one station to another. With this agency all stations will be about equally loud and the sudden blasts that used to occur when one tuned from a weak distant station to astrong local station are obviated. Thus, it is not necessary for the listener to have one hand on the volume control knob while manipulating the tuning control, since practically all stations will come in at the level that the manual volume control determines.

However, all good things are not without their bad aspects. Automatic volume control is no exception. The trouble that is incurred is that without a visual tuning meter, the listener cannot tell when he has accurately tuned the station in, because slightly-off resonant position yields as loud a response as does resonance. Thus, the use of automatic volume control renders a tuning meter essential. Thoug, this is an added expense, it is not a big item, since such meters are obtainable in these days of mass production for very little cost.

By and large, it might even be said that the tuning meter is an advantage since very few persons know how to tune a station in accurately. With such a meter, this process is rendered foolproof and it is thus that automatic volume control drags along with it another advantage in the form of a tuning control meter that almost performs the tuning process itself.

(Continued from preceding page)

Second Group

First figure of second group indicates form of aurora:

0 Homogeneous quiet arcs without ray structure.
1 Homogeneous bands without ray structure.
2 Pulsating arcs without ray structure.
3 Diffuse luminous surfaces without ray-structure.
4 Pulsating surfaces without ray-structure.
5 Feeble glow without ray-structure.
6 Varied forms without ray-structure.
7 Flaming aurora.
8 Varied without ray structure and flaming.

Second figure of second group indicates form of aurora:

0 Arcs with ray structure.
1 Bands with ray structure.
2 Draperies with ray structure.
3 Rays.
4 Corona.
5 Varied forms with ray structure.
6 Flaming aurora.
7 Varied ray structure and flaming.

Third figure of second group indicates maximum area covered on the basis of a scale of 1 to 5.

Fourth and fifth figures of second group indicate average altitude in degrees.

Third Group

First, second and third figures of third group indicate general position of aurora, combinations being reckoned for included position in a clockwise direction:

0 South.
1 Southwest.
2 West.
3 Northwest.
4 North.
5 Northeast.
6 East.
7 Southeast.
8 Zenith.
9 Whole sky.

Fourth and fifth figures of third group indicate the Greenwich mean time, preceded by zero if the hour is less than ten, of the observed greatest display in the 24 hours preceding the time of filing the report.

As an example, a consideration of AUR 15082, 25355, 57817 reveals that on Sunday, there was a strong auroral disturbance, lasting 8 hours while the sky was two-tenths overcast. The aurora was of the pulsating arc type without ray structures and varied forms with ray structure, which covered three-fifths of the sky at its maximum. Its average height was 55 degrees, from northeast to southeast to zenith. The greatest display occurred at 17:00 GMT.

KHL (Kennelly-Heaviside layer)

First Group

First figure indicates the place of observation:

3 Washington, D. C., (U. S. Bureau of Standards).
5 Medford, Mass. (Tufts College).
Others to be announced.

Second, third, fourth and fifth figures give the frequency in kilocycles divided by 10.

Second Group

First figure indicates day of the week.

1 Sunday.
2 Monday.
3 Tuesday.
4 Wednesday.
5 Thursday.
6 Friday.
7 Saturday.

Second and third figures give the nearest hour of observation in GMT.

Fourth and fifth figures give the height of the Kennelly-Heaviside layer in kilometers divided by 10.

Third and Other Groups

Additional observations expressed in the same code as second groups.

Illustrating this set of coded data, let us consider KHL 31348, 61513. Interpreting this, we find that the Kennelly-Heaviside layer was observed on Friday at Washington, D. C., on a frequency of 13480 kilocycles at 15:00 GMT, and found to be 130 kilometers high.

If the demand arises and as the information becomes available, it is proposed to enlarge this service by adding the following information to the cosmic data message as constituted at present:

Terrestrial electricity — Predominating direction of natural earth currents as registered for the preceding 24 hours. At this time, no earth current system is installed in this country, though it is planned. It will be noted from the Science Service reprint that the French have this data at present.

Radio Phenomena—Signal intensity for long- and short-wave reception at representative stations has been suggested for inclusion in the message.

Solar Activity—In addition to the broadcasting of sun spot data, it is proposed to include values for the daily intensity of other phenomena on the sun's surface, such as, character figures for bright hydrogen flocculi, calcium flocculi, dark hydrogen flocculi, magnetic character—number prominences, faculae, etc.

The collectors and transmitters of these data are interested in the utility of these messages to individuals and would welcome reports as to this point and also suggestions for improvement of the service.

Why the Oscillator Is Higher

All Considerations Favor It Exceeding Station Frequency

By Herman Bernard

IN superheterodyne practice the oscillator frequency is almost always made higher than the station-carrier frequency. Many perhaps wonder why this is so.

In the first place, if the oscillator frequency is lower, the frequency range becomes limited, especially for low frequencies. Assuming that the low-frequency spectrum is merely the standard broadcast band, 540 to 1600 kc, and the intermediate frequency is 465 kc, if the oscillator were lower, it would have to tune from 540 — 465 to 1600 — 465, or from 75 to 1135 kc, a frequency ratio of somewhat more than 15 to 1, and a capacity ratio of a bit under 4 to 1, which would require a 0.001 mfd. condenser for the oscillator, whereas the other sections of the gang could be 0.00035 mfd.

This large oscillator condenser would make for bulk and awkwardness, not to mention increased difficulty in padding, whereas when the oscillator frequency is higher than the other, the ratio of frequency or capacity is always smaller for the oscillator than for the station-carrier frequencies of a particular band.

Workable Ranges for Oscillator

For instance, for the standard broadcast band, same intermediate frequency, the oscillator would have to be tuned from 1005 kc to 2065 kc, a frequency ratio of 2.05, or capacity ratio of 4.2 plus, a condition easily achieved by series padding of the oscillator, for then the effective capacity of the oscillation section is reduced and the frequency and capacity ratio likewise. Fortunately, the reduction becomes smaller and smaller as the frequency of tuning any one band increases, so that at the high-frequency end the percentage of frequency difference occasioned by the series condenser is trifling. In absolute values however, particularly on short waves, this series condenser effect is considerable, but is readily atoned for by parallel padding (trimmer adjustment).

On the strictly electrical side there are other reasons for favoring the higher frequency.

Many may have noticed in superheterodynes of days gone by, where the oscillator was separately tuned (as in the Victoreen and the Magnaformer) either the higher or the lower oscillator frequency could be used for part of the band, especially as the i. f. was low, that is, the difference between the two settings was moderate in frequency. Only the broadcast band was covered in thóse sets, and the intermediate frequency was around 92 kc, so that the two oscillator points would be separated by twice the i. f., or 184 kc.

Results Differed

It might have been noticed also that there was a difference in the type of reception. It was clearer though not always louder when the oscillator frequency was higher. The same would be true in more up-to-date receivers, if the lower setting were used, but with gang condenser and padded oscillator of course it is not usually practical to attain the low-frequency oscillator setting, too, except for very high station-carrier frequencies, upward of 10 mgc, and then only as a vice.

The second tuning point is always there, but suppressed so far as practical, and for frequencies lower than 10 mgc the practicality is excellent. The nomenclature of today is somewhat different. The suppression of any response due to the lower oscillator frequency, particularly where that the same oscillator frequency is the low one for some other station-carrier frequency, is called image suppression. The image is the response resulting from an impulse in the antenna circuit (and there is nearly always some sort of interfering impulse of that kind there) being separated from the desired or intended reception frequency by twice the intermediate frequency. Thus, in receiving 10 mgc the oscillator would be at 10.465 mgc, for .465 mgc i. f., whereas 10.465 mgc is the low-frequency oscillator setting for 10.93 mgc, hence if there is anything of 10.93 mgc frequency in the antenna system, there will be response in the receiver. It was intended to tune in 10 mgc, and in point of fact both 10 mgc and 10.93 mgc could come in together, were not the image suppression adequate.

Bad Effects

The reason why the reception is better, using the higher frequency for the oscillator, is that the oscillator and modulator frequencies are then out of phase. When the oscillator frequency is rising the modulator frequency is falling, and while there is not a parity of action here, the voltages being different, at least the operation is in opposite directions. Therefore the effect on the bias is to have it reduced less. Not much negative bias is needed, either, to prevent or limit grid current. If the low-frequency method is used the two voltages are in phase, and there is sometimes built up on the modulator such a high voltage that considerable grid current will flow. This reduces sensitivity and selectivity and increases distortion.

There is some distortion involved in all modulation, but when the grid current becomes enormous not only does the distortion become great, but also the tuned circuit is vastly upset. The tracking of a frequency-calibrated dial, for instance, depends on repetition of the grid-current conditions existing when the calibration was made. If the condition was one of no grid current then, grid current must not flow now, or the dial can not be tracked. If some grid current did flow, about as much should flow to track the dial, although the quantity of such current is not critical, so long as some does flow, and so long as the original amount is not grossly exceeded.

Effect of Grid Current

The reason why this tuning effect shows up is that grid current increases the capacity across the tuned circuit. For tremendous grid current, say, values equal to the plate current, the grid instead of being an open circuit to d.c., or nearly so, is much of a conductive circuit, hence a partly closed one, or approaching in the direction of a short circuit. The frequency ratio of tuning then will be found to contract seriously, as it would under any conditions of substantial equivalent parallel capacity. In fact, the larger the capacity, the closer to a short circuit, and if the condenser across the coil is entirely too large there will not be any oscillation.

The reason for this capacity effect is not far to seek. The tube may be considered as a resistance, a high one at no grid current, a lower and lower one as grid current begins and increases. The tube is effectively a series resistance separating input and output parameters. As this resistance is reduced, as by grid current flow affecting the input and output, the isolation of one stage from another is reduced, or coupling made stronger, and the capacities of related circuits tend to become in parallel, just as if two circuits were separated by a resistance, the value of the resistance reduced, and finally when the resistance was zero the coupling would be unity. Thus grid current tends to add the capacity of one circuit to that of a prior or subsequent circuit.

Something to Agree On

It is notorious that the amplitude of oscillation is greater, usually much greater, at the higher frequency end of a particular band, than at the other end, hence with the voltage (oscillation and signal) cumulative on the grid of the modulator, the worst condition of grid current would exist in this notorious part of the tuning. A corrective would be introduced—obviously increasing the negative bias on the modulator tube—but that would be done solely to atone for the high amplitude region of oscillation. Every one knows the reduced sensitivity resulting from negative bias increase, for isn't that method used very well for volume control? So the increased bias that made the set decently workably over part of the tuning spectrum of one band would leave the system in an insensitive condition for the rest of the tuning of that band. This trouble would be most pronounced at the higher-frequency bands of multi-band sets, most pointedly the very highest band.

Electrical Institute Meeting

The American Institute of Electrical Engineers, the national organization of Electrical Engineers, will hold its annual winter convention January 22d to 25th, at the Engineering Societies Building in New York City. Notable engineers will present papers on topics of vital interest to engineers and others who depend upon engineering advances. The talks cover a wide range of topics that can be roughly headed under the following titles: Electrical machinery, communication, transformers, education, transmission of power, illumination, noise, welding, electronics, motors, etc.

A 4-TUBE PORTABI

High Ratio of Inductance to Capacit

By Windsor

AS soon as any attempt is made to build a portable receiver of any kind, just then do compromises begin. It is not practical to have the circuit completely up to the voltage and current requirements for maximum performance without the battery size and weight becoming prohibitive, or the receiver becoming a "mobile" rather than a "portable."

A usual compromise is to have the B voltages low, where not a great deal of difference in performance results. For instance, in the example of the 34 tube, both screen and plate are returned to 67.5 volts, and this is recommended in official tube manuals, for portable use.

The maximum B voltage would be 135 volts at the batteries, but the current drain would be too much if this full voltage were utilized on the 34, which is an intermediate amplifier in this diagram. However, 135 volts are entirely practical for the 1C6, as the B drain is small, the screen, by the way, drawing more current than the plate.

Current Economy

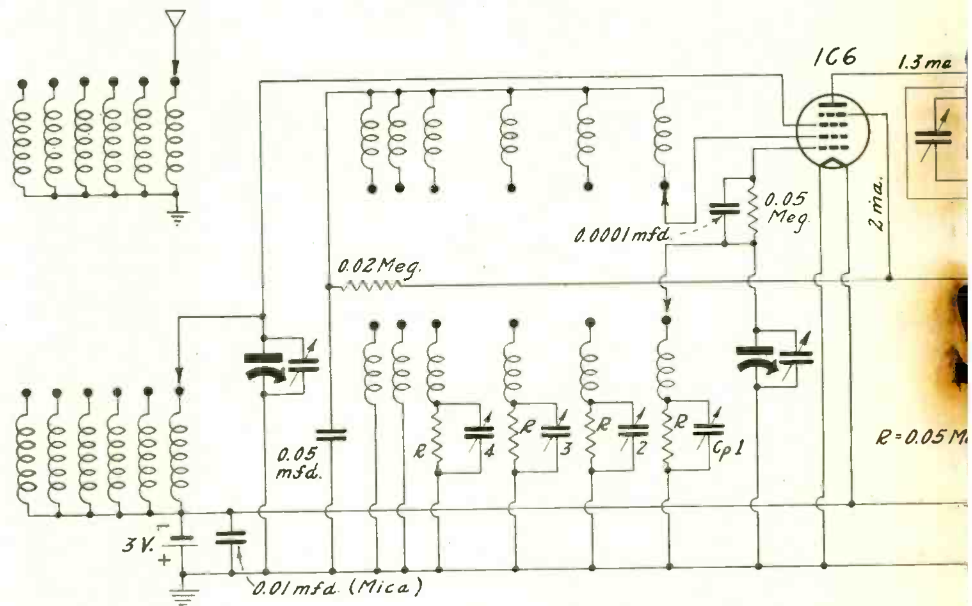
With some more sacrifices it is practical to use 1.5 volts on the filaments, instead of 2 volts. The filament drain will be large, anyway, 0.4 ampere, if the filament voltage is 2 volts, but if the filament has 1.5 volts the current is around 0.32 ampere. It then becomes not too absurd to use a No. 6 dry cell, which has a nominal rating of 0.25 ampere, as the excess taken from it is "only" 50 per cent, and this isn't so bad, in portable practice. Everything is done in about that way for portable purposes.

Of course, a danger lies in the oscillator, because while there will be plenty of oscillation for the broadcast band and the first and second short-wave bands, there may be some trouble on higher frequencies due to the lowered emission of the 1C6, account of 1.5 volt d.c. applied to filament, whereupon the 0.02 meg. resistor, there for stabilization purposes, would have to be reduced or omitted.

However, an equally important consideration is the use of a small dual tuning condenser, maximum capacity a shade under 90 mmfd., so that six coils of large inductance-capacity ratio are necessary to cover to the highest receivable frequency, indirectly determined by the frequency at which the 1C6 stops oscillating. At that, the 1C6 at 1.5 volts has a better oscillating conductance than the 1A6 had at 2 volts, so there is something to be said in favor of the method shown.

Two-Volt Current Values Shown

Any one who desires to use two No. 6 dry cells in series—and there will be more compact cells than the familiar 6-inch-high type soon to be announced—may reduce the 3 volts to 2 by interposing a resistor of 2.5 ohms between the A switch and the fixed condenser is grounded connection next to it, and reduce the 3 volt biasing battery at left to a cell of 1.5 volts, using 4.5 volts for biasing the second detector, where "6 v. Approx." is imprinted on the diagram. The 13.5 volts may remain as shown for biasing the power tube. The reason for the changes just suggested is that the 1-volt drop in the filament resistor becomes auxiliary to the batteries for negative biasing.



This 4-tube superheterodyne all-wav dry cell directly

The current values shown on the diagram are for 2-volt operation of the filament, with the amendments to bias as given in the preceding paragraph, except that the power tube will draw somewhat less than 14.5 milliamperes, because the effective bias is 14.5 volts, adding the 1-volt filament-resistor drop to the battery biasing voltage. This voltage is not so critical.

As stated, the tuning condenser is of small capacity, therefore the ratio of inductance to capacity is high, and this makes for higher gain at less noise, and also for better support of oscillation in the triode of the 1C6.

Only the input to the 1C6 is tuned to the station-carrier frequency, as the inclusion of a 3-gang condenser and the extra set of coils would make the physical attainment to boulky and also increase the filament consumption, which it is advisable to keep as low as practical.

Short Antenna's Effect

The other side of the picture is that a short antenna would be used anyway, and with good tracking there would be adequate rejection of images, that is, within portable requirements. It must be understood that the selectivity increases considerable as the antenna is made shorter, but the pickup is reduced at about the same pace, so the circuit as a whole has to be made to produce considerable gain.

Working backwards, this would require that a pentode output tube be used, and there is practically no choice save the 33.

Requirements Stated

The 32 is the most sensitive negatively-biased detector, and it is only by the negative-bias method (fixed bias here) that the second detector can stand the input it should get. The 34 is the i-f amplifier and the 1C6 is the pentagrid converter tube, of combination oscillator and modulator.

The input is taken from the small antenna, the tinsel cord or equivalent type such as found in midgets, while the output goes to a magnetic speaker, as there is no power

Broadcast Allocation

The local chapter of the Institute of Radio Engineers held a meeting in New York City recently on the subject of broadcast station allocation. Among the speakers were C. B. Jolliffe and A. D. Ring, of the Federal Communications Commission, and C. M. Jansky, Jr., S. L. Bailey, M. M. Garrison, and G. I. Jones, of Jansky and Bailey.

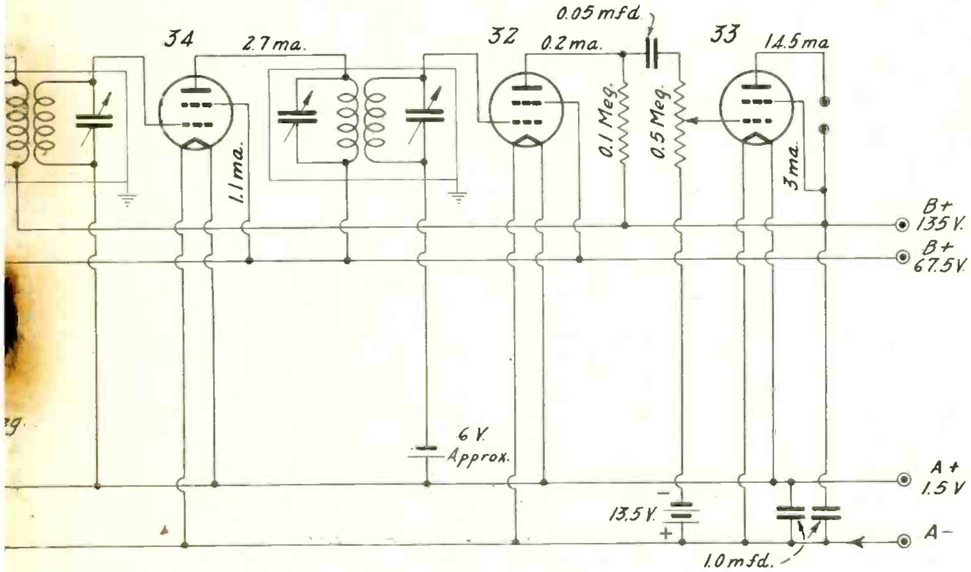
The government men delivered a paper entitled "The Allocation of Broadcast Facilities."

It is estimated that the radio broadcast industry today represents a total investment in transmitting and receiving equipment of approximately a billion dollars, they said. The usefulness of this equipment depends on the maintenance of an orderly and technically sound allocation of the available facilities. The responsibility for this allocation is now vested in the Federal Communications Commission. The paper gave the historical development of the present allocation, the effects thereof on technical developments, of various changes in the radio law and the technical standards used in considering allocation problems. Future developments in broadcast allocation and the possibilities of

LE ALL-WAVE SET

y Reduces Noise, Increases Sensitivity

· L. Parsons



e portable uses 1.5 volts from a No. 6 on the filaments.

available for energizing a dynamic. In between these two limits there must be (a) an effective mixer, one that oscillates to permit reception to 20 meg. anyway; (b) a high-gain i-f channel, and (c) a resistive-loaded screen-grid detector. The detector has an output capacity of 10.5 mmfd., not enough to bypass the radio frequencies, but no plate-circuit bypass is included because through its absence the results is retained a certain amount of feedback in the intermediate channel. Some feedback is necessary if the gain is to be high enough, and the self-capacity of the plate to cathode path of the 32 is all that is included therefore.

Regeneration Values

If there is not enough hop to the intermediate channel, which should reach a gain of 200 anyway, some regeneration should be introduced at the i-f level by connecting a condenser and a resistor in series, one of them variable, and joining one free end to plate of the 1C6 and the other free end to grid or plate of the 34, depending on which method yields regeneration when the variable is adjusted.

Try 0.0001 mfd. and 0.1 meg., either variable. Whether the cone connection is to grid or plate depends on the polarity of connection of the interstage coils, and therefore the suggestion about trying one or the other. Another method would be to try reversing the wind connections to the wind in one winding of either i-f coil, in line of switch from plate to grid. Once regenerative action is present it is set at a desired level, just below spillover or generation of the frequency, and is left thus.

This is only a four-tube set, but it can work a speaker satisfactorily, while if earphone reception is desired, this could be arranged simply by having the phones replace the speaker. The plate current is not so serious, less than 15 milliamperes, and it is safe to pass this directly through file field winding of speaker or phones. Since there is no output transformer, there is no matching device, and the speaker should have an impedance of around 6,000 ohms, whereas the phones might be whatever you have, since some power loss, even a large one, is tolerable on phone use, because the phones would rattle on most stations anyway, unless the volume control where set at a low value.

The four-tube design lends itself to compactness consistent with satisfactory performance. More performance can be obtained if an extra i-f stage is included, but then the detector has to an extra tube to be used, leading to a more extensive outfit than originally intended, and causing the batteries to lose their usefulness sooner.

LIST OF PARTS

Coils

Two sets of coils, one for modulator, one for oscillator; six coils per set; total 12 coils.
Two 465 kc intermediate-frequency transformers, primary and secondary tuned.

Condensers

One two-gang 90 mmfd. condenser.
One 0.0001 mfd. mica grid condenser.
One 0.01 mfd. mica fixed condenser.
Two 0.05 mfd. condensers.
Two 1.0 mfd. condensers
Four padding condensers, Cp1, Cp2, Cp3, Cp4.

Resistors

One 0.02 meg. (20,000 ohm) resistor.
Five 0.05 meg. (50,000 ohm) resistors.
One 0.1 meg. (100,000 ohm) resistor.
One 0.5 meg. potentiometer with switch attached.

Other Requirements

One two-deck, six-position switch (double pole, six throw).
Four sockets: one six-hole; two four-hole; one five-hole.
Four tubes; one 1C6, one 34, one 32 and one 33.
Two 45-volt B batteries.
One battery affording C voltages to up 13.5 volts.
One magnetic speaker, 6,000 ohms impedance.
One pair of earphones.
Output twin post.
Antenna, ground posts.

Discussed at Institute

approaching nearer to an ideal allocation, taking into account engineering and economic principles without artificial restrictions, are discussed.

The Jansky and Bailey men provided the guests with a discourse entitled "A Case Method Treatment of Certain Broadcast Allocation Problems." This paper presented a discussion of certain fundamental problems involved in the quantitative evaluation of broadcast service and interference on shared channels by a detailed consideration of the steps taken by which the coverage of a certain shared channel station was increased approximately 500 per cent. First, field measurements were made to evaluate the service obtained from the original transmitter site. These led to the selection and removal of the transmitter to a far more favorable location at which a highly efficient radiating system was installed. Permission was then obtained to increase the power of the station from 250 to 1,000 watts after field measurements using an automatic recorder proved that a further large increase in coverage could be obtained with practically no detriment to the service of any other broadcast station.

More Work Hours Reported in the Radio Industry

Per capita weekly earnings of the reporting companies in October were $19.87, an increase of 7.6 per cent. over the preceding month, and 3.7 per cent. over those of October, 1933. Average hours worked per week during October 1934 were 35.9, an increase of 9.1 per cent. over the previous month, but 1.1 per cent. below October, 1933.

Average hourly earnings of radio employes during October, 1934, were 52.7 cents as compared with 53.3 cents in the previous month, a decrease of 1.1 per cent., but were 9.9 per cent. larger than October, 1933.

Resistor-Capacity Filters

Values for Stabilization and Hum Reduction

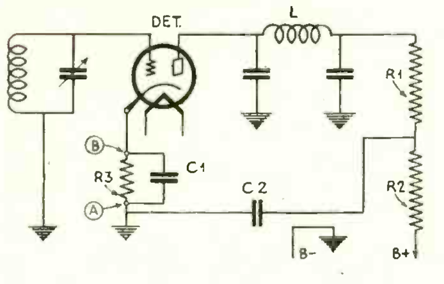


FIG. 1

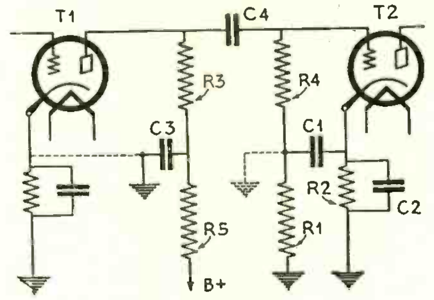


FIG. 2

Two circuits showing how to connect the resistor-condenser filter.

PLATE and grid circuit filters consisting of resistors and condensers prove very effective in reducing the coupling between the input and output circuits of vacuum tubes and amplifiers. Consider, for example, the circuit shown in the first figure which represents a typical detector circuit with a resistance capacity filter consisting of R2 and C2 connected in the plate circuit. Such a circuit eliminates common coupling between the detector and other tubes.

In a circuit mentioned, the B plus terminal would be connected to the proper tap on the rectifier filter system. It is desirable that the A-C audio currents in the detector circuit be prevented from flowing through the B supply circuit. The audio currents can be confined to the detector circuit by means of the filter consisting of R2 and C2. Let us analyze this circuit and see how this filter functions in order to keep the audio frequency currents confined to the detector circuit.

Detector Input

To the input of the detector, we apply a modulated radio frequency voltage and let us assume that, as a result of the detector action, we get in the plate circuit, at a certain moment, a one hundred cycle signal with a magnitude of ten volts. This voltage will cause a current to flow through the plate resistance of the detector tube, through the load resistance R1, and hence through the condenser C2 back to the cathode of the detector tube. Since the impedance of the condenser C2 should (for proper design) be low in comparison with R1, the A-C current will be nearly equal to

$$\frac{E}{R_p + R_1}$$

If Rp, the plate resistance of the detector, is 25,000 ohms and R1 is 100,000 ohms, then the current will be

$$I = \frac{10}{25{,}000 + 100{,}000}$$
$$= 0.00008 \text{ Amperes}$$
$$= 0.08 \text{ Ma}$$

Two Current Paths

The current has two paths to follow. One path is through C2 to B- and bias resistor to cathode and the other path is through R2 then through the B supply circuit, hence to B minus and back to the cathode.

Since we want the currents to follow the first path, through C2 direct to B-, we must make the reactance of C2 much less than the resistance of R2. By computing the reactance we find that the reactance of the 10 mfd. condenser is 160 ohms at 100 cycles, the reactance of a 1 mfd. condenser 1600 ohms, and the reactance of a .1 mfd. condenser, 16,000 ohms at 100 cycles.

An idea of the value of R2 can be obtained from the relation between the resistance of R2 and the reactance of C2. It will be noted that the percentage of the total current flowing through C2, the desired path, increases very rapidly with increase in the ratio of R2 to the reactance of C2.

Beyond the ratio of about 50, there is but a slight increase in filtering efficiency and we can say that the resistance in such a filter should have a value of about 50 times greater than the reactance of C2 at the lowest frequency it is desired to filter, say Aerovox Wireless Corp. engineers. If we design the filter to function efficiently at the lowest frequency, then it will be even more efficient at higher frequencies due to the fact that the reactance of the condenser decreases as the frequency increases.

Other Ratios

It will be appreciated that there is nothing absolute about this ratio of 50 and that in certain circuits higher ratios may prove desirable. Our purpose here is simply to indicate the basis of operation in such circuits without attempting to do the impossible of setting down any hard and fast rules.

If we assume a ratio of fifty, then the following resistance values would be used:

If C2 is	Then R2 should be
10.0 Mfd.	8,000 ohms
1.0 "	80,000 "
0.1 "	800,000 "

Any one of these combinations will reduce the current through the B supply circuits to about 2% of what it would be without the filter. It is not surprising therefore that such filters are to be found in practically all high quality amplifiers.

Which combination of the above capacities and resistances would actually be used would depend somewhat upon the circuit of the amplifier. In most cases the combination of a 1 mfd. condenser and 80,000 ohm resistor would prove most desirable. Higher values of capacity would increase the cost and smaller values of capacity would necessitate a resistance of such a high value as to cause a serious reduction in the voltage actually applied to the plate of the tube. It is necessary that the experimenter determine in a particular amplifier which combination will in his particular case give the best compromise between cost and efficiency.

Hum Reduced

Such circuits also have the effect of reducing the hum voltage applied to the tube. No B supply filter circuit is perfect and there will always be some hum voltage across the output of the filter. This hum voltage will cause a small a-c current to be present in the plate current circuits of all the tubes. Referring again to the left figure, this A-C current will have to flow through R2 and hence through either C2 or R1. Since the impedance of C2 should be much lower than the resistance of R1, practically all the current flows through C2 and the A-C hum voltage effectively in the plate circuit of the tube is therefore the same as the A-C hum voltage across the condenser.

In terms of the hum voltage output from the B power filter circuit, the A-C hum current flowing through R2 and C2 will be equal to

$$I = \frac{E}{\sqrt{R_2^2 + \left(\frac{1}{\omega C_2}\right)^2}}$$

and working with this equation, we finally can determine that the ratio of the hum voltage from the B supply to the hum voltage present in the tube circuit is proportional to

$$\sqrt{(R_2 \, \omega \, C_2)^2 + 1}$$

Since $(R_2 \omega C_2)^2$ will, in a proper filter circuit, be much larger than unity, we can neglect the latter in the above square root and say that the reduction in hum voltage applied to the tube is proportional to $R_2 \omega C_2$ which is really the ratio of the resistance of the reactance.

Filter Properties

We can say in conclusion therefore that a resistance capacity filter in the plate circuit of a tube does two things: It keeps the audio currents in the proper circuit and thereby prevents common coupling, and secondly, it reduces the hum voltage applied to the tube. In both cases the effectiveness of the circuit is proportional to $R_2 \omega C_2$ the ratio of the resistance to the reactance.

The fact that such filter circuits reduce the hum applied to a particular tube does not necessarily mean that the hum in the loud speaker will be decreased by the same amount. The hum in the loud speaker depends upon many things, and one of the most important of these is the manne. in which the hum voltage from one tube combines with the hum voltage in another tube.

If the hum voltage in one tube is such as to balance out the hum voltage of another tube, then the overall hum is decreased. In a circuit in which this was occurring, there would result an increase in hum from the loud speaker if a hum filter circuit was placed in the plate circuit of any tube, since reducing the hum from the tube would mean that the balancing out effect could no longer occur and the loud speaker hum would therefore increase. If, on the other hand, the hum voltages from the various tubes were such as to aid each other, then reducing the hum in any one circuit would cause a corresponding reduction in the hum from the loud speaker.

An example of this was recently experienced in the laboratory in some tests to reduce the hum output from a midget receiver. It was found possible to decrease the hum to a negligible value by decreasing the effectiveness of the filter in the plate circuit of the detector. This increased the hum in the detector circuit which balanced out the hum produced in the power tube circuit and caused a marked overall reduction in the hum audible from the loud speaker. Consideration of these facts must be realized in any experimental work on amplifiers for it is such effects which cause the hum to increase when a change is made in a circuit that at first thought would appear to be one which ought to cause a reduction in hum.

Different Filters

There are of course various ways in which resistance capacity filters may be connected to the tube. Certain possibilities are illustrated in the right, Fig. 1. In this circuit we show a resistance capacity filter in plate circuit of T1 and indicate how the condenser C3 may be connected either to ground or directly back to the cathode of the tube. In such circuits, it is usually better to connect the condenser directly back to the cathode since this arrangement returns the A-C audio currents directly to the cathode of the tube. In this connection, however, it must be realized that such an arrangement causes the hum currents from the B supply circuit to also flow through the C bias circuit. In certain cases this may prove desirable, and in others undesirable, and it is a matter of experiment to determine which arrangement gives the best results.

Resistance capacity filters are also connected in the grid circuits as shown in Fig. 3. Here we also show two possible arrangements: one which utilizes a resistance R1 and a condenser C1 with the condenser returned to the cathode of the tube and the resistance connected to the ground. The alternative arrangement is to eliminate the resistance capacity filter and connect the lower end of R4 directly to ground. The latter arrangement is usually best for the following reasons.

The A-C current in the plate circuit of T1 causes current to flow thmrough R3 and C4 R4. Since these currents originate from T1, it is necessary that they be returned by the most direct path back to the cathode of T1. The currents through R3 are returned to the cathode by C3. The currents through R4 must also be returned to the cathode of T1. If we use a resistance capacity filter R1 C1, in the grid circuit of T2, then the currents in R4 must flow through C1 and the C bias circuit of T2, in order to return to the cathode of T1. Such arrangement is obviously undesirable and it is therefore better not to use any filter in the grid circuit but to connect R4 directly to ground. With such an arrangement the currents go directly to ground and hence back to the cathode of T1. To use a resistance capacity filter in the grid circuit of T2, would actually cause an increase in the common coupling between the two tubes. Such filters in the grid circuit should therefore not be used in resistance coupled amplifiers. They can be used in conjunction with transformer coupled amplifiers since in such amplifiers the primary and secondary of the transformer isolates the two circuits. Using grid circuit filters in resistance coupled amplifiers, may actually cause an increase in hum and increase in coupling between the two circuits.

In the circuits shown in the two sketches, we also indicate condensers connected across the C bias resistor. The size of this capacity is determined largely upon the value of the C bias resistor and the amplification constant of the tube. It is usually sufficient, however, to make the bypass condenser across the C bias resistor of a value such that the impedance of the C bias circuit is small in comparison with the value of the C bias resistor. Let us, for example, consider a power tube circuit in which no resistance capacity filter is used in the grid circuit of the power tube. The A-C current developed in the plate circuit must return to the filament through the C bias circuit. The A-C voltage drop across the C bias circuit will be equal to the A-C plate current times the C bias impedance. The voltage drop across the C bias circuit is impressed back on the grid of the power tube and it has a phase relation such as to decrease the amplitude of the signal. The overall gain of the power tube circuit is therefore reduced if any considerable amount of A-C voltage appears across the bias circuit; to keep the voltage across the circuit low, it is necessary to use bypass condensers across C bias resistors.

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Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns.

Sources of Quartz

WHAT ARE the principal sources from which quartz is derived for the purpose of piezo oscillators?—L. K. B.

Piezo oscillator crystals are usually made from the quartz that may be found in Brazil, Madagascar, Japan, and some parts of the United States. The largest crystals are usually found in Brazil.

* * *

Diathermy

WHAT IS THE GENERAL theory involved in the generation of internal heat in the human body by means of radio apparatus?—J. E. L.

It has been found that the frequencies around 56 megacycles have the property of inducing within human tissue an electric current that is productive of a rise in body temperature. By controlling the time and power of such application, body temperature may be raised to any desirable point which has been a boon to the medical profession as such work materially helps the work of the doctor, especially as the "fever" may be localized at an infected lesion, whereas other methods of raising temperature made the whole body febrile. Commercial varieties of such apparatus have utilized a 250-watt tube.

* * *

Constants for Amplifier

WILL YOU INDICATE the constants of the parts used in the high-gain amplifier shown in RADIO WORLD of November 10, 1934?—F. A. S.

The diagram to which you allude has been drawn for the general case of any tubes with the number of electrodes shown. Since the constants of tubes vary in a wide range, constants cannot be given for the general case. Another factor that required special consideration is the plate potential. This parameter will affect the size of the grid bias condenser and resistor materially. Thus, in order to present definite constants, it is essential that the type of tubes and the plate voltages be known. In general, plate resistors of 250,000 ohms, grid load resistors of 1 meg. and filter resistors of 100,000 ohms, with 1 mfd. or more for bypassing, suffices.

* * *

Radio Law Violation

WHAT ARE THE steps that one has to take when notified by the Federal Communications Commission of having violated the law?—F. M. K.

We quote from section 24 of the Rules and Regulations of the Federal Communications Commission: Any licensee receiving official notice of violation of Federal Laws, the Commission's rules and regulations, or the terms and conditions of a license shall within 3 days from such receipt, send a written reply direct to the Federal Communications Commission at Washington, D. C. The answer of each notice shall complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. If the notice relates to some violation that may be due to the physical or electrical characteristics of the transmitting apparatus, the answer shall state fully what steps, if any, are taken to prevent future violations, and if any new apparatus is to be installed, the date such apparatus was ordered, the name of the manufacturer and the promised date of delivery. Section 26 states further that: If the notice of violation relates to some lack of attention or improper operation of the transmitter, the name and license number of the operator in charge shall be given.

* * *

High Notes Missing

I HAVE BUILT what was represented to be a high-fidelity amplifier, but find that I do not get the high notes. I've tried different dynamic speakers and I used good parts in the assembly. Also, the voltages are O. K. However, I've determined that the trouble lies in the second stage of the layout. The arrangement of this amplifier included push-pull 58's, push-pull 56's and push-pull 2A3's. Please advise where the high notes have disappeared.—A. K.

High notes may be lost through the use of transformers that do not have a reasonably flat characteristic up to the high notes or too much capacity anywhere else across the signal line. It is therefore useful that you check up on the characteristics of your transformers. The shunting condensers of large values are notorious for robbing the high frequencies. It is recommended that you try reducing the capacity of all condensers that are shunted across your amplifier. Also, in push-pull ampliers, it is imperative, for efficient operation, that all parts be perfectly balanced. In other words, your 58's should be perfectly alike in all characteristics, likewise the other tube pairs. It is also important that your push-pull transformers be well matched, as to impedance as well as to balance.

* * *

Motor Interference

I AM EXPERIENCING a great deal of trouble in receiving radio signals at my location due to a number of motors and generators in use at an adjoining saw mill. Where can I receive expert information as to the minimizing of this trouble at the source?—H. T. W.

Any of the companies that make a specialty of manufacturing condensers or resistances will be glad to furnish you with data accumulated by their engineering staff just for such interference problems. If you will address these firms, you will get a comprehensive answer. It might be said in brief that by suitable combinations of condensers, resistances and inductances your object may be achieved.

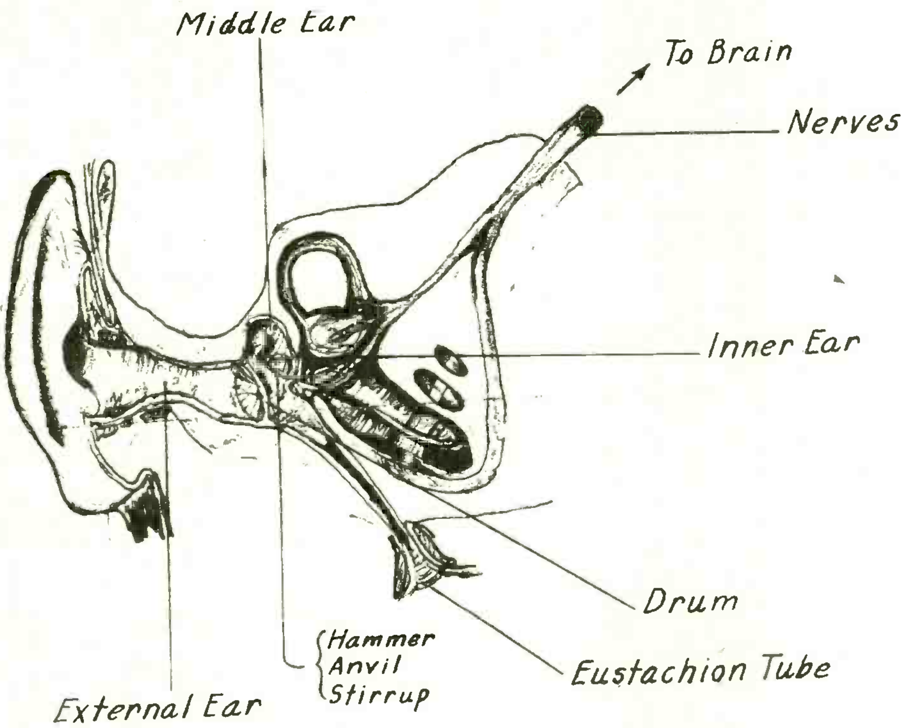
* * *

Correction

C. C. GALL, of Richmond Hill, N. Y., takes exception to our statement that "A" in the musical scale vibrates at 427 times per second. He states that the American Federation of Musicians standardized this tone at 440 vibrations per second in 1917 and that the United States Government adopted this standard in 1920. We regret this error.

How We Hear the Radio

Ear Not a Delicate Instrument But Performs Marvels



The Human Ear

The marvel of hearing is better understood by a study of the human ear's construction. In this effort, the ear is divided into the external, middle and inner ear. The external ear serves to collect the sound. The middle ear serves to conduct the collected sound to the inner ear, where the delicate organs are located that transform the sound energy into nervous energy, now considered electrical, to cause the sensation of hearing in the brain. The wonders of the ear are further enhanced by the inclusion of the eustachian tube which allows the ear to withstand tremendous sound pressures. This tube is essentially a by-pass that connects the middle ear with the throat and nose so that excess pressure can be detoured from the delicate ear drum out through the mouth or nose.

BY far the greatest application of radio and its allied fields is transmitting and amplifying sound. This is true of broadcasting, telephony and public address. Sound is received as a sensation of our auditory sense of which the ear is the external organ. It would seem, therefore, that those engaged or interested in application and transmission of sound should have a fundamental understanding of the phenomena we call hearing.

When some object such as a cone of a loudspeaker vibrates, sound waves are imparted to the surrounding air. These vibrations, generated by any vibrating body, may be imparted not only to air, but to water, wood, or any other surrounding medium; and, through this medium, they may be transmitted as waves of sound.

The ear is an organ specially adapted to receive these vibrations and to transform them into nervous impulses.

Divisions of Ear

Anatomically the ear is divided into three separated and distinct parts. These parts are so inter-connected that sound waves are transmitted from one part to the next. These parts will now be briefly analyzed.

External Ear. This consists of the external part, the part we commonly call the ear, and a short tube about one inch long along which sound passes inwards to a sort of drum.

Middle Ear. This small cavity lies on the other side of the membrane of the drum. By means of the Eustachian tube this cavity is connected with the throat and, thereby, the air within is under the same pressure as the air in the external ear. This releases extreme strains on the membrane between these two sections.

Stretching directly across the cavity of the middle ear is a chain of three very small bones, called the hammer, anvil, and stirrup. These bones are bound together and transmit vibrations from the tympanic membrane between the external and middle ear, to the portion of the inner ear known as the cochlea.

Inner Ear. The inner ear receives the ultimate terminations of the auditory nerves and is the essential part of the organ of hearing. Without going into detailed anatomy, the inner ear may be said to consist of a system of small bony spaces and tubes within which lies a membranous labyrinth. Forming part of the lining of the membranous labyrinth are sensitive cells between which are the endings of nerve fibers. These conduct the impulses to the brain.

Limits of Perception

The vibrations that can be perceived by the ear as musical tones lie within certain limits. These limits, of course, are subject to considerable individual differences. Usually the lower rate of vibrations is placed at 30 cycles per second, although some people respond to vibrations as low as 16 cycles. Below this limit, if a reaction occurs, it is due to either pressure sensation or harmonics (overtones).

The high limit of audibility is about 40,000 cycles. Very great variations exist in different individuals. The ability to hear high-pitched sounds also decreases with age. However, sounds of a frequency higher than about 10,000 cycles are usually overtones and are not missed except by a trained critical listener.

Considerable variation in loudness must occur before the change will be noticed. In general the ear is not a very critical apparatus. It does not discriminate well between different degrees of loudness, fails to notice small percentage of distortion, fills-in missing gaps, and possesses tonal gaps and tonal islands. Tonal gaps are the failures found in some individuals to hear well or not at all certain frequency ranges. Tonal islands, on the contrary, is the special ability to hear well and discriminate a fine variation of pitch in certain frequency ranges.

Nevertheless, the ear is a marvelous device, being able to detect a feeble whisper and yet not break under the strain of great noises, such as firing of a cannon or spoutings of a political orator.

—M. N. Beitman and I. Gebel.

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.*

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Mutual Film Exchange, Box 4241, G. P. O., Sydney, Australia.
A. Porter Bancroft, 91 Lakeview Ave., Lynn, Mass.
Mr. Brown, W9RBP, 2724 Calumet Ave., Chicago, Ill.
Vital Bastarache, c/o Motor Repair Shop, 176 Botsford St., Moncton, N. B., Canada.
A. E. Hinkley, Avilla, Indiana.
Nieto & Cia., 711 Entre Rios, Buenos Aires, S. A.
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G. B. Craom, 4121 Grant Ave., Fresno, Calif.
E. L. Dague, 7361 Hamilton Ave., Pittsburgh, Pa.
R. L. Danielson, Hardin, Mont.
Ewing Gentry, 2222 Kaelin Ave., Louisville, Ky.
G. M. Guy, 2704 S. Redondo Blvd., Los Angeles, Calif.
Mr. F. M. Hughes, c/o W. M. Lynn Furniture Co., P. O. Box 217, Olney, Texas.
B. Reinhard, 373 Second Ave., Phoenixville, Pa.
W. F. Onder, 3725 Louisiana Ave., St. Louis, Mo.

A Vibrator B Supply

A 6-Volt Storage Battery Furnishes Potentials

By Louis C. Batton

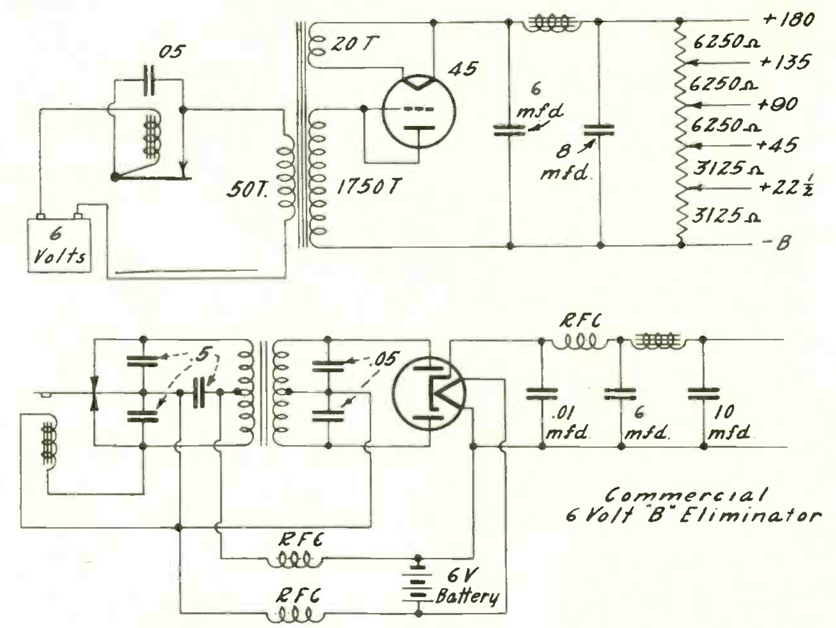
ALL of us who have grown up with the art of radio and have seen it through its battery stages know what a nuisance B batteries can be, especially when replenishment of 180 volts is required with its outlay of four or five dollars. When one is on a farm or other outlying section where there is no convenient 110-volt power line, he becomes dependent upon these batteries even in these days when a-c receivers take so much of the grief out of radio. Of course, there is the possibility of one's generating plant, but that is quite a luxury—even in the small 32-volt variety. It is accordingly of utility to design a means of generating adequate power from a 6-volt storage battery, which battery may be readily recharged. Of course for a B supply it is necessary that this voltage be stepped up to the requisite value of 180 volts. Since direct current cannot be stepped up it is necessary to transform this direct current of the storage battery to alternating current so that may be increased to the desired voltage level. This is accomplished by means of a vibrator which is nothing more than a buzzer essentially.

Various Voltages Obtained

By this means, the d.c. of the battery becomes a constantly interrupted direct current which can be stepped up by a suitable transformer to a desirable level. This high-voltage a.c. is then fed to a means of rectification to produce direct current of high voltage, which is then obtainable at any desired voltage level, within the limits, from a tapped resistor across the line. This is shown in the top sketch on this page. For the purpose of comparison, a commercial form of this type of eliminator is shown in the bottom sketch.

How to Wind Transformer

The vibrator may be an ordinary buzzer. But, it is essential that it be able to withstand a current of about two amperes so that it should be chosen with a discerning eye for the contacts. These contacts should be quite large and of tungsten to minimize deterioration. For further protection, a .05 mfd. condenser is shunted around the contacts to absorb the sparking at these points. Since the buzzer electromagnetic coil is in this 2 ampere circuit, it should also be sufficiently heavy to carry this current—wound with wire of about No. 20 gauge.



In the upper sketch, a number of common parts are assembled together to produce a "B" eliminator that is suitable for a small three or four tube set. The lower sketch indicates the diagram of a commercial product that does the same thing.

The transformer contains a primary and two secondary windings. One of the secondaries is for heating the filament of the rectifier tube while the other secondary is the high-voltage winding. If a 45 type tube is used with its grid and plate tied together, the first secondary coil should contain 20 turns of No. 20 wire and the high voltage section should contain 1,750 turns of No. 28 wire, while the primary should consist of 50 turns of No. 14 wire. In winding this transformer it is desirable that the primary winding be located between the two secondaries.

The rectifier can be seen to be a 45 type tube with plate and grid tied together. This tube might also be one of the O1A, 12A or 71A type, in which case different filament windings would be necessary on the transformer (upper diagram). The filter is composed of a B choke coil shunted by two large condensers as shown. This choke may have a value on the order of 10 henries with as low a resistance as possible, of the order of 150 to 200 ohms.

Voltage Divider

The voltage divider is shown with variable taps since the voltages obtainable from them depends upon the load on each section. Since such a unit will probably be used all types of receivers, it is recommended that the voltage divider be of proportions approximately similar to that shown.

With this arrangement, a small receiver can be adequately powered from only one 6-volt storage battery to furnish both the A and B battery potentials.

Oakley's Overall Test Method

A method of overall measurements of receiving sets has been described by H. D. Oakley of the General Electric Company. Here, a radio frequency oscillator is modulated in a Heising circuit and the output is supplied to an antenuator which supplies the apparatus under test with a small voltage of known magnitude. The output of the receiver is measured by means of a vacuum tube voltmeter that is connected across the loudspeaker terminals.

The oscillators, together with the measuring apparatus, are housed in a completely screened room, while the apparatus under test together with the attenuator and the vacuum tube voltmeter are housed in an adjacent screened room. The function of the first screen is to prevent direct induction from the oscillator into the apparatus under test while the function of the second screen is to shield the apparatus under test from fields due to external sources. The attenuator consists of a copper wire with a concentric return, the point of contact between the two being grounded and connected to the filament circuit of measured apparatus. The inductance per unit length is calculable and, by means of various taps, small voltages of known magnitude may be obtained.

The thermo-junction instrument used for measuring the current in the potentiometer is situated in the oscillator screened room and accordingly does not give a true measure of the current in the attenuator at the high frequencies. The input may be applied to the apparatus directly, to a dummy antenna having characteristics that are similar to those of the actual antenna or to a loop antenna. The results obtained are expressed as audio output voltage existing across the speaker terminals with respect to the known input radio frequency voltage modulated at a definite percentage by a definite audio tone.

The selectivity of the receiver is expressed in terms of curves connecting the input voltage with definite modulation with respect to the frequency change around the normal resonance point for a constant output across the speaker terminals. The properties of the audio frequency amplifier are determined by varying the frequency of the modulator while maintaining a constant input voltage and a constant percentage of modulation.

Overall measurements of a receiver made in this way or any other way that is equally accurate will supply the means for obtaining a quantitative picture of a receiver's performance as a whole and with such an analysis available, the performance of various receivers may be definitely compared.

How to Use PRE-6 Generator

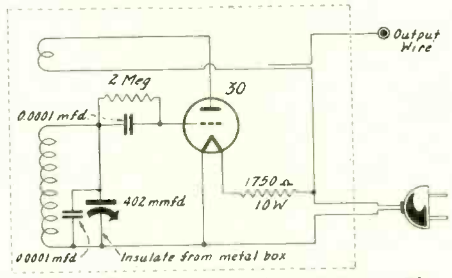
Frequencies from 109 kc Well into Short-Wave Band May Be Measured

THE Signal Generator, designed and calibrated by Herman Bernard, covers fundamental frequencies of 109 to 205 kc with a direct-frequency reading dial and is intended primarily for lining up intermediate channels. Harmonics are used for lining up intermediate frequencies higher than 205 kc.

The Signal Generator is for a.c. or d.c. use, 90-125 volts, and has modulation on a.c. (line hum), but scarcely much modulation on d.c. However, on d.c. there are usually commutator ripple and other line noise to constitute a low percentage of modulation. Oscillation takes place immediately—no waiting for tube to heat up.

Connections: The line plug is connected to the 90-125-volt line. If the line is a.c. the plug may be inserted either way. If the line is d.c. the plug must be inserted a particular way. There is no danger if the plug is reversely connected to d.c., but the Signal Generator will not oscillate then, so reinsert the plug the other way. The single wire emerging from the Signal Generator is for connection to the circuit to be measured or peaked.

Intermediate Frequencies: If the frequency of an intermediate channel is to be measured, disconnect the antenna from the receiver and connect the output wire of the Signal Generator to the plate of the modulator tube (primary of first intermediate transformer), and turn the Signal Generator dial until a response is heard. If there is only one response as the Signal Generator dial is traversed, then the maximum sound output from the measured circuit, or brightest illumination or greatest needle deflection, depending on what type of indicator is used, in general will indicate resonance at the fundamental frequency as read on the top tier. If there are more than one response, the unknown is an harmonic of a read frequency. The important frequencies covered by harmonics are on the second from top tier of the dial and appear twice: 400, 450, 465 and 480. However, 250 kc and 260 kc are on that tier, too, but appear only once. These would yield only one response, though second harmonics. The instances where harmonics are principally used, e.g., 400, 450, 465 and 480 kc, appear twice because when response is obtained at one point, the other point serves as a check and the unknown can not be any frequency other than the one read. This is an exclusive harmonic-confusion-elimination method. For the very important 465 kc frequency, use the setting for 465 directly under 116¼, for that is the more accurate, while the repeat point will fall a little to the right of the second 465 imprint.



Circuit diagram of the PRF-6 Signal Generator. The 0.0001 mfd. fixed condenser causes the tuning to be almost straight frequency line.

The more usual requirement is that a channel is to be peaked at a predetermined frequency, rather than measured at what it is, but in so many instances must a superheterodyne be relined, in actual practice, that it is well first to measure the actual frequency, and thus note whether any change is needed, and, if so, in what direction. If the frequency should be lower, increase the capacity of trimmers; if the frequency should be higher, decrease the capacity of trimmers.

To line up the i-f channel at the correct frequency the connection may be left at the modulator plate, except in the cases of i-f interstage trouble, or extremely selective three-coil channels, when it may be necessary to start at the plate of the first i-f tube, line up the second and third i-f transformers, then move the connection back to the modulator plate and finally line up the transformer that comes directly after the modulator. The desired frequency is read from the dial in this operation. If an harmonic is used, then, for the important frequencies, the second response point on the generator is used as check. Here also, in the case of 465 kc, use the position directly under 116¼ kc.

For 456 kc, use 114 kc of the fundamental, check for elimination of confusion due to harmonic, by repeat point at 158-2/3 kc, although the repeat point need be read only approximately, without in any way marring the accuracy.

For measuring any other desired intermediate frequency higher than 205 kc, if not on the dial, divide the desired frequency by any number that produces a result falling in the fundamental range (109 to 205 kc), and then divide the same desired frequency by a number that is one higher or one lower than the previous divisor. Thus you obtain the repeat point, due to the next successive harmonic order, and eliminate all confusion.

Higher Frequencies: These may be measured even to megacycle ranges (although channels may not readily be preset to some selected frequency in these harmonic ranges) by using an adroit method of harmonic analysis. Wrap the Signal Generator output wire around the antenna leadin near the set, or if need be, remove the antenna connection and replace it with the Generator's output wire at the set antenna post. Read the frequency on the fundamental (top tier) of the Signal Generator, an harmonic of which is producing the response. Then turn the Signal Generator dial until the next successive response is heard, receiver remaining unmolested. Note the two frequencies. Subtract the lower from the higher. Divide the result into one of the read frequencies and then you know the harmonic order of the **other** read frequency. For instance, suppose you read 150 and 180 kc as the two fundamental frequencies whose harmonics furnish consecutive responses. The difference is 30. Divide 30 into 150 and you get 5, the harmonic order (not of 150, but) of the other frequency, 180. Hence the unknown is 900 kc. Had the difference, 30, been divided into 180 kc, yielding 6, then 150 would have been multiplied by 6, giving the same answer, 900 kc. In this way harmonic orders lose all their cloak of mystery, and frequencies well into the short-wave spectrum may be measured, and with high accuracy, because the almost straight-frequency-line characteristic of the uncrowded Signal Generator dial separates fundamentals by only 1 kc.

Wavelength and Degree Scales: Besides the frequency scales at top there are, at bottom, a fundamental wavelength scale, 1500 to 2700 meters, and a 0-180 degree scale. When wavelength values are desired in using harmonics, ascertain the harmonic order and, instead of multiplying as with frequencies, divide the read wavelength by that harmonic order. The 0-180 scale enables recurring to any special frequency for unusual tests.

Tube Required: The Signal Generator requires the insertion of a 30 tube.

Special Connection Advice: Wherever a set manufacturer has given directions for connections contrary to those recommended above, follow the manufacturer's advice.

A THOUGHT FOR THE WEEK

AGAIN THEATRE MANAGERS ARE BLAMING RADIO. They are talking —and very definitely, too—about reducing permanently the scale of prices for theatre seats, especially in the Metropolitan zone. And they say that radio is furnishing the necessity for revising the prices of admission. Does it occur to them that the increase in box-office schedules of some years ago was based on the fact that the public was supposed to pay the freight no matter how poor the quality of the haulage? And the public —ably assisted by Hollywood—made up its combined mind that it wouldn't be squeezed any more. The good shows have always drawn the money—and the poor ones never, no matter how low tariff or how good or bad the times.

Radio perhaps is to blame for a lot of things—not forgetting that it has been a means of livelihood for a small army of entertainers who, without the lure of the air programs, would be in the bread line instead of before the microphone.

TUBES IN PARALLEL

Two equal tubes in parallel have twice the mutual inductance of one tube alone.

Westinghouse Promotes Evans

Walter C. Evans, manager of Westinghouse's radio division, announces the appointment of J. G. Beard as manager of all of the company's police radio activities. His duties will include the design, manufacture, and sale of this line of equipment. Mr. Beard has been actively associated with radio developments since 1918, and for the past five years has been with the Westinghouse Electric and Manufacturing Company at Chicopee Falls, Mass.

Coils for Short Waves

How to Determine Inductance Required Short Cuts to Actual Construction

By Wallace Eddy

COILS for short waves are divided into two classes, depending on the method of band shifting: plug-in type and switch type. The plug-in type is losing popularity only because of inconvenience, heightened by the fact that the superheterodyne is the leading circuit, a pre-selector stage is required for a home receiver, there are four bands at least, so as three coils would have to be changed for each band there would be fifteen changes to encompass the spectrum.

The fact that plug-in coils are inconvenient is practically the only argument against them. Numerous difficulties are removed by use of such coils: dead spots due to adjacent coils, higher contact resistance that may be present in the switch, small diameter for winding, present in all switch-type coils because of space limitations for numerous coils that must stay in the receiver, elimination of necessity of total shielding and elimination of the practice of winding all coils on a single form.

The plug-in type is self-explanatory as to construction and offers no options. The switch type enables one to choose among various methods of layout and construction, including all windings on one form, separate form for each separate coil, and combinations of the two methods.

Stopping Dead Spots

The deadspot trouble has to be solved, because adjacent coils may have a natural period (especially when a trimmer remains across them) that is in the frequency spectrum of a next higher-frequency coil. Then the expediency is used of shorting out the adjacent coil, so no voltage will develop across it. Stromberg-Carlson uses this shorting-adjacent-coil method. RCA-Victor has windings on a single form for each stage.

Sometimes the circuit is adapted to coil considerations. For instance, one desire is to do as little switching as possible. This would result in large capacity tuning condenser, requiring fewer switch positions and also fewer coils for covering a band, and circuit selection to economize on the coil construction. The circuit selection in mind is the Hartley oscillator, which requires a tapped coil, whereas all other systems that operate on the grounded-rotor principle require two separate windings, except the dynatron, which requires only a single untapped winding, but has to be stabilized, as it wobbles badly, and the stabilization is more of a job than using some more dependable oscillator.

The Hartley coil therefore may be considered as a single winding, and the tap is simple to produce in manufacture of the coil. The same amount of switching has to be done as when a tuned-grid or other type oscillator is used (save the dynatron) but the coil construction is undoubtedly simplified, and compactness is served.

Where They Stopped

Although theory has been to the contrary, the Hartley is not as good an oscillator as is the more popular tuned-grid type. This fact has been recently confirmed by measurements of two sorts: one, the actual amplitude of the oscillations, when the coupling was the same, and the frequency the same and obtained by the same constants; and the other, observation of the highest frequency, in the short-wave realm, where the oscillator stopped oscillating under equal conditions. The tuned-grid type oscillated to 22 mgc when the Hartley stopped at 17 mgc. Of course the Hartley's oscillation could be restored by closer coupling, better coil, etc., but the comparison was made on an even basis, and since circumstances often introduce factors (such as proximity to metal) that work against oscillation, it is sparing of trying experience to ascertain which oscillator is preferable for sustaining oscillations over a wide frequency-shifting range.

As for the actual winding of the coils, the first thing to ascertain is the required inductance. This can be calculated if the lowest frequency and highest capacity are known. Also the ratio of tuning, or frequency ratio, can be calculated from the capacity ratio, being the square root of the capacity ratio. However, once the inductance for the largest secondary is known, the capacity ratio being known or calculated, the required inductance of the rest of the secondaries can be ascertained by simple division. Divide the larger inductance by the capacity ratio to obtain the inductance required for the next higher frequency band.

The frequency ratios need not be troublesome, as they may be taken from experience. For condensers of 0.00035 to 0.0004 the ratio, without too much trimmer capacity, that is, trimmers not all the way in, will be at least 3. For 0.00014 mfd. the frequency ratio will be at least 2.4. For 80 mmfd. the ratio will be just a bit more than 2. These ratio values take into consideration the distributed capacities of the circuit, including the condenser minima, tube capacity, wiring, socket, etc.

The Condenser Capacity

It is assumed that everybody knows at least approximately the capacity of the condenser they are using. If not, he can take the condenser to some radio store and let the service man there estimate the capacity, as he is familiar with that aspect of condensers. Also, there is some leeway, as noted in the fact that the same ratio was applied to values lying between 0.00035 mfd. maximum and 0.0004 or so mfd. maximum. So, too, for 0.00014 or 0.00015 mfd., etc., the same ratio, 2.4, may be accepted. By the way, for the old capacity of 0.0002 mfd. the ratio is 2.6. For 0.00025 mfd. it would be about 2.7, but this is an estimate. The rest have been checked experimentally.

(See next week's issue for Short Wave Coil Winding Data Table)

Practical Formula Units

If the maximum capacity is known, no account need be paid to the circuit capacities other than to add 10% to the maximum and then since the lowest frequency desired is known, the inductance may be computed. The inductance formula is:

$$L = \frac{1}{(2\pi f)^2 C} = \frac{1}{(6.28f)^2 C}$$

where L is in henries, f is in cycles per second and C is in farads. However, since these units are too large and not of practical use, we shall transform these units into their everyday form of microhenries, megacycles and microfarads.

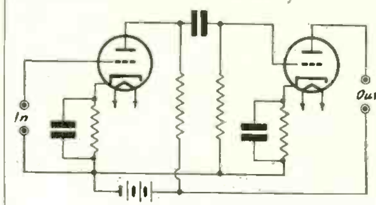
In order to do this, we have to assure ourselves that we do not destroy the equality of this equation by this conversion. For this purpose let us revamp the equation to its equivalent form:

$$(L)\ (C)\ (2\pi f)^2 = 1$$

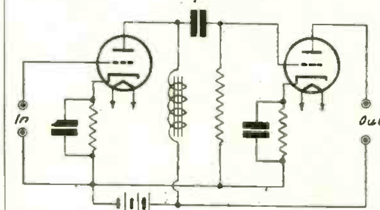
Here we see that when the units are henries, farads, and cycles, and the product of the three terms is the number 1. In order that we may convert the units to the micro variety, we have to operate on the equation in such a way that the product of the three terms still is 1. To reduce L in henries to L in microhenries we have to multiply the first L by one million since there are one million microhenries in one henry. Since we also desire C in microfarads, we have to multiply C by a million also, for the same reason. Now, what have we thus far? We have multiplied the left side of the equation by one million twice so that the product of the equation is no longer one but 1,000,000,000,000! Obviously, in order for the equation to equal one, we have to divide the $2\pi f$ term by 1,000,000,000,000. It will be remembered that the $2\pi f$ term is in cycles per second. In order to transform this term to megacycles per second we have to divide the cycles per second by 1,000,000. However since this term is squared, we divide the $2\pi f$ term by $1{,}000{,}000^2$ or 1,000,000,000,000. Thus, we return to the situation where the equation is equal to 1 again and the units of the equation are correct. We are thus enabled to substitute these quantities in terms of microhenries and microfarads when the frequency is given in megacycles per second. So, using the equation at right, because $2\pi f$ is stated in numerical value, L will be in microhenries when f is in megacycles and C isis in microfarads.

AUDIO COUPLING

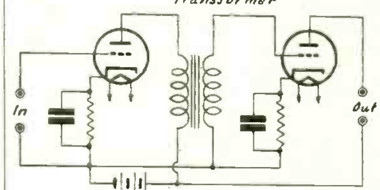
Resistance



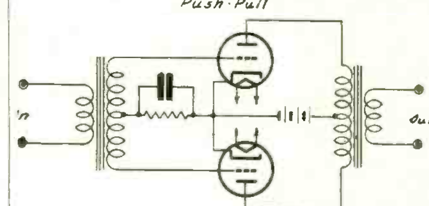
Impedance



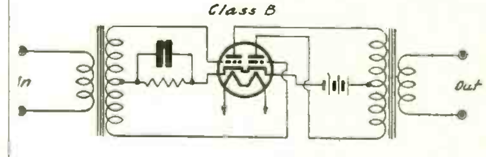
Transformer



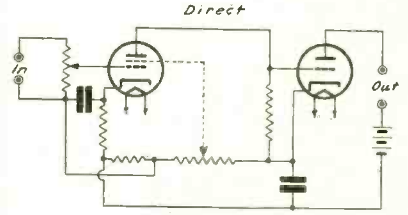
Push-Pull



Class B



Direct



The audio-frequency stages of a radio receiver may be coupled in any one of the fashions shown above.

Philco Engineers Home Art Stunt for Set Display

The radio as a musical instrument was exhibited in six Philco radio music rooms sponsored by the Philco Radio and Television Corporation at the Drake Hotel, Chicago, recently in cooperation with the Association of Arts and Industries.

Philco invited six leading Chicago decorators to execute their ideas of what the modern radio music room in the American home should be. Six smart, elegant and totally different rooms resulted, all of them exhibiting to the best possible advantage the latest Philco models.

The Association of Arts and Industries sponsored the exhibit because of their interest in furthering good design in commercial products of all kinds.

Thousands of spectators passed through the rooms. Special events were conducted with the idea of bringing visitors from the higher income brackets who would be possible customers for the expensive radio instruments on display.

Four Philco models, the company's highest priced ones, were used in the six rooms which varied in decoration schemes from ultra-modern to Regency and Biedermeier, including 18th century English and one room which was without decorative pedigree but altogether pleasant and delightful.

Philco was motivated by the conviction that the time has come when radio programs are of such quality as to require perfect tonal reproduction in fitting surroundings.

Ben Nash, rated one of the ten best commercial designers in America, was given the job of making a radio cabinet into a musical instrument case. One of the models on display retails at $600 and others are nearly as costly.

More Power from Old Sets

Bias Can Be Arranged to Aid the Results

By Morris N. Beitman

Supreme Resistor Company

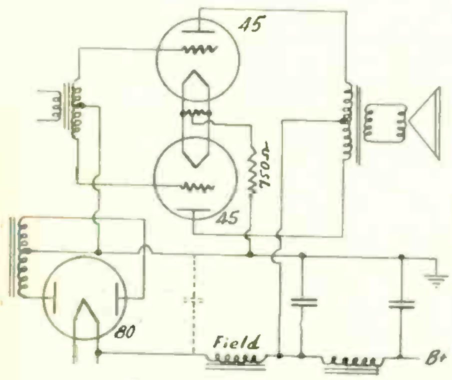


Fig 1-a Self biased 45 Amp.

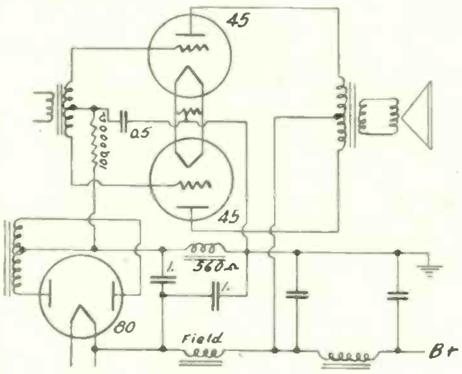


Fig. 1-b Semi-fixed bias 45 Amp.

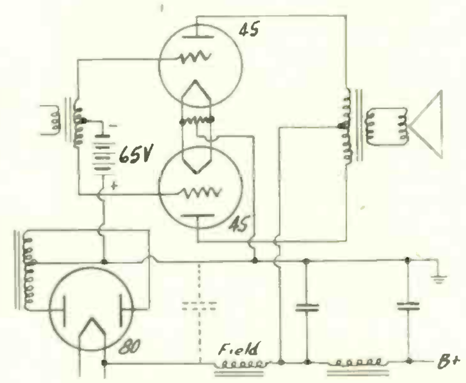


Fig 2 - Fixed bias 45 Amp It is possible to obtain nine watts of audio power with this circuit without any special parts

At left is a self-biased amplifier, the bias being derived from the plate current flow in the 750-ohm resistor. At center is an example of semi-fixed bias, grid being returned to negative of the B line, cathode grounded (positive in respect to center tap of the high-voltage winding). Fixed bias, at right, derived from batteries.

A GREAT many receivers purchased a few years back, and still in active use, utilize type 45 tubes in push-pull in the last audio stage. Even with conservative rating, the power output of a couple of these tubes with 250 volts on the plates is over three watts. This is in class A, self bias. At one time this was the height of perfection, at the time when the 71 and 50 were the only competitors. Now, when in extreme cases, much larger power is demanded from an average receiver, new tube models were developed. The types that compare with the 45 in plate voltage and current requirements, are able to produce much greater power with the same percentage distortion. For example the 2A3, in certain circuits, is able to produce 15 watts of audio power.

Recently it has been shown that under certain conditions in a class A prime circuit, a pair of 45's in push-pull will produce as much as 19 watts with not more than the allowed 5% distortion in the output. This much greater power necessitates the use of special input transformer, low impedance C supply, and carefully matched output transformer to keep the distortion within the allowed limits.

Few Changes

It is of interest to see if the power output of radio sets using push-pull 45's in the final audio stage could be increased with but a few changes. A receiver of the type using 45's, had a power transformer supplying about 375 volts on each half of its high voltage secondary. Considering the voltage drop in the 80 rectifier, the field coil used as a choke, and the self biasing resistor or choke, about 250 volts remained for use as the plate voltage. This voltage is even lower with a choke input rectifier. Under these conditions the maximum output from two 45's will be about 3.2 watts. Not very much by comparison with a possible 19 watts.

It is possible, of course, with somewhat drastic changes to obtain this much power, but such procedure would call for a new rectifier, filter, input and output transformers. However, up to about nine watts of power can be obtained from an ordinary set of this type with little changes. In fact the only additional parts that would be required are a 65 volt B battery, and the replacement of 27 tubes, if used, in the detector and first audio stage with type 56.

In ordinary class A application the operating point is chosen somewhere near the midpoint between the current saturation and plate current cut-off. The grid bias is the negative voltage needed to keep the current equal to this selected value with no signal. The grid swing is then approximately from zero to twice the bias voltage.

Shift of Point

By shifting the operating point closer to the cut-off point by increasing the bias, the tube may be operated somewhere between class A and class B. This unsymmetrical relation will result in considerable harmonic distortion. However, the use of two similar tubes in a balanced circuit will eliminate the even order harmonics. Under these conditions much greater power will be obtained.

The 45's are usually wired for use either with self bias or semi-fixed bias. These two circuits with essential part of the rectifier are illustrated in Fig. 1. Only one choke is used to filter the plate current because of the nature of the push-pull circuit to balance out the A.C. hum. Usually this choke is the speaker field. Many times the first filter condenser is omitted and at times is made smaller than the other filter condensers. The advantage of the semi-fixed bias is somewhat greater power output and better regulations.

Fig. 2, shows either of these two circuits changed to produce about 9 watts of audio power. The changes of the 27's to 56's mentioned before are not shown, but must be made. The reason for this is the necessity of higher grid voltage swing, and the 56 has almost twice the mu or amplification factor of the 27.

Plate Voltage

The full plate voltage is here applied to the 45's; this, however, should not be greater than 275 volts. The B battery is used as a C bias and its voltage is not very critical. About 65 volts will do.

Receivers having low-gain in the r-f stages and small transformers will probably not give the expected nine watts, never-the-less the power obtained after this change will be much larger. The change is so simple that it is worth trying. In some receivers experimented with, as much as 13 watts were obtained, and the quality of the tone was much finer.

Book Tells How to Make Things You Wondered About

If you have ever "yearned" to dabble and putter with chemicals, you can satisfy that yearning now. "Practical Everyday Chemistry," simply written, is a book that tells you how to make adhesives, alloys, animal remedies, anti-freezes, antiseptics, automobile specialties, blacking, bleaches, bakery preparations, carbon paper, cements colors, cosmetics, crayons, disinfectants, drugs, dyeing, emulsions, extracts, fireproofing, fireworks, garden specialties, greases, inks, insecticides, liquors, mouth washes, paints, plating, polishes, soaps and cleaners, stain removers, varnishes, and hundreds of other articles, with which you are in daily contact in the office, factory, school, and home.

This book is true to its title in being "practical." It is no mere re-hash of old and impractical recipes, but, on the contrary, a book, modern in context, making use of many new chemicals and processes discovered right up to 1934. It is a broad education in the composition of familiar materials because of the great variety of subjects covered. All one must be able to do is read, measure, and weigh.

Everyone no matter what his calling, will find information, pleasure, and profit in reading "Practical Everyday Chemistry." Radio technicians will find numerous applications in their line, as some chemistry applies to radio practice.

Station Sparks *By Alice Remsen*

GIVING YOUTH A CHANCE

YOUNG WRITERS WHO HAVE LEAPED INTO PROMINENCE through the success of their first stories, novels, poems or dramas are being heard in a series of programs now being broadcast over NBC networks each Thursday at 6:00 p.m. William Lundell interviews these young people, each of whom reads an original work, written especially for radio, in his or her NBC program, WJZ and the blue network carries this most interesting broadcast. . . . A new kind of radio comedy—the burlesquing of the world's bores and ridiculous customs by means of satirical songs and sketches—is now being offered by Beatrice Lillie over a nation-wide NBC-WJZ network each Friday at 9:00 p.m. Deflating the "stuffed shirts" from Park Avenue and Main Street and all intermediate highways and byways is Miss Lillie's microphone objective. Through her inimitable characterizations and laugh-provoking songs, with their special lyrics and intentionally off-pitch tones, she pokes fun at silly vanities and practices. The usual radio paraphernalia, including an orchestra, an announced and assorted supporting players, assists her. . . .

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THE ROMANTIC DON MARIO

Penthouse Serenade, a new half-hour musical show featuring romantic Don Mario, formerly heard from the NBC studios in Hollywood on the Maybelline Musical Revue, is on the air weekly from NBC's Chicago studios each Sunday at 3:30 p.m., EST, over an NBC-WEAF coast-to-coast network. Charles Gaylord's distinctive orchestra, and Nora Martin, better known to radio listeners as Dorothy Hamilton, Hollywood beauty expert, assist the young Spanish tenor in the half hour broadcasts under the sponsorship of the Maybelline Company.

Don Mario, who is a real Spanish don and whose full name is Don Mario Alvarez, and Nora Martin came to Chicago from the nation's film capital to join the new Penthouse Serenade cast. The orchestra which helps to set off Mario's tenor voice has scored numerous successes on fashionable dance floors and in motion pictures under the baton of Charles Gaylord, who for six years was assistant director, played the violin and sang under Paul Whiteman. The organization appeared as the Bakers orchestra in "Palmy Days," with Eddie Cantor, and in "Confessions of a Co-Ed," with Bing Crosby. It has played for two seasons at the Ambassador Hotel in Atlantic City and filled engagements at the William Penn Hotel in Pittsburgh and the Montmarte Cafe in Hollywood. . . .

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GOES UP IN SMOKE

Rhythm and melody features Chesterfield's 1935 series of radio programs over the WABC-Columbia network. Andre Kostelanetz conducts the new series, which is presented on Monday, Wednesday and Saturday nights from 9:00 to 9.30 P.M., EST. Besides the brilliant orchestra which Kostelanetz has assembled, he has the assistance of a wide range of voices in building programs in which the dance numbers of today and the hit tunes of Broadway's most popular shows share honors with some of the best loved and most seasoned ballads. Kostelanetz was at work more than a month assembling a 14-voice chorus capable of harmonizing with the full richness of his 40-piece orchestra, and the ensemble effects created by the use of the full blended effect of these two units is a new achievement in beauty of tone and sound. Novelty and variety is introduced in presenting a new quartet, which Kostelanetz organized after several weeks of experiment in combinations of male voices. The distinctive harmonies of the new quartet is prominently featured in each of the three broadcasts weekly. The members of the new Kostelanetz combination, each known as an accomplished soloist, are Floyd Sherman, tenor; Gordon Cross, tenor; Hubert Hendrie, baritone and Darrell Woodyard, bass. . . .

DIANE AS A MYSTERY

"Diane and Her Life Saver," a new musical comedy program starring Rhoda Arnold, soprano, and Alfred Drake, baritone, with Lucille Wall and John Griggs in leading roles, is a twice-a-week series over the coast-to-coast WABC-Columbia network. "Diane and Her Life Saver" will be heard every Monday and Wednesday at 8:00 P.M. Unique in several striking features, the new series is being created by two of radio's most successful script writers, Henry Fisk Carlton and William Ford Manley. The roster of distinguished talent features dual singing and dramatic roles in a series of romantic and amusing episodes dealing with Diane and her suitor, interspersed with outstanding musical selections from the field of operetta and light music. Lucille Wall, who has played many prominent roles in important radio productions, is heard in the dramatic part of Diane, while Rhoda Arnoud, popular lyric soprano, sings Diane's musical selections.

Opposite Miss Wall is John Griggs, distinguished young actor of stage and radio now starred in Hassard Short's production of "The Great Waltz." "Diane and Her Life Saver" also introduces Alfred Drake, a talented young baritone recently chosen for his part from a large field of vocalists. Written in a light romantic vein, the new series features the amusing and exciting adventures of Diane, her family, and her mysterious suitor. . . .

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Jane Froman's no comedienne but the lovely songstress is never without some good yarn when she comes to the NBC studios for a broadcast. It's not the kind of a yarn that you think, though. It's a sweater she's knitting for herself. She carries it in her bag to the broadcasts and works on it between shows. . . . Tim and Irene, NBC comedy team, made the Crosby cocktail famous: one drink and—Bing! But it remained for Phil Baker, the old Armour Jester, to put the Jekyll and Hyde cocktail on the map. One drink and you're another man! . . . Celebrated guest artists who appear on Rudy Vallee's variety programs at the NBC studios are seeing a lot of each other these days. Not that their association develops a new intimacy, which it may, but because they sit in the wings facing each other, like passengers on a French train. . . . BORN: To Mr. and Mrs. Vincent Gilcher, on Monday, December 10, a daughter, Anne Marguerite, Gilcher is manager of technical service for NBC. The new daughter, already nicknamed Peggy Anne, is their first child. . . . Because she is so slender, Beatrice Lillie seems very tall. Actually she's about five feet two.

Emergency Work Bureau to Erect Six Portables

The Westchester County Emergency Work Bureau has been granted permission to erect six portable-mobile transmitters to be used in that county in the State of New York with 2 watts of power on the following frequencies: 31600 kc, 35600 kc, 38600 kc and 41000 kc. Call letters that have been assigned are W10XEP, W10XEQ, W10XER, W10XES, W10XET, W10XEU.

"SAFETY-FIRST" SHORT-WAVE KITS

These Leonard kits contain complete parts; nothing else to buy, for building a 1 or 2 tube regenerative detector short wave and broadcast radio set tuning from 15 to 550 meters.

Many enthusiastic builders have registered reception from as far as India on these small sets. Simple instructions are furnished so that any one, young or old, can build it with no trouble at all.

Features of the Kit:

All broadcast type vernier dial, complete set of 5 coils from 15 to 550 meters, chassis of heavy steel with black crackle finish as well as panel; silver contact regeneration control for smooth action; complete blueprints and instructions, all necessary wire, nuts, screws, etc.; all controls on front panel; special vernier to bring in those weak signals.

1-TUBE BATTERY KIT

A battery operated short wave receiver which covers from 15 to 550 meters. Police signals, amateurs, foreigners, transatlantic phone stations. Uses 1-230 tube, 2-2½ volt dry cells and 1-45 volt "B" battery. Tubes not supplied.

Cat. No. C4000.
Our Price **$4.75**

2-TUBE BATTERY KIT

Similar to the one tube, only here we can actually operate a loud speaker on some stations because of the addition of another 230 tube which makes the signal much louder. Uses 1-230 detector and 1-230 as first audio, 2-2½ volt dry cells, 2-45 volt "B" batteries. Not supplied.

Cat. No. C4001.
Our Price **$5.45**

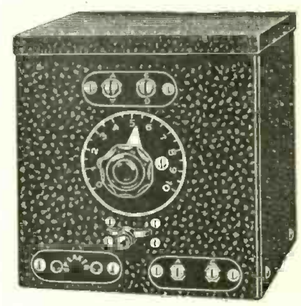
2-TUBE A.C.-D.C. KIT

The latest in efficient small sets—Same layout as the battery sets but with no necessity for either A or B batteries. Simply plugs into the A.C. or D.C. line. Uses the latest type dual 6F7 tube as detector and one stage of audio and 1-37 as rectifier. Not supplied. Foreign reception is most consistent with this set.

Cat. No. C4002.
Our Price **$6.50**

Either Kit Wired at Factory $1.00 Extra

Federal 5 and 10 Meter Transceiver



FEATURES: A highly efficient wired transceiver which is gaining in popularity every where.
Designed for portable work as well as for stationary use.
A correctly engineered unit designed to give the service required of it.
Operation on five or ten meters by simply changing coils.
Five and ten meter coils provided with the unit.
Uses only parts made by the foremost manufacturers.
Performance limited solely by topographical location.
Is now in use by leading amateurs.
Weight only 6 pounds.
Adaptable for six volt, 2.5 volt and 2 volt operation.
Size 5½ x 5¾ inches.

The transceiver is mounted in a strong steel case which is finished in black crystal. All component parts are mounted on a steel cadmium finished chassis. Transmission and reception are done by the simple throwing of a switch.

Models: The 6 volt model uses a 76 and 41. This is ideal for use in motor boats, airplanes, automobiles, etc. A six volt battery lights the filaments, and either "B" batteries or 6 volt "B" eliminators supply plate voltage. As low as 90 volts will operate this unit. The 2.5 or A.C. model is suggested for stationary usage. Here we use a 56 and a 2A5. For this unit we supply an especially designed power pack which not only supplies the plate and filament voltages, but supplies microphone current. No batteries are needed. It may be well to mention that this unit and the 6 volt may be used interchangeably by inserting the proper tubes.

The two volt model is ideal for both portable and FIELD WORK. Where there is no voltage source available, this model is brought into play. Through the use of a 30 and 33, only 2 volts of A battery are necessary, and as little as 90 volts of "B" will operate the transceiver efficiently.

Model 601. For 6 volt operation (using 76 and 41 tubes, not supplied)
Your Price **$13.50**

Model 602. 2.5 volt or A.C. operation (using 56 and 2A5 tubes, not supplied)
Your Price **$13.50**

Model 603. For 2 volt (using 30 and 33 tubes, not supplied)
Your Price **$12.50**

A.C. Power Pack for all electric operation of Model 602 Transceiver
Cat. No. 602P. Our price, less 80 tube **$5.50**

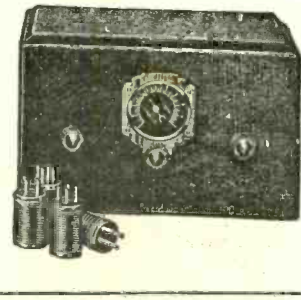
Above four products are sold only in wired form.

Federal All-Electric 3 Tube A.C. — D.C. Short Wave Receiver

A new, wired deluxe complete short-wave set with the highest of efficiency.

Consistent world-wide reception is now within the reach of everyone's pocket. Through the use of the latest tubes a three tube set, self-powered from either A.C. or D.C. is made possible.

Thousands of these sets are now rendering excellent service. Amateurs, experimenters and short-wave authorities have proclaimed its merits. Points 12,000 miles distant have been heard consistently, some stations on loud speakers. Some favorites are London, Germany, Rome, France, Russia, etc. Though primarily designed for short wave, it very efficiently receives signals simply by the insertion of broadcast coils.



Latest type full vision Airplane Dial, 270° scale; latest type tubes (1-77, 1-43, 1-25Z5); 1-high efficiency plug in coil (set of 4), 15 to 200 meters; silver contact regeneration control finished chassis; crackled finished heavy steel cabinet; four section filter system, hum-less built-in power supply. Size 11¼ x 7¼ x 7¼ (overall).

Cat. No. C4003. Our Price (with 4 coils, less tubes) **$13.95**

Two broadcast coils, extra 89c (both)

GUARANTY RADIO GOODS CO., 145 W. 45th St., New York, N.Y.