Vol-11 #24 284

SEPT. 3, 1927 15 Cents

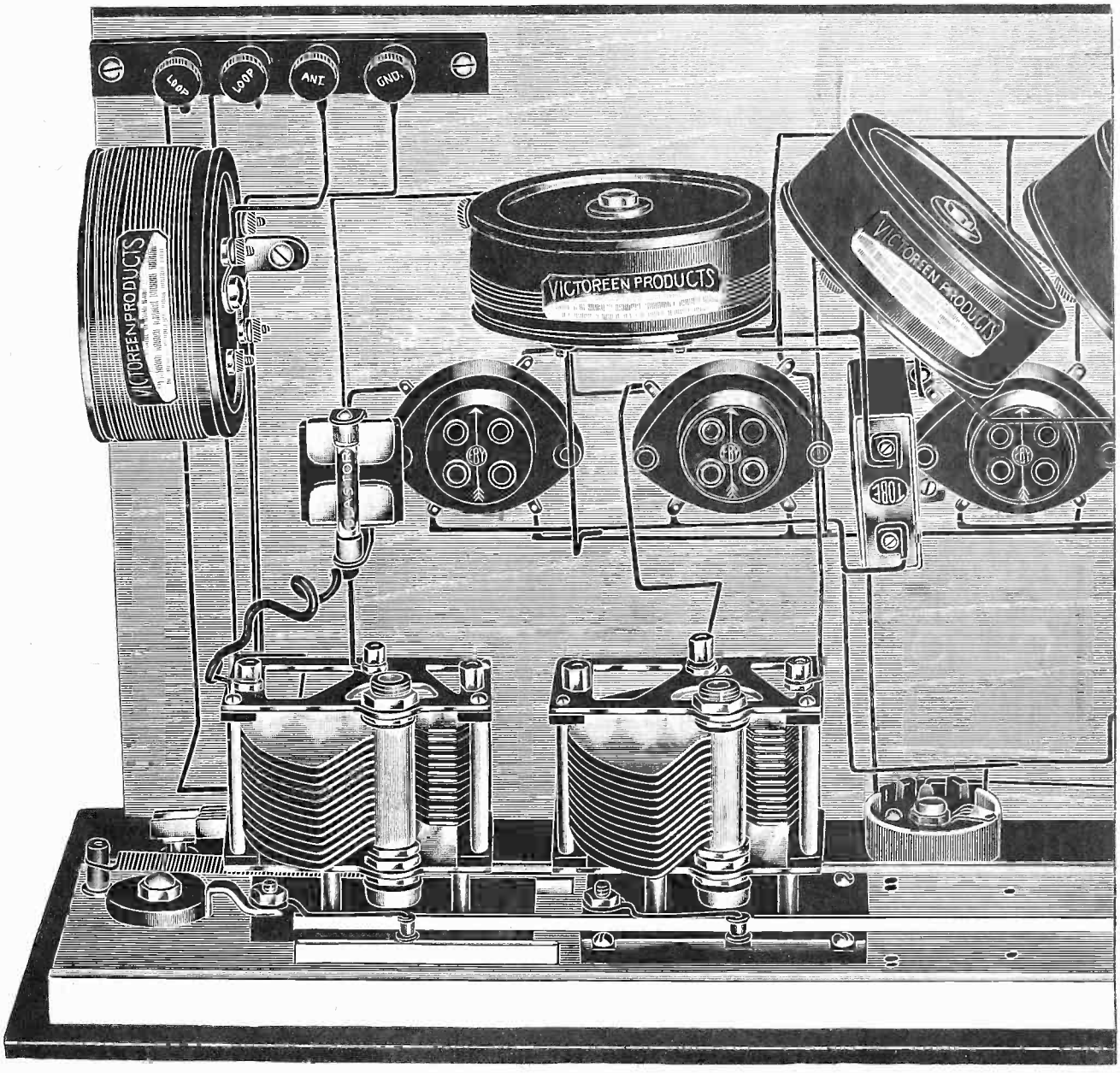
RADIO WORLD

REG. U.S. PAT. OFF.

WORLD

America's First and Only National Radio Weekly

The 1928 VICTOREEN!



A New Position for the Oscillator is One of the 1928 Victoreen Features **(See page 3)**

Vol. XI
No. 24
Whole No. 284
September 3, 1927
15c per Copy. $6.00 per Year

SIXTH YEAR
RADIO WORLD
REG. U.S. PAT. OFF.

A Weekly Paper Published by Hennessy Radio Publications Corporation from Publication Office, 145 W. 45th Street, New York, N. Y.
Phones: BRYant 0558 and 0559

[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1897]

The 1928 Victoreen Universal

By Capt. Peter V. O'Rourke

THIS will be a Super-Heterodyne year. Thousands of fans who have waited for the perfect receiver have come to the conclusion that the Super-Heterodyne is as nearly perfect a receiver as the radio art has to offer this year and is likely to be so for many years to come. They have concluded that to wait for further improvements in the art of radio reception is merely to deprive themselves of the very fine entertainment which is all around them in the ether and which is theirs for the tuning.

They have decided to get their Super-Heterodyne this year and to add any possible future improvements as they come along.

Out of the many different types of receivers to choose from why have they chosen the Super-Heterodyne? There are innumerable reasons which have contributed to their choice, and they all can be summed up in the inherent superiority of the circuit. To name all the advantages of the Super-Heterodyne is equivalent to naming all the desirable qualities in a receiver. They sound familiar from descriptions of the ideal set.

Let us name some of the facts of the Super-Heterodyne circuit. First comes the selectivity. No other type of receiver can compete with the Super in respect to selectivity. The Super was developed for the purpose obtaining greater selectivity than any other circuit could provide. And the Super-Heterodyne is capable of such high selectivity that practical designers are forced to limit it to desirable values.

"The Most Sensitive"

Then comes its sensitivity. It is the most sensitive receiver ever devised or constructed in a unit. The selectivity of the receiver can always be made as great as desired and the only practical limit is the atmospheric noise level. And this sensitivity can be obtained without any entangling relations between the magnetic fields of the several tuned circuits. In other words, it can be obtained without any squealing.

Tone quality of late has become a household word everywhere. The receiver must be capable of the highest quality. Does the Super-Heterodyne meet the requirements on this point? It does, if the designer of the circuit knew what the meaning of the term quality and if he understood the factors which contribute to fidelity of reproduction. The designer of the Victoreen Universal Super-Heterodyne has long been regarded as an authority on the subject.

Simplicity of tuning is another desirable feature in any receiver. With two or three independent controls this cannot be achieved and when two or more controls are combined in the ordinary receiver, loss of selectivity and sensitivity is inevitable. In the Super-Heterodyne only two tuned circuits are necessary, one for the modulator and the other for the oscillator. These can be put on one control, as has been done in the 1928 Victoreen.

It is customary in connection with a Super-Heterodyne to use a loop alone for picking up the signal out of space. When Major Edwin H. Armstrong first described the Super-Heterodyne he made the statement that the circuit could not be used with an antenna. Numerous experimenters since that time have found that results are generally better with a loop. The difficulties with the antenna have been heterodyning with other stations from so-called image interference and serious overloading of the amplifier tubes. The trouble from image interference has been due to lack of selectivity in the radio frequency tuner and the trouble from overloading has been due to inadequate and misplaced volume controls. There is no need for either type of trouble now.

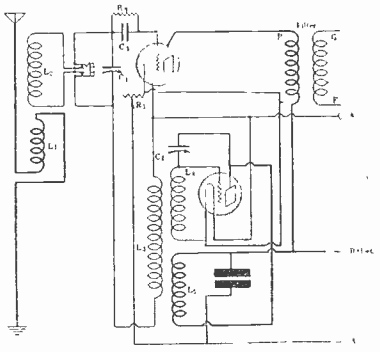
So You Have Your Choice

At the present time the antenna is gaining in popularity, especially as receivers have been made so sensitive that an indoor antenna will serve admirably. This type of antenna does away with most of the objectionable features of the open circuit antenna. The receiver will not overload so quickly, it will be much more selective than with the high outdoor antenna, and it is not subject to atmospheric conditions. An indoor antenna can be used very well with any Super-Heterodyne properly designed.

In the 1928 model Victoreen Super-Heterodyne provision has been made for both an open circuit antenna and a loop. Thus the type of pick-up is left with the fan himself, and he can always choose to suit the local and present requirements. If there is little interference and he desires extreme long distance reception he can use an outdoor antenna 150 feet high if he likes. If there is likely to be some interference and he wants to reach out a thousand miles or so he can use an indoor antenna. If there is severe interference he can choose the loop. Under average reception conditions the indoor open circuit antenna should serve all reception requirements.

In the 1928 Model Victoreen the loop and the indoor antenna can both be left connected in the circuit if desired, and to switch from one to the other it is only necessary to turn a jack switch located on the panel. A special terminal strip containing four binding posts suitably inscribed is provided for the loop and the antenna.

The Oscillator Circuit Sketch



THE oscillator and the modulator circuits employed in the Universal Victoreen are coupled by means of a small coil placed in the grid return lead of the modulator and wound around the oscillator coil. The connections are shown in this diagram of the mixer.

Coil Facts

The radio frequency and the oscillator coils have been made alike in appearance and physical dimensions. This not only to improve the visual aspects of the receiver but to make adjustments of the two circuit easier and more accurate. The radio frequency coil has two windings, a primary or antenna coil of a few turns and a secondary of about 160 microhenrys. The oscillator coil has three windings, one for the grid circuit, another for the plate circuit, and a third for the oscillation pick-up. The plate an grid windings are connected in series aiding through a large by-pass condenser. The tuning condenser is connected across the two coils.

The placement and connection of the pick-up coil have a great deal to do with the performance of the receiver. In the Victoreen coil the number of turns has been determined experimentally to give the best pick-up without causing overloading in the detector or in the subsequent tubes. The pick-up coil is connected in the grid circuit of the modulator below the tuned circuit that is, on the ground side. This the Victoreen engineers found gave the best results in their receiver.

Observe on the photograph of the receiver, reproduced on the front cover, that the radio frequency coil and the oscillator coil have been placed at right angles. This adjustment is quite necessary to minimize electrostatic and stray electromagnetic coupling between the two systems. The distance apart of the two coils also minimizes the stray coupling.

Strictly Confined

What is desired is to make the pick-up coil the only means of transferring the

oscillations over to the modulator tube. If energy could also get over via the stray electromagnetic coupling, this might either neutralize the coupling through the pick-up coil or it might reinforce it. In the case of neutralization the circuit would not be sensitive; and in the case of reinforcement it would be overloaded on strong signals and distorted reproduction would be the result. If the electrostatic coupling also contributed to the pick-up, the receiver would be very erratic. It would be sensitive in certain regions of the broadcast band and insensitive in others.

The modulator tube operates on the principle of grid leak and stopping condenser with positive grid return connection. This has been found to be more sensitive than the grid bias method, particularly when the grid leak resistance is high and the stopping condenser is small.

While the oscillator in a Super-Heterodyne has been called the heart of the circuit because it pumps life into it, the intermediate frequency amplifier is the strength-giving element.

A Super-Heterodyne either stands or falls on its intermediate frequency amplifier.

If the intermediate frequency has not been properly chosen the set might be too selective, it might not be selective enough, it might be subject to a great amount of image interference, or it might be nothing but an uncontrollable electric whistle.

Mistakes Avoided

If the intermediate frequency filter is not sharply tuned the set will not be selective; if it is too sharply tuned the signals that get through it will be distorted. If the filter is not well tuned and adjusted the set will be insensitive; if the filter is accurately tuned and if the coils are not placed properly, the amplifier will oscillate; and this will ruin all reception.

The intermediate frequency amplifier is very critical, yet it is an indispensable part of the Super-Heterodyne.

In the Victoreen 1928 model four intermediate frequency transformers are used, which means that there are three tubes in the circuit which act as intermediate frequency amplifiers in addition to the second detector. These coils are all exactly alike. This is to facilitate the accurate adjustment of 1/3 of 1% to which they are held in manufacture. The coils are also placed exactly alike with respect to the amplifier tubes. This is to maintain the accurate adjustment to which they have been subjected individually.

Another reason for placing the coils similarly, particularly the angular orientation, is to minimize magnetic coupling between them. If the coils are placed at a certain angle with respect to the straight line which passes through their centers, the fields of any two adjacent coils are at right angles, and there is no magnetic coupling between the coil. There is still some capacity coupling. This is neutralized by changing the angle required for zero magnetic coupling just a little bit.

The placement of the intermediate transformers is important and the recommended layout should be followed scrupulously.

Those who meet with failure and then say that they followed directions exactly usually do not know the meaning of the term "exactly." They think it means "about."

Volume and Oscillation

The care in tuning and placing the intermediate frequency coils is not enough to insure success. The coupling ratios and the primary impedances must also be properly chosen with respect to the tubes which are to be used in the amplifier. This is a problem which the designer of the coils had to solve. It has been solved in the Victoreen in such a manner that the step-up per stage is the greatest consistent with stability of the amplifier.

A circuit in which the amplification is as great as it is in this intermediate amplifier, a volume control is necessary. Without one the volume would be so great on most of the stations desired as to overload most of the tubes. Quality reception would be impossible under these conditions no matter how well the audio circuit had been designed. Hence a 6-ohm rheostat has been placed in the filament circuit of the three intermediate amplifiers. This is permissable for volume control in the intermediate frequency level but not in the audio. In the intermediate or radio frequency level no serious distortion effects can result from throttling down the filament current.

There are times also in a super-sensitive receiver like this when oscillations will occur in the intermediate frequency amplifer even though it is perfectly stable under normal conditions. This abnormal behavior seems to be due to weather conditions. No matter what their cause, it is desirable to have some means handy for stopping the oscillations whenever they occur. One of the simplest and most effective means of doing this is to connect a 400-ohm potentiometer across the filament circuit of the intermediate amplifiers and to connect the grid returns of these tubes to the slider of the potentiometer. By means of this the grid bias on the intermediate frequency tubes can be adjusted so as to stop the oscillations. It is best to set the slider near the negative end and use the rheostat as much as possible for controlling the oscillations as well as the volume. The potentiometer should be used in emergencies only.

The detector following the intermediate amplifier, like the modulator, operates with grid leak and stopping condenser. High sensitivity of this arrangement has led the designers of the circuit to adopt this method of detection. Some Super-Heterodynes employ the grid bias methods, which can also be used in this circuit if all the sensitivity is not required. There is a .002 mfd. condenser connected from plate to filament in the detector circuit to by-pass the intermediate frequency currents across the primary of the first audio transformer. A condenser is necessary but it is not advisable to employ a larger one than .002 mfd.

It would not be sensible to take every precaution sound engineering practice can suggest to make the radio frequency and the intermediate frequency parts of the circuit flawless and then spoil the receiver by installing an indifferent audio amplifier, which is very often done. The Victoreen engineers have not only carried sound engineering principles to the ultimate binding post but they have made special studies to get the audio amplifier as nearly perfect as possible. A new audio frequency unit, the Victoreen 112, has been designed. This unit is large enough to handle large powers without core saturation; it has primary impedance adequate enough to hold up the amplification to the lowest audio notes; and it has windings of low distributed capacity so that the higher audio notes are not by-passed. In other words, the overall frequency characteristic of the unit from the lowest note of the piano to the highest audible frequency is satisfactory. It is practically a straight line.

Some Pointers on AF Tubes

As an aid in the prevention of distortion from overloading of tubes it is recommended that both the audio tubes be of the 112 type and that high voltages be used on them. Plate voltages as high as 400 with suitable grid bias are recommended. The volume obtainable with this combination is very large as compared with volume ordinarily obtained from receiver, and what is more, the volume is free from second harmonic distortion, or any other harmonic distortion The result is that when the output is heard through the medium of a Western Electric 36" cone it is as delightful as when it is heard through a pair of condenser earphones connected to a crystal rectifier.

Objection has been raised to the use of high plate voltages on several grounds. They are high enough to be dangerous; they are too high for the tubes; they are difficult to obtain. It is true that voltages around 400 volts are dangerous where there is unlimited power behind them, but there is not in a radio set. There are many high resistances between the source of power and the person who might blunder himself into a shock. These resistances will prevent any dangerous stock yet the shock will be severe enough to constitute a sharp warning that someone has been careless.

It is also true that the voltages are too high for the tubes—when too low grid bias is used. The ordinarily recommended voltage for these tubes is 157 volts. This is also too high without proper grid bias. A voltage of 400 volts with proper grid bias for that voltage will not be a severe test on the tubes. They stand it. A blue glow suggesting ionization need not be feared.

[Part II of this illuminating article on the theory and practice of 1928 Victoreen will be published next week, issue of September 10.]

LIST OF PARTS

One Victoreen No. 400 400-ohm potentiometer.
One Victoreen No. 2 2-ohm rheostat.
One Victoreen No. 6 6-ohm rheostat.
One Victoreen master control unit type V. U. (condensers).
One Victoreen audio control unit, Type 3-R2, consisting of one 30-ohm rheostat and two 10-ohm rheostats.
One Victoreen audio transformer unit No. 112.
Four Victoreen RF transformers (No. 171 for dry cell tubes and No. 170 for storage battery tubes.)
One Victoreen No. 150 oscillator coil.
One Victoreen No. 160 antenna coupler.
One Yaxley No. 10 battery switch.
One Yaxley No. 760 double-pole double-throw jack switch.
Two Yaxley No. 416 pup jacks.
Eight Eby UX type Universal sockets.
Eleven Eby Ensign engraved binding posts.
Two Dubilier .00025 mfd. grid condensers with resistor clips.
One Dubilier .002 mfd. by-pass condenser.
Two Daven 2 megohm grid leaks.
One Tobe 1 mfd. precision condenser.
One Jewel 1 Pattern No. 135 voltmeter; 0-8 and 0-5.
One Mar-Co No. 302, 0-100 vernier dial.
One Corbett cabinet 7x26 inch (10 inches deep).
One Lignole 7x26x3/16 inch front panel.
Two binding post strips, 5/8 x 9 3/8 x 3/16 inches and 5/8 x 4 1/2 x 3/16 inches.
One wooden baseboard 9 1/2 x 25 1/2 inches.
Ten lengths of Acme celatsite (strip or radio wire).
Six 1 3/8 inches No. 6 round head brass wood screws.
Twenty-three 7/8 inch No. 6 round head brass wood screws.
Eighteen 3/8 inch No. 6 round head brass wood screws.
Four lengths 3/16 inch brass tubing or four angle brackets each 7/8 inch long for binding post strip separators.

Accessories

Six 201A, 301A or Ce Co type A tubes
Two 112 tubes or two Ce Co type F tubes.
One spool of Kester rosin core solder.
One Vee-dee loop.

PRECAUTIONS
You Should Take In Equipping a Power Supply

Ventilation Is Necessary—Switch Should Serve Purpose Intended and Tell-tale Light Should Be in the Primary

By Herbert E. Hayden

THERE are many details of construction which the amateur battery eliminator builder should not overlook. Some of these are adequate ventilation, placement of indicator lamps, types of switches to use, protection against dust and other foreign matter.

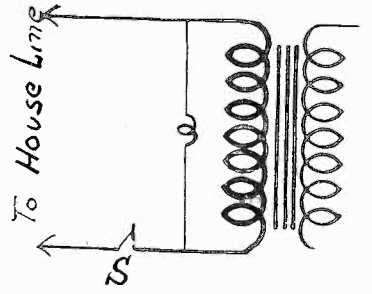
Battery eliminators are not 100% efficient. More power must always be put into the devices than can be taken out of them. The difference is lost in heat. If the housing is not properly designed the parts inside may get so hot as to ruin the device completely. The conductors in the transformers and chokes may get so hot as to damage the insulation, and the rectifier tube may get so hot as to break down. These must be carefully guarded against.

The way to prevent the parts from getting too hot is to provide adequate ventilation and adequate radiating surface. Holes cut in the sides and top of the housing of the eliminator will aid in the ventilation by allowing for an air draught.

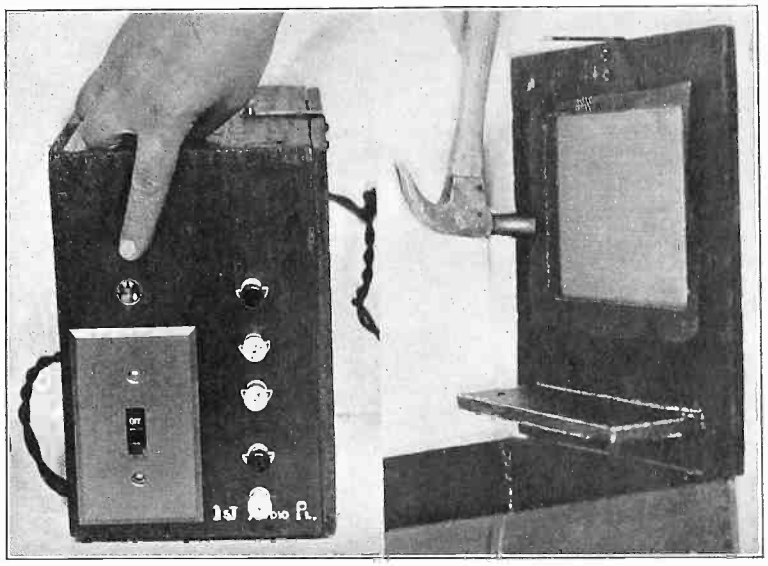
A Screened Ventilator

A very satisfactory way is to cut a very large hole in the side and then cover this over with a fine mesh copper screen. The screen will admit the air freely but will prevent the entrance of solid objects. It will even keep out a great deal of the dust which always flies around. This method of ventilation is illustrated in the photograph at the right above.

Another detail is the location of the indicating lamp. This is often made a six-volt lamp and placed in the secondary circuit. When it is placed in that manner the power may be on and still there will be no indication in the lamp. The lamp shows whether the secondary circuit is open or closed. It does not show whether the primary is open or closed. When the secondary circuit is open and the primary is closed a current flows in the primary. Not much power is drawn from the mains



THE switch S located in the primary circuit.



(Hayden)

THE control panel of a battery eliminator (at left), showing the output binding posts, the on-off switch and the pilot light. In all eliminators there is considerable heat generated which must be removed from the box. The photograph at right shows a large screen covered window cut in the side of the box for that purpose.

but enough current flows to make it worth while opening the switch. If the indicator lamp is placed in the primary it will indicate whether the power is on or off, and there will be no doubt about it.

If the pilot light is placed in the primary of the supply transformer it should be connected across the line. That means that the light must be designed for 110 volts. Such lamps are available in minute powers. They will not fit into standard pilot light sockets but small sockets are also available for these lights.

It would be very desirable to have a pilot light of one color in the primary and another of a different color in the secondary. This is especially desirable when a storage battery is used in the secondary as a ripple remover. When the power switch is opened both of the lights should go out at the same time. If one stays lit it means that the relay failed to operate. Conversely, when the switch is closed, both lights should go on at the same time. A failure of one of the lights to respond to the power switch would again indicate a defect in the relay. It is desirable to have the indicating lamp or lamps very close to the switch. In the photograph at the left is shown a control panel in which the pilot light is directly over the switch.

Still another point that should not be overlooked is the type of switch that is installed to make or break the power supply. In radio sets we are accustomed to switches which have been designed to work in six-volt circuits with heavy currents. Such circuits will break clean without any arcing.

Greater Danger of Arcing

When we deal with high voltages in circuits having high inductance there will be arcing whenever the circuit is broken. It is desirable to have switches which will stand the high voltages and at the same time break quickly and definitely. There are many types of switches for sale in electrical supply stores. And they are not expensive.

There are also switches of distinctly radioesque lines which have been developed for eliminator manufacturers. Usually these are smaller than the switches designed for general electrical purposes, but they have been so made as to stand the higher voltage.

Be sure to get the right switch.

Col. Green to Test Strength of Signals

New Bedford, Mass.

Col. Edward H. R. Green has agreed to carry on a series of experiments for the Government at the request of Commissioner Henry A. Bellows. The object of the experiments is to establish the relative strengths of signals over land and sea. It is known qualitatively that radio waves travel much better over water than over land, but there is no quantitative data available.

Commissioner Bellows of the Federal Commission, who called on Col. Green to make the arrangement, said:

"We have been very much interested in the work that is being done at Round Hills, especially on the radio fog signal, with the possibilities it holds for improving radio communications between land stations and airplanes. Colonel Green will work up a series of experiments for us in this connection.

"The Hawaiian flight has demonstrated the necessity for a great deal of further development in means of communication between airplanes and land stations. We are very much interested in this connection in the measurement of signals that are put out over land stations and over water.

"It is known that the waves that pass over water are much stronger than those that pass over land, but it is not known how much stronger. It is important to know, so that the amount of power needed to send out the signals may be determined."

His work is eagerly awaited.

A Spot of

A WHITE table scarf or doily placed under the radio cabinet helps to break up the somber assembly and gives it that delightful feminine touch. The comfortable Windsor chair adds convenience in tuning and comfort while listening, as shown at extreme left. Relief from the sombre hues of the radio set is obtained in another installation by placing an ornate and brilliantly colored scarf on top of the radio table. Symmetry of placement of radio set and speaker also adds to the salutary effect.

"IT does not seem to belong," said an artist friend of mine one evening while we two were discussing the installation of a radio receiver in the artist's home.

For three years this man had been considering the purchase of a radio set. For three years he had been unable to reconcile himself to what he called the new idea. The radio set does not belong in his artistic world, was his idea. It does not belong because the old masters did not have radio sets, because the paint on the receivers has not cracked yet, because the worms have not furrowed the wood in it, because it has not been retrieved from an old junk heap.

He would like to have an up-to-date receiver if he could only hide it completely somewhere in his home.

Can the set be placed in a clothes closet, a bureau drawer, under the library table, behind the high boy, in the dumb waiter? These were some of his hopeful questions. He was very anxious to find a hiding place for his prospective radio set before the Dempsey-Tunney fight. But he would not even listen in on that event if the radio set were visible.

Foolishly Misses Much

And while this gentleman was trying to find a place of concealment for the set he intended to buy, he was missing much entertainment which was good enough to justify even a breadboard hook-up set!

Many persons of a more practical than "artistic" turn of mind have installed radio receivers in their homes and have reaped rich cultural dividends from them.

But it is admitted that many radio receivers are of a sombre and depressing hue. There is often not a bright spot about them as far as their effect on the eyes is concerned. Some sets even lack the simplest symmetry. As an example of somberness look at the receiver on the left above, forgetting for the moment its surroundings. The dial shield is dark bronze, though it looks white in the photograph; the cabinet is dark mahogany, the table on which the set stands is likewise two-tone mahogany, the panel is jet black. There is just one speck of color about the set, and that is the tiny pilot light under the bronze shield. Its red light gives a little relief from the depressing tone of the radio assembly.

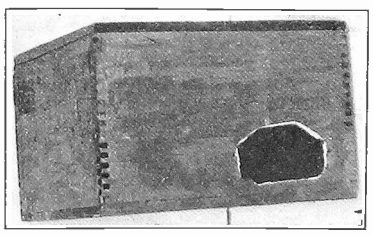
A Lively Setting

But there is no need of placing the sombre outfit in an equally dismal setting. The enlivening influence of the feminine touch can be distinctly seen in the photograph A simple white doily placed under the set relieves the somberness entirely. The placement of the receiver in a bright and attractive corner of the room adds further relaxation to the senses. The comfortable Windsor chair with its brilliant and fluffy cushion stimulates the visual senses. The chair is particularly

Lazy Experimenter Puts Mouse to Work

We have all heard of the old adage: Where there is a mouse and a piece of cheese there is a hole also. At any rate we have all heard the mouse make the hole trying to get to the cheese. How many ever thought of putting the mouse to work for us? It really takes a genius for avoiding work to do that. We have found one of this variety. The photograph shows a hole made by a mouse getting the cheese in the box. The cat got to the box before the cameraman.

An enterprising eliminator builder can put a mouse to work for him cutting a hole in the side of the box by fastening a piece of cheese over the place where he wants the hole, locking the box and outlining the desired hole on the outside of the box. The hungry mouse will do the sawing and the gnawing.



(Hayden)

AN ambitious and hungry mouse can cut a hole in a wooden box and save the amateur set builder some of the work, as this photograph shows. A bit of cheese is splendid inducement.

Short Waves in North Blanket

A blanket which is almost opaque to the short radio waves covered the northern half of the world for several days recently. It was difficult to receive any signals from stations operating in the northern hemisphere. The unusual conditions were evidently due to the aurora borealis.

An engineer of the Radio Corporation of America said that short wave tranmission on the transatlantic circuits was below normal one day but returned to normal the next. He ascribed the phenomenon to the influence of the aurora borealis.

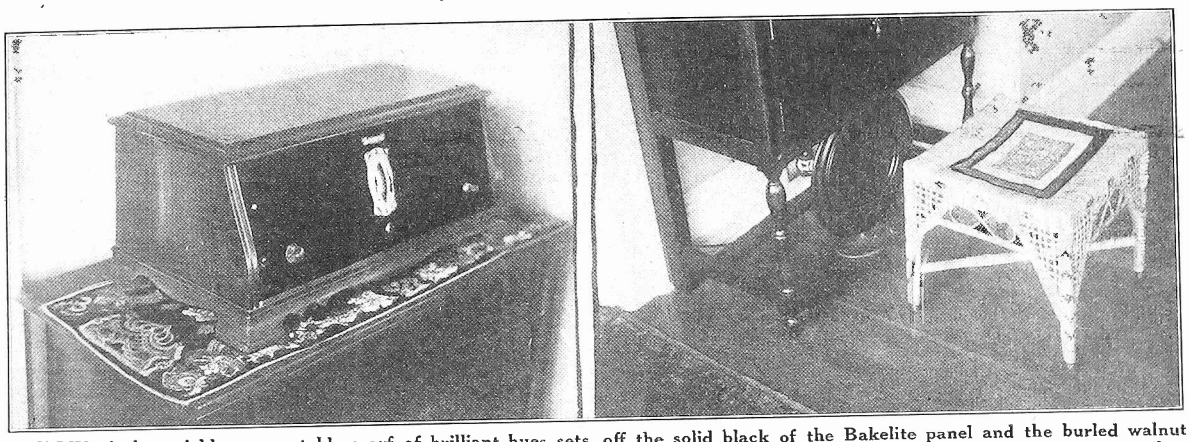
Engineers of Bell Laboratories, who are engaged in short wave research, said that they had noted variations in the signal strength during a few days, but that the fluctuations had not been intense enough to cause any special comment.

Signals from the west and the south came in with normal or super-normal intensity.

Signals from northern and eastern stations were very weak and caused consideralbe mystery for a while.

Color Makes an Installation Stimulating

By Muriel Chickerland



HOW nicely a richly woven table scarf of brilliant hues sets off the solid black of the Bakelite panel and the burled walnut of cabinet and table is shown at left. Another point of contrast—something light in tone—is a fancy wicker stool, not too low to permit of comfortable tuning. Note that the reproducer is under the table.

useful when you want to tune, because of the armrests.

In the photograph at the right is shown the same type of receiver in another setting. Symmetry has been effected by the feminine hand. The loudspeaker has been placed on top of the set exactly in the middle. Similarly the set itself has been placed in the center of the table. The radio receiver's appearance has been enhanced by an ornate and brilliantly colored scarf on top of the table. Where black and brown colors predominated before this scarf was placed, a flaming red now calls the attention most forcefully.

The technician might object to the placement of the loudspeaker on top of the cabinet on the ground that it is too close to the detector tube. It is likely to cause a howl. His argument might induce the man of the house, who is not keenly appreciative of symmetry, to move the loudspeaker over to one side, or even to place it on the scarf on the table.

The Ruling Voice

Regardless of the technical reasons for having the speaker off to one side, the feminine abhorrence for the eccentric will ultimately force the speaker to the center, unless the microphonic effect is too severe altogether.

A variation in the placement of the speaker which not only satisfies the technician and husband but also the wife is shown in the photograph at the right on page seven. The loudspeaker has been put on the carpet under the radio table. For technical reasons this arrangement is excellent because the fluffy carpet kills all mechanical vibrations between the set and the speaker and thus prevents howling from microphonism of the detector.

From the artistic point of view it is also satisfactory.

In this photograph is shown a wicker stool of delightful Indian design. It is not only a useful addition to the radio corner in that it furnishes a convenient resting place while tuning, but it also greatly adds to the appearance of the corner. It is a relief from the depressing colors of the radio receiver.

Canadian Stations Fewer, Busier

The latest list of Canadian broadcast stations shows a reduction from eighty to seventy-five since last Autumn. Most of the stations now on the roll are actively broadcasting, whereas last year many were merely license holders.

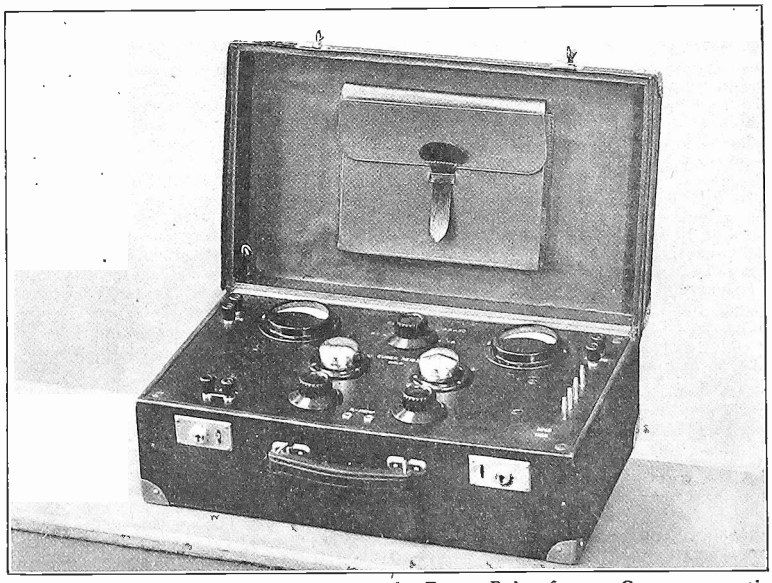
It is thought that the clearing up of the radio situation in the United States has had a great deal to do with the greater activity in Canada. The Canadian National Railways operate a chain of eleven stations.

100TH KENT PROGRAM

The broadcasting of the 100th Atwater Kent radio concert marked a mile-stone in what is generally recognized as the greatest continuing series of concerts ever presented, and to the world's record audience.

Beginning with the concert by Reinald Werrenrath, broadcast October 4, 1925, the Atwater Kent Hour has presented regularly each Sunday night leading artists of the musical world.

BRIEF CASE FEATURES PORTABLE



IN THIS FINE portable receiver, designed by Eugen Reisz, famous German acoustical inventor, a brief case has been mounted in the lid for the convenience of the traveling business man.

The Three

How These Phonogr

By J. E. Anderson

A PHONOGRAPH pick-up is a little box with a needle stuck in one side and a pair of wires emerging from the other. Although a certain amount of mystery has been created around it, there is really nothing mysterious about it, nor anything complicated.

Just as an experiment connect the two leads that come from the pick-up to the output of a radio detector and listen to the needle. A sound will emanate from it. Connect the leads to the output of an amplifier, preferably through a transformer, and feel the needle. It will vibrate. Is not that exactly what happens when a headset or a loudspeaker is connected to the receiver in the same way? Sure! The diaphragm or the armature vibrates and emits a sound.

Now let us try another experiment. Take a loudspeaker of the cone type, connect the two leads to the grid circuit of the first amplifier tube. Then tap the surface of the cone gently with the finger tips and listen to the output of the amplifier with another speaker. A dull sound will be heard. Then tap the tip of the cone with a pencil or similar object. Now a high pitched sound of musical character will be heard.

A Headset in Reverse

The same experiment can be performed with an ordinary headset. Connect the two leads to the input of the amplifier and tap the diaphragm gently with the tip of a pencil. A sharp musical note will be heard in the loudspeaker connected to the amplifier.

A phonograph pick-up is nothing but a telephone receiver working in reverse. Of course, there are small differences in the details of construction made necessary by the manner in which they work.

The primary purpose of the telephone receiver is to transduce electrical energy into acoustical energy. The primary purpose of the phonograph pick-up is to convert mechanical energy into electrical energy. That is, the objects of the two devices are almost reciprocal.

There are three elements in an electric circuit—resistance, inductance and capacity. Electric phonograph pick-ups can be made which work by varying any one of these elements. The resistance in a circuit can be varied by making the phonograph record vary the pressure on a mass of carbon granules. For this purpose a carbon microphone can be used. The inductance in the circuit can be varied by making the record change the reluctance in the magnetic circuit. This is the principle of most pick-up units in use and is the reverse of the ordinary headset or speaker. The capacity in the circuit can be varied by causing the record to change the distance between the plates of a small condenser. This is the principle of the condenser microphone.

Components Explained

In Fig. 1 is illustrated the principle of the electro-magnetic pick-up, or the variable inductance pick-up. NS is a strong horseshoe permanent magnet. PP are pole pieces attached to the poles of the magnet for the purpose of concentrating the magnetic flux at a convenient point. A coil L consisting of many turns of fine wire is wound around the permanent magnet or around the pole pieces PP. The moving parts of the assembly consist of the phonograph needle (n), the needle chuck (c), the pivot (pv) and the iron armature (a). The moving part is so mounted that the iron armature is in the small air gap (G) between the pole pieces. As the needle follows the wiggly groove the armature moves in and out of the intense field across the pole pieces.

When the armature is out, the reluctance of the magnetic circuit is high and the flux is low; when the armature is in reluctance is low and the flux is high. The flux varies in the same manner as the wiggles in the groove, and when the flux varies an electromotive force is induced in the coil L. This electromotive force (emf) can be measured across the coil terminals in volts.

If the primary of a transformer is connected across the terminals of coil L the emf will send an electric current through the circuit, and this current will in turn induce a higher emf in the secondary of the transformer. But if the terminals of coil L are connected from grid to filament of an amplifier tube, the emf induced in coil L will be amplified by the tube just as if it had been first induced in the secondary of a transformer.

Determination of Sensitivity

The sensitivity of such pick-up unit depends on the intensity of the magnetic field across the pole pieces PP, on the distance between these pole pieces, on the distance the armature moves in and out of the field, and on the number of turns in the coil L. It also depends on how faithfully the movements of the needle point are transferred to the iron armature. For high sensitivity the number of turns should be large, the field across the pole pieces should be intense and the swing of the iron armature should be wide.

The weight of the pick-up unit should not be too heavy or it will engrave the record and quickly spoil the quality of the recorded music. Still the unit must be so heavy that it will not move with the needle. If it moves with the needle the low notes are likely to be lost, as it is on these notes that the relative motion between the magnet and the armature will be small if the unit is too light.

The movement of the armature should be entirely on one side of the field. That is, it must not swing beyond the point of greatest flux. If it does, the reproduction will not be faithful.

A Pure Output

Fig. 2 illustrates a modified form of magnetic pick-up. In this case the armature is attached to the neutral point of the magnet and the coil is wound around it. The needle is attached to the free end of the armature which it causes to move back and forth between the two poles. An alternating voltage is induced in the coil as the armature moves back and forth, and this is due to a differential change in flux in the two halves of the assembly. Even harmonics are absent from the induced voltage and hence the output is purer in this arrangement than in the preceding.

These are just two types of pick-up units. Any headset or loud speaker unit can be converted into a pick-up unit by putting a needle chuck in the armature. The more sensitive the device is as a reproducer the more sensitive it will be as a pick-up.

Fig. 3 illustrates the capacity type of pick-up. A small condenser formed of the metallic diaphragm b and the heavy metal plate a is connected in series with a battery B and a resistance R. This resistance is across the two output terminals (1) and (2) and forms the grid leak when it is connected to an amplifier tube. The groove (g) wiggles the needle (n) set into the chuck (c) on one end of a lever pivoted at (pv).

Comparison of Types

The other end of the lever is attached to the center of the diaphragm plate of the condenser. As the needle moves the capacity of the condenser is varied and a varying voltage is impressed on the grid of the tube. This device is not so sensitive as the electromagnetic type.

The resistance variation pick-up is shown in Fig. 4. A is a heavy metal plate, b a light metal diaphragm and c is a mass of carbon granules packed loosely between the two metal plates. The lever in this case is the same as in the condenser type. One end of it is attached to the center of the diaphragm and the other carries the needle. As the needle moves the thin plate vibrates and varies the pressure on the carbon granules.

As the pressure varies the resistance of this mass to electrical-current varies. The three elements abc form a part of an electric circuit containing a low voltage battery B and the primary of a modulation transformer T. The secondary of this transformer is put in the grid circuit of an amplifier.

The Only Difference

The only difference between this and an ordinary microphone is that in the microphone the diaphragm is set in vibration by sound waves and in the pick-up it is set in vibration by waves engraved in the record.

For faithful reproduction of the engraved record, all moving parts in the pick-up unit should be as light as possible. If they are not light the needle will not be able to follow the higher frequencies. If the needle is flexible it will bend and will not transmit the vibrations to the armature. If the needle is very stiff it will probably skip straight over the ridges instead of following the meanderings of the groove. That is, it will try to follow a straight line.

New Radio Beam to Cross the Atlantic

A new wireless beam service between New York and London is to be put in operation by the Radio Corporation of America. The system will increase the speed of signal from the present 50 words per second to 225 words or more. Increased secrecy is also one of the advantages of the beam system. Not only is the secrecy increased by the fact that the beam covers a narrower area but also by the fact that the speed is so great that no one can copy the messages without intricate and expensive apparatus.

The beam will be operated on short wave lengths. Beams have been in operation between London and Australia and between London and Canada. The system was developed by the Marconi Company.

Types of Pick-ups

...ph Devices Work

...ributing Editor; Consulting Engin-
...eer; Associate, Institute of Radio
Engineers

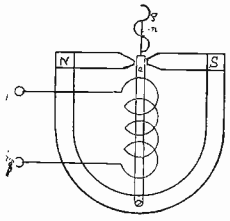


Fig. 2 shows well the principle of another form of electro-magnetic pick-up. In this case the record is made to move the armature back and forth between the two poles. The coil is placed around the armature in the case.

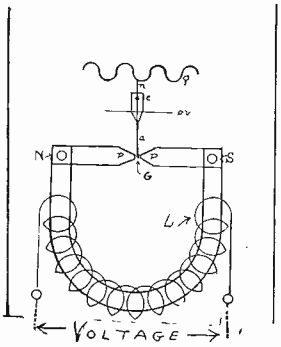


Fig. 1 illustrates to you the principle of the electromagnetic type of pick-up. The wiggly groove causes the iron armature to vibrate in the small air gap G and this sets up a voltage in the coil L.

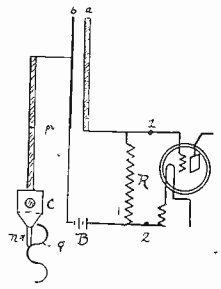


Fig. 3 illustrates the principle of the condenser type of pick-up. The record is made to change the capacity of the small condenser formed of the plates a and b. A varying voltage is set up in the resistance R, which is impressed on the amplifier tube.

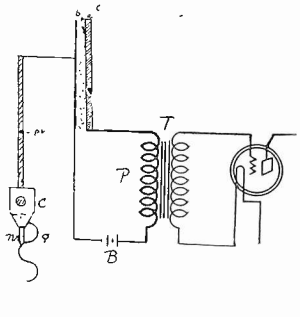


Fig. 4 is an illustration of the resistance variation pick-up, which is like an ordinary carbon microphone. The record is made to vary the pressure on the carbon granules between two plates. A varying current is set up in the primary of the transformer.

How to Wire Filaments for Series Connection

By Charles Golenpaul

American Mechanical Laboratories

Of the several methods suggested for full socket-power operation, none is quite so simple as the single ABC radio power unit supplying the tube filaments wired in series. There is nothing radically new about this arrangement, for we start out with the well-known B-eliminator simply on a larger scale, and the well-known and time-tested vacuum tubes that have been used for years back with storage battery source of supply.

Perhaps it is the series wiring that causes radio fans to hesitate in employing this method, yet there is nothing formidable about series-connected filaments. In fact, it is just as logical to wire filaments in series as in parallel, and if anything, series wiring is simpler and neater.

Any receiver, whether to be constructed or already built, can be arranged for series filaments. There are just two factors to bear in mind, namely: first, the manner in which the grid bias is obtained for the various tubes; secondly, the proper order in which the tubes shall be arranged in sequence.

Rewiring the Filaments

In the case of the receiver being built, the wiring is planned in the first place and duly executed. In the existing receiver, on the other hand, the best results are obtained by removing all the present wiring going to the two filament terminals of the tube sockets. The usual filament switch is omitted, since the power supply is turned on or off at the primary or input end of the radio power unit.

The order in which the quarter ampere tubes are connected in the series arrangement is as follows: the minus B or ground point should go directly to the detector socket. After that come the first AF and second AF sockets, in the case of radio sets employing a three-stage audio-frequency amplifier with resistance or impedance coupling. Otherwise, the first AF socket is followed by the radio-frequency sockets until the chain is completed. The last audio socket, taking the power tube with its one half ampere filament, is supplied with alternating current, supplied by taps on the power transformer, or by a separate transformer.

Use Twisted Pair

The filament wiring to this last tube should be in the form of a twisted pair of wires, or, better still, copper-shielded wire, properly grounded, so as to eliminate troublesome AC pick-up by the adjoining components.

The method of obtaining grid bias is to place resistance of proper value in series with the filaments, so that the voltage drop will give the required grid bias. This value of resistance depends upon the amount of bias required, and is equal to the required voltage multiplied by 4, or 18 ohms in the case of the usual 4.5 volt bias (4.5 x 4 = 18 ohms). The resistors carry the full quarter ampere which the tubes require, and may be made up of 20-ohm rheostats adjusted to the required value.

Another satisfactory method is to get the proper grid bias from the tubes themselves. Placing the grid return on the farther side of minus filament terminal will give a bias depending upon the number of tubes and the voltage drop in each. As it is very easy to become confused and thus fail to make the proper grid bias return, it is suggested that the plus and the minus markings of the sockets be rigidly followed in making all connections. Series filaments are easier to wire than parallel, and the wiring makes a very neat appearance when so arranged.

Use of By-Pass Condensers

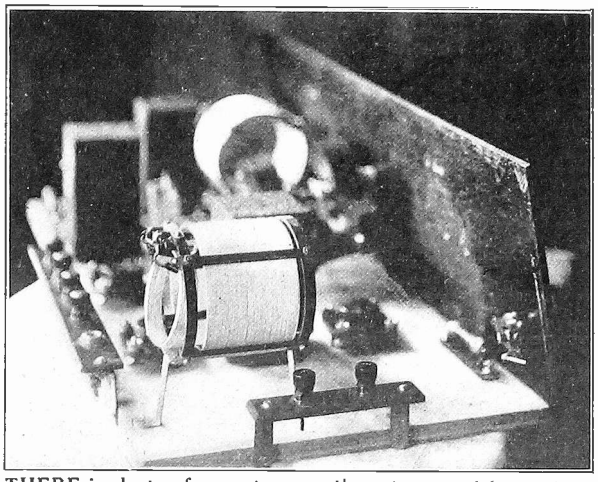
The filament terminals of each socket should be by-passed with a 1 mfd. condenser, with the exception of the power tube socket. A control of the volume is most desirable, and may be accomplished with a 0-5 megohm Clarostat, mounted in the hole vacated when one of the rheostats was removed from the panel, or otherwise suitably mounted, and connected across the secondary of the first transformer.

The filaments are now controlled as one, which will be found quite satisfactory with vacuum tubes of reliable make, the filament characteristics of which run sufficiently uniform for group control. Of course the usual rheostat method is no longer effective.

Short Leads, Long Service

How to Get Both On the One-Dial

Witz



THERE is plenty of room to move the antenna coil forward or backward for permanent placement, depending on which location eliminates oscillation trouble. The FMC double impedances are seen in the background. The tuning condenser is Gardiner & Hepburn's double unit, .00035 mfd.

By A. Irving Witz

PART II

A REVIEW of the circuit diagram of the One Dial Witz will show that there are only four controls in the set. One of these is the double condenser (C2ab) another is the variable grid leak R4; a third is the volume control potentiometer P1; and the last is the filament switch S. Only three of these need be placed on the panel. The grid leak resistor R4 well may be placed inside the cabinet, and it should be located as close to the detector tube as practical. This is in the interest of short leads. The three controls that must be brought out can be disposed symmetrically on the panel. The tuning condenser is placed in the middle, the filament switch at the extreme left, in the lower corner, and the knob for the potentiometer is placed in a corresponding position in the extreme right corner.

This layout for the panel suggests the layout of the baseboard inside the set. The radio frequency transformer L1L2 is placed on the left of the tuning condenser. The other transformer, L3L4, is placed on the right of it, both near the panel. The RF tube and the detector are placed in the same row with the coils, but outside of them. That is, the RF tube is placed near the filament switch S and the detector is placed near the potentiometer R4. This disposition of the radio frequency parts and the detector makes it possible to wire the entire set with short leads.

There is only one lead which is longer than is desirable, and that is the connection between the plate of the first tube and the primary of the second radio frequency transformer. But there is ample room in the set so that this lead may be placed far enough away from grid leads to prevent undesired interaction. It is better to place the parts in such a manner that only one lead is longer than desirable than to place them so that a number of them are long, some of which might be critical grid leads.

Wiring Simplified

Having disposed of the radio frequency amplifier and the detector in the front row we have the whole back row in which to arrange the audio frequency amplifier and auxiliary apparatus. When the detector and the volume control potentiometer are placed at the right as in this circuit it simplifies the wiring of the audio amplifier, provided that this is made to run from right to left. This construction makes the leads between the output of the detector and the input to the amplifier very short. The final audio output in this case will be near the left end of the set, near the binding post strip, which is placed at the left end. Although this particular method of construction brings the radio frequency input in close proximity to the audio frequency output there is not the slightest evidence of injurious interaction. In other words, there will neither be radio frequency nor audio frequency oscillation due to this bending of the circuit.

A large baseboard, 7x20 inches, has been provided for holding the parts not mounted on the panel. Thus there is ample room for everything and there is no need of crowding. Since the parts are well separated both in the radio and audio frequency sections of the circuit, all troublesome couplings will be minimized.

The circuit diagram shows that the loudspeaker is to be connected directly into the plate circuit of the last tube without any intermediaries. This is in the interest of good quality. But if a power tube is used it is not safe to connect the loud speaker windings in that manner. They will probably burn out.

Output Choice

Either of two methods can be used for protecting the speaker. An output transformer of generous proportions can be interposed between the tube and the speaker. This will transfer only the A.C power to the speaker, the only part of the output of the tube which is of interest. Unfortunately, some transformers slight the lower notes, and when such instruments are used a great deal of the character of the music is lost.

The second method is the use of the high inductance choke in parallel and a condenser in series with the speaker. This combination also depresses the volume on the low notes, and hence some of the quality of the output is lost. There is little to choose between the two methods when it comes to quality. The determining factor is usually availability and cost.

There is one other factor which should be considered when choosing the method of coupling the loud speaker to the power tube, and that is the tendency to motorboat. While this circuit is relatively free from this trouble, as has already been discussed, conditions may arise which would make the circuit motorboat. Then it is well to remember that the transformer method of coupling does not affect the oscillation very much while the choke and condenser, if properly connected, may stop it.

Depends on Frequency

If the frequency of the motorboating is very low, say near the lower limit of audibility, the inductance of the choke must be very high and the capacity of the condenser in series with the speaker also must be very high if this coupling method is to be effective in stopping the oscillation. If the frequency is below audibility no practical values of choke and condenser would help much, and it would then be necessary to redesign the amplifier. Such an extremity will not be met in the double impedance amplifier because its design prevents the amplification of the sub-audible frequencies enough to cause motorboating.

If oscillations should occur in this set between 100 and 10,000 cycles it is easy to stop it with a moderate sized by-pass condenser across the plate battery or eliminator. The size of condenser to use would depend on the total effective amplification of the audio amplifier, on the type of plate voltage supply that is used, on the intensity of the oscillation and on the frequency of it. The more intense the oscillation, the lower the frequency of it, and the higher the resistance of the plate voltage source, the greater the value of the condenser would have to be. The question can only be decided by experiment. A condenser of 1 mfd. is a good starting point.

[Part I was published in the August 27 issue. Other features of the circuit will be discussed next week.]

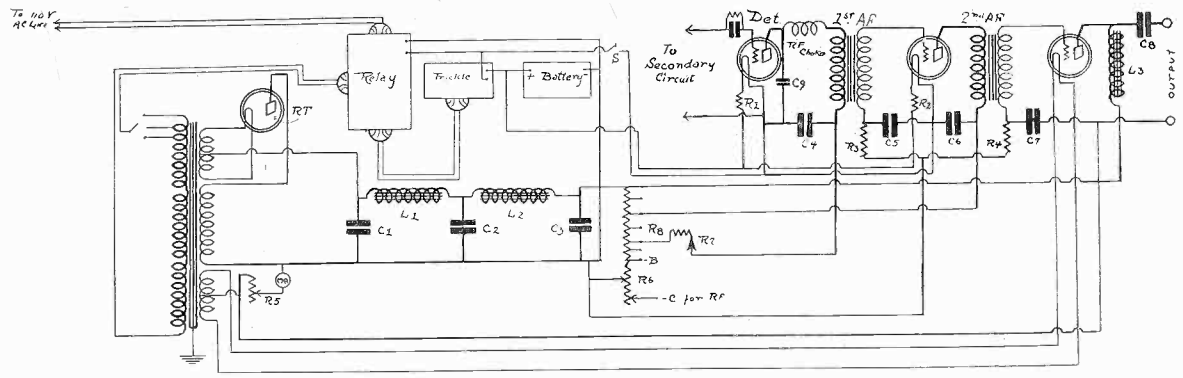
WHN in New Home in Bungalow on Roof

Entirely new broadcasting equipment for WHN has been installed on top of Loew's State building, at Broadway and 45th St., New York, in a bungalow built on the roof. The new station is equipped with a piezo-electric wave meter for controlling the frequency of the transmitter. Its assigned frequency is 760 kc, and the crystal will hold it to within the 500-cycle limit set by the Radio Commission.

Another new feature of the station is the device called the SOS Interlocking System. This is a device which will make it impossible for the station to begin broadcasting as long as there is distress call from a ship at sea. The station is next door to the building in which RADIO WORLD is located.

KNOWING ONE'S VEGETABLES

A special program in connection with the annual convention of the Vegetable Growers' Association of America at Syracuse, N. Y., was broadcast by WGY during the agricultural program. The address of welcome was delivered by President Walter Marion of the Association.



The circuit diagram of the Amertran Powerpack hooked up to a relay trickle charger and battery arrangement.

Some Sidelights On Amertran Power Pack

By Robert Frank Goodwin and Stuart S. Bruno

[*Part I was published last week; Part II, the conclusion, follows.*]

A simple rule can be employed for obtaining the proper trickle charger rate to employ for the number of tubes you use in your set. Take the number of hours you use the set and multiply that by the number of amperes the tubes in your set draw. Substract the number of hours that the set was in use from the number of hours there are in a day and divide the result by the first result obtained, or the number of hours the set was in use multiplied by the number of amperes the set draws. Let us say that a set employing tubes which draw 2 amperes, is used three hours. Six amperes will then have been taken out. Now there are 21 hours left in the day and by dividing, we get .3, which is the charging rate to use.

The operation of the relay is unique in its simplicity. A small coil through which some iron has been placed does all the work. That is, when the filament switch is closed, this coil becomes energized and attracts a contact which closes the B eliminator input circuit and disconnects the trickle from the line. When the filament switch is opened, the coil loses its magnetic properties and the circuit that it made is, of course, broken, causing the B eliminator to be disconnected from the line and the trickle connected to the line.

The RF choke used in the detector circuit should be one having an inductance of approximately 65 millihenrys, such as the General Radio. The proper insertion of the fixed condensers and leaks in the audio amplifier is very important as to the successful operation. Each and everyone in there plays its part, and should by no means be left out. Also, be sure that before inserting them, they are all in good order. A C bias is provided for the RF tubes, if such is desired. This helps the selectivity of the set.

The complete eliminator may be placed in a metal housing and then kept away from inflammable material such as wood or curtains. Keep it out in the open and you will be doing well.

LIST OF PARTS

One Amertran power transformer, type PF52.
L1, L2, L3—Three Amerchokes, type 854.
C1—One Dubilier 2 mfd. fixed condenser, 1,000 volts DC.
C2, C3, C8—Three Dubilier 4 mfd. fixed condensers, 600 volts DC.
C4, C5, C6, C7—Four Dubilier 1 mfd. fixed condensers, 160 volts DC.
C9—One Dubilier .001 mfd. fixed condenser.
R1, R2—Two No. 1A Amperites.
R3—One Electrad 250,000 ohm fixed resistor.
R4—One Electrad 100,000 ohm fixed resistor.
R5,—One DeJur 2,000 ohm variable resistance.
R6—One DeJur double arm 2,000 ohm variable resistance.
R7—One Centralab 100,000 ohm variable resistor.
R8—One Amertran resistor, type 400.
One Armertran DeLuxe first stage audio transformer.
One Amertran DeLuxe second stage audio transformer.
One Brach Controlit Relay.
One Armor CF-501 amplifier tube.
One Armor CF-510 power amplifier tube.
One Armor CF-516B rectifier tube.
One Readrite 0-50 milliammeter, MA.
Three DeJur Buffalo sockets.
One Benjamin filament switch.
Two rolls DeJur Celatone.
One baseboard, 12x21 inches.
One piece of galvanized iron for shield.

System Choice Differs In Super-Heterodynes

By James H. Carroll

Contributing Editor; Associate, Institute of Radio Engineers

Since the superheterodyne came into popular favor among the fans numerous radio engineers and super experts have been experimenting in an effort to design the really ideal receiver of this kind. That is, not only ideal from the laboratory standpoint but also from that of the fan. Many good and even wonderful circuits have resulted and many more have failed to pass the test of time.

The good ones have survived and will continue to do so and even gain favor as their merits spread. There is always room for many good Super circuits, for the reason that the true Super Heterodyne fan thinks nothing of having several receivers in his den, experimenting with each in turn and getting lots of fun and plenty of kick out of each. And he is always ready to build another, provided it is good and embodies new features. In fact, the Super bug is the elite in radio, and next to the genuine "ham" has greater knowledge of radio than any other type of fan. It is always a pleasure to pay a tribute to the true Super fans for they are the pillars of radio, always building, always boosting and keeping radio alive, always willing to swap ideas and give the best that is in them.

These fans, then, are always posted and are aware of the theory of the Super and what has been done in the past on this great circuit, namely, the standard, the short wave intermediate frequency and the one-spot long wave systems.

In the standard system, the received signal was changed by the oscillator to a long wave in this way. If the intermediate frequency amplifier was designed to a frequency of 40 kilocycles a signal of 700 kilocycles or 428 meters had to be counteracted with an oscillator of 740 or 660 kilocycles, respectively 405 and 455 meters. With this system, therefore, there are two settings on the oscillator condenser for each station.

In the short wave intermediate frequency system, instead of utilizing the difference of frequencies for intermediate frequency amplification, the sum frequency is used for this purpose. An intermediate frequency amplifier of 3,000 kilocycles will require a beat frequency of 2,300 kilocycles for a 700 kilocycle signal. It is therefore seen that two critical features play their parts in this circuit. First, the short wave oscillator and, second, the short wave intermediate frequency amplifier. The difficulties that arise here can only be overcome with extremely careful design and expert layout.

Another system uses the long wave transformer which utilizes a frequency slightly lower than the broadcast band. This system was carried out successfully a while ago and gained wide popularity deserved by sound engineering principles. In this case again, a differential frequency was used but in such a form that only one oscillator frequency could be produced for the beat note.

In order to make come true the dreams of Super-Heterodyne engineers and experimenters, a compromise had to be reached between this and the long wave system, and this has been worked out by Ernst Tyrman.

New WEAF Planta

50,000-Watt Transmitter Will
Describes the Technical Feature
Bias Tubes Are Powerf

The National Broadcasting Company's new 50-kw transmitter at Bellmore, Long Island, New York, now known as 2XZ, the call letters recently assigned by the Federal Radio Commission, soon will adopt the call letters WEAF. The date on which the new 50-kw transmitter will replace WEAF's present 5-kw equipment will be announced shortly.

The specifications for this new transmitting plant were drawn up by the company's Board of Consulting Engineers made up of Dr. Alfred N. Goldsmith, chief broadcast engineer, Radio Corporation of America, Chairman; Dr. E. F. W. Alexanderson, consulting engineer, General Electric Company, and Frank Conrad, consulting engineer, Westinghouse Electric and Manufacturing Company.

WEAF will be under the supervision of O. B. Hanson, manager of the National Broadcasting Company's Plant Operation and Engineering Department. J. J. Beloungy, for the past two years engineer-in-charge of WEAF's West Street 5 kw apparatus, has been appointed to act in the same capacity at the Bellmore plant.

The National Broadcasting Company's new plant occupies an eight-acre tract of land on Maple Avenue in Bellmore.

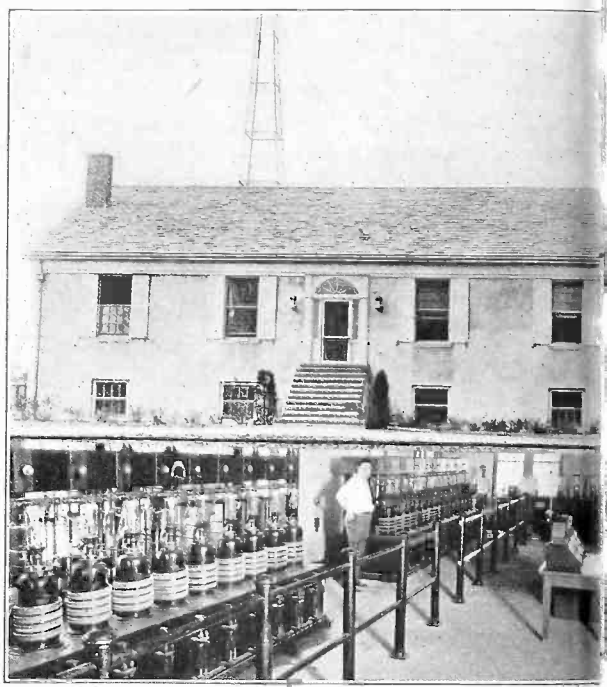
By Carl Dreher

Staff Engineer, National Broadcasting Company

The steel towers of the new transmitter at Bellmore, 300 feet in height, are visible for a considerable distance over the flat terrain of Long Island. When one comes close to the eight-acre plot the antenna becomes visible. It is a single 3/8 inch wire suspended between the towers with the downlead in the middle, forming a T-shaped antenna of great mechanical strength to withstand severe sleet storms.

The horizontal section of the antenna is 250 feet long, affording ample clearance from the towers, which are spaced some 600 feet. The towers are supported on heavy, glazed porcelain insulators and in normal radiation remain insulated from the earth.

This type of antenna has a high effective height and radiates efficiently in all directions. Incidentally, the period is well above 600 meters, necessitating the use of a series condenser to tune the system to 491.5 meters, corresponding to the frequency of 610 kilocycles assigned to the station. At night the towers will be flood-lighted for the guidance and protection of airplane traffic.



WERE IT not for the tower in the background in the upper lef L. I., N. Y., houses the National Broadcasting Company's new 5 apparatus. At lower left is a view of the thirty-two tubes used. frequency of 6

Residential Touch in Architecture

The station building is a one-story and basement stucco structure set about midway between the towers. It makes an attractive picture on the landscaped grounds and fits neatly into its suburban surroundings. The architecture might be described as a compromise between the residential and the style usual in power plants. The effect is one of simplicity and grace.

Entering the station from the front, one passes through the engineer's office to a control room on the right where the broadcasting circuits terminate. Here are located the input and monitoring panels and the preliminary amplifiers of the station. The latter, in their last stages, include tubes more powerful than the largest found in most broadcasting stations.

The monitoring and switching panels comprise apparatus such as small amplifiers and volume indicators, used in measuring the strength of incoming currents, equalizers to correct for the loss of high musical frequencies along the line, signal lights showing the condition of various circuits, and a compact oscillograph which indicates the depth of modulation of the carrier.

Uses Resistance AF

Besides these visual checks there is a high quality cone fed from a radio frequency rectifying system, used for "monitoring" the output of the station. This means simply that the operators on duty listen to the program just as other members of the audience do at more remote points. On these panels there are also jack panels and switching facilities for conveniently changing lines, connections, etc.

The first speech amplifier in the actual broadcasting circuit within the station building is a UV-211 tube with a 50 watt oscillator rating. (As amplifiers, tubes have a much lower power rating than as oscillators, but it is customary to give the oscillating output as a measure of the size of the tube). This is resistance coupled to another tube of the same size.

The next unit is a 1-kw UV-851 air cooled tube which swings the grids of the modulators, the connection being effected through a low capacity cable. These three vacuum tubes derive their filament supply from a storage battery, while the plates are fed from generators large enough to supply a complete 500-watt broadcasting station.

The audio amplifier consisting of the two 50-watt and one 1,000-watt tubes is mounted in a metal case about seven feet in height, with doors giving access to the tubes and suitable meters mounted on the panel. It is provided in duplicate, with a power control and change-over panel set between the two amplifier units.

The main transmitter room of the station contains the following units: main power switchboard; crystal controlled low power amplifier; intermediate power amplifier; 50-kw power amplifier; modulator for 50-kw amplifier; rectifier; tuning apparatus; operator's control desk. The apparatus is placed along the walls, with access to the open high tension sections barred by a wooden railing. The operator's control desk is placed in the middle of the floor. With all this apparatus, the room, 70 by 30 feet in size, is by no means crowded.

The radio frequency (610 kilocycles) portion of the circuits begins with the crystals, of which there are three(housed in a box whose temperature is thermostatically controlled. Any crystal may be selected by means of a switch.

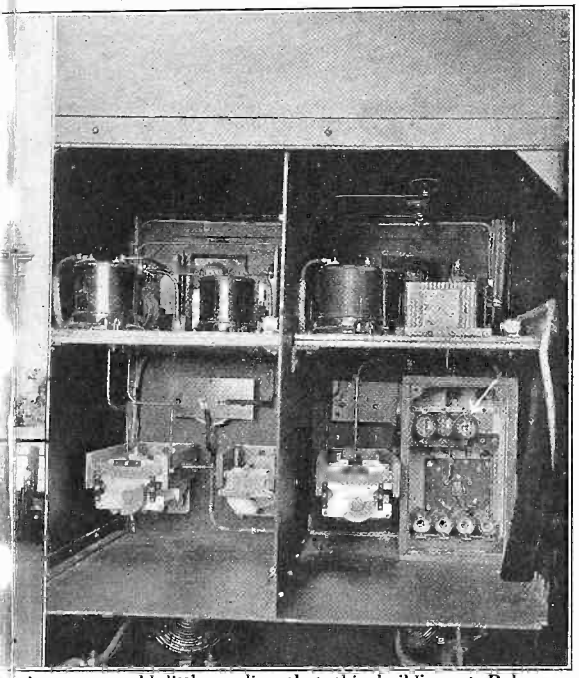
These crystals act as oscillation governors to keep the station rigidly on its assigned frequency. Their natural operating period varies slightly with changing temperature, and it is planned to keep the heating current on day and night, whether the station is on the air or not, in order to maintain perfectly equable physical conditions for this delicate equipment.

The first tube controlled by the crystal is a UV-210 of 7.5 watts rating, a size commonly found in the output of high quality amplifiers and radio receivers. It is radio frequency coupled to a second tube of the same size which in turn is followed by stages employing one and then two UV-211 (50-watt) triodes. At the next stage the level becomes formidable and a 1kw (UV-851) Radiotron is required to handle it.

Up to this point the tubes have been

Marvel of Efficiency

end Broadcasts Soon—Dreher —Even Small Generators That Enough to Electrocute



oto, one would little realize that this building at Belmore, transmitter which will soon replace WEAF's present 5 kw ight, arrow points to crystals which will keep the station's c steady.

r cooled, i.e., cooled by radiation of eat from the glass. But now a single)-kw tube, as the next stage in the radio requency chain, constitutes the inter- ediate power amplifier, and this requires ater cooling. It is also a separate unit ith its own panel, meters and controls.

These water cooled tubes are built with he "plate," which in smaller units is ctually a plate or small rectangular sheet f metal, in the form of a closed hollow ylinder, housing the grid and filament. he amount of energy conveyed to this node may be of the order of 30,000 atts, at a voltage of perhaps 15,000. The fficiency of the device is between 60 and) per cent so that some 20,000 watts may e withdrawn in the form of useful oscil- ations, leaving 10,000 watts dissipated at he anode in the form of heat. This nergy warms the water circulating hrough the hollow cylinder at the rate f two or three gallons a minute.

The inescapable loss of plate energy in ne power tube alone of a station like he new WEAF, if that unit is run at its ull capacity, would be sufficient to supply ll the power for a normal 500 watt roadcasting station. This does not take nto consideration the power of over 1 kw 52 amperes at 22 volts) required to heat he filament of each unit. In broadcast ractice the tubes are run at inputs below he allowable figure in order to prolong fe and minimize interruptions.

The power board of the station is simi- lar to that of a good-sized electric sub- station with the same circuit breakers, meters, relays, signal lights and controls. The equipment for starting and stopping the various machines and energizing the different frames is located here.

Once a station is running, however, it may be taken off the air instantly by a small tumbler switch on the operator's control unit, which is placed on a table in the middle of the room. This table also holds the 600 meter receiver and a loudspeaker always in service on marine wavelengths. An operator sits at the table, and, should an SOS call be picked up, immediately takes the station off the air after a covering announcement. If a modulator or amplifier tube should break down in operation, the operator is also in a position to remove it from the circuit and energize a spare unit by throwing two tumbler switches on the control unit. These actuate large solenoid-operated switches which perform the operations required. Such automatic controls, while complicated and costly, insure the continuity of service which is vital in such a plant.

The modulator, which moulds the amplitude of the 50 kilowatts of radio frequency energy in accordance with the speech or music of the program, is a similar unit in appearance. It contains sixteen tubes—twelve in use and four "spares." These are connected and disconnected in groups of two. Near the radio frequency amplifier, which is placed in one corner of the room, is located a huge, hollow plate condenser standing well over the height of a man's head, and variable by means of a motor.

This, in conjunction with an equally large pair of flat spiral inductances, constitutes a 610 kilocycle tank circuit which delivers the modulated radio frequency energy to a transmission line running some 30 feet out to a small tuning house directly under the antenna downlead. This line operates at a potential of 5,400 volts, but, instead of the usual 60 cycle current of commercial power circuits, is designed for a 610,000 cycle carrier, with its two program-bearing sidebands.

The line is terminated in some further tuning equipment variable from the main power board of the station to effect the transfer of the radio frequency energy with its burden of music and voices to the antenna which flings it into space.

In the Basement

In the basement of the National Broadcasting Company's new transmitting plant are found the transformers which step up the 2,300-volt power supply to the high voltage required to feed the rectifiers, the reactors which smooth out undesired variations, the speech reactor coupling the 50-kw amplifier with its modulator, and the rotating machinery of the station. The latter includes the three 25-kw filament motor generators, four 3-kw plate motor generators, two .55-kw bias motor generators, and, in a separate room, the pumping equipment for the water cooling system. There is also a storage battery room, heating equipment, and a vault for spare tubes. The basement of the station with its heavy cement blocks and ponderous machinery looks like a power plant—and sounds like it.

The transformers emit their characteristic threatening drone. The generators run with a higher-pitched and louder noise. It is hard to realize that here energy in its primitive form is being converted into subtle and intricate inflections of human thought and emotion, in instantaneous and accurate obedience to the performance in the studios thirty miles away.

Interesting Sidelights

The amount of filament energy used to light the filaments of the tubes in the transmitter of the National Broadcasting Company's new 50-kw plant at Bellmore, Long Island, would supply enough current to operate the filaments of 200,000 type 199 tubes, or approximately 50,000 of the average dry battery receiving sets now in use.

The amount of electrical energy used to supply the plate circuit of this transmitter would provide sufficient plate current for 550,000 type 199 Radiotrons.

4,000 gallons of distilled water pass through the tube cooling system each hour of operation.

The N. B. C.'s Bellmore transmitting plant is, perhaps, the only one of its kind in the country to hold a license for the operation of a "still," used to distill the water for the tube cooling system.

The two antenna towers will be painted in alternate 12-foot bands of black and yellow. Both towers will be illuminated by flood-lights, principally to serve as a beacon for aviators.

The floors, ceilings, walls and windows of the entire plant building are double-shielded.

The grid bias for tubes may be individually adjusted. The bias voltage is provided by a pair of small generators which are, nevertheless, large enough to supply electric power for a residence. The bias voltage is not much below 1,000, so that there is some danger of electrocution on any of the Bellmore frames even if one does not come into contact with the plates of the tubes.

LIST OF STATIONS

With wavelengths, frequencies, location and power, corrected to Aug. 24. Time sharers in parentheses.

Station	Kc	M	Watts
WAAD—Cincinnati, O.	1120	267.7	25
WAAF—Chicago, Ill. (WBBM, WJBT)	770	389.4	500
WAAM—Newark, N. J. (WGBS)	860	348.6	500
WAAT—Jersey City, S. J. (WGBB and WEVD)	1220	245.8	300
WAAW—Omaha, Neb. (6 to 7 only)	860	348.6	500
WABC—Richmond Hill, N. Y. (WBOQ)	920	325.9	2500
WABF—Pringleboro, Pa.	1460	205.4	250
WABI—Bangor, Me.	770	389.4	100
WABO—Rochester, N. Y. (WHEC)	1290	232.4	100
WABQ—Philadelphia, Pa.	1410	212.6	500
WABR—Toledo, O. (WTAL)	1070	280.2	50
WABW—Woester, O.	1210	247.8	50
WABY—Philadelphia, Pa.	1210	247.8	50
WABZ—New Orleans, La.	1210	247.8	50
WADC—Akron, O.	1250	239.9	1000
WAFD—Detroit, Mich. (WTHO)	1370	218.8	250
WAGM—Royal Oak, Mich.	1330	225.4	50
WAGS—Somerville, Mass.	1390	215.7	5
WAIT—Taunton, Mass	1400	214.2	10
WAIU—Columbus, O. (WEAO)	1060	282.8	5000
WALK—Bethayres, Pa. Portable)	1490	201.6	50
WAMD—Minneapolis, Minn.	1330	225.4	500
WAPI—Auburn, Ala.; daytime only	610	491.5	1000
WARS—Brooklyn, N. Y. (WSDA. WBBC)	1320	227.1	500
WASH—Grand Rapids, Mich.	1170	256.3	250
WASN—Boston, Mass.	990	302.8	100
WATT—Boston, Mass.	1490	201.6	100
WBAA—West Lafayette, Inc (WRM)	1100	272.6	500
WBAK—Harrisburgh, Pa. (WPSC)	1000	299.8	500
WBAL—Baltimore, Md.	1050	285.5	3000
WBAO—Decatur, Ill.	1120	267.7	100
WBAP—Fort Worth, Tex. (WFFA)	600	499.7	1500
WBAW—Nashville, Tenn.	1210	247.8	100
WBAX—Wilkes Barre, Pa. (WBRE)	1200	249.9	100
WBBC—Brooklyn, N. Y. (WARS, WSDA)	1320	227.7	500
WBBL—Richmond, Va.	1210	247.8	100
WBBM—Chicago, Ill. (WJBT, WAAF)	770	389.4	1000
WBBP—Petoskey, Mich.	1250	239.9	100
WBBR—Rossville, N. Y. (WJBI and WEBJ)	1170	256.3	1000
WBBW—Norfolk, Va.	1270	236.1	50
WBBY—Charleston, S. C.	600	499.7	75
WBBZ—Chicago, Ill. (Portable)	1470	204.0	100
WBCN—Chicago, Ill. (WENR)	1040	283.3	250
WBES—Takoma Park, Md.	1010	296.9	100
WBET—Boston, Mass.	1240	241.8	500
WBKN—Brooklyn, N. Y. (WWRL, WIBI, WBMS)	1120	267.7	100
WBMH—Detroit, Michigan	1420	211.1	100
WBMS—Union City, N. J. (WBKN, WWRL, WIBI)	1120	267.7	100
WBNY—New York, N. Y. (WLTH, WKBQ, WKBO)	1370	218.8	500
WBOQ—Richmond Hill, N. Y. (WABC)	920	325.9	500
WBRC—Birmingham, Ala.	1230	243.8	250
WBRE—Wilkes Barre, Pa. (WBAX)	1200	249.9	100
WBRL—Tilton, N. H.	1290	232.4	500
WBRS—Brooklyn, N. Y. (WCDA, WCGU, WRST)	1420	211.1	100
WBSO—Wellesley Hills, Mass. (WDWF)	780	384.4	100
WBT—Charlotte, N. C.	1160	258.5	500
WBZ—Springfield, Mass.	900	333.1	15000
WBZA—Boston, Mass.	900	333.1	500
WCAC—Mansfield, Conn. (WDRC)	1090	275.1	500
WCAD—Canton, N. Y.	820	365.6	500
WCAE—Pittsburgh, Pa.	580	516.9	500
WCAH—Columbus, Ohio	560	535.4	250
WCAJ—Lincoln, Neb. (KMMJ)	790	379.5	500
WCAL—Northfield, Minn. (KFMX)	1270	236.1	500
WCAM—Camden, N. J.	1340	223.7	500
WCAO—Baltimore, Md. (WCBM)	780	384.4	250
WCAT—Rapid City, S. D.	1210	247.8	100
WCAU—Philadelphia, Pa.	890	336.9	500
WCAX—Burlington, Vermont	1180	254.1	100
WCAZ—Carthage, Ill.	880	340.7	50
WCBA—Allentown, Pa. (WSAN)	1350	222.1	100
WCBD—Zion, Illinois (WLS)	870	344.6	5000
WCBE—New Orleans, La.	1320	227.1	5
WCBH—Oxford, Miss.	1240	241.8	100
WCBM—Baltimore, Md. (WCAO)	780	384.4	100
WCBR—Providence, R. I. (Portable)	1490	201.6	100
WCBS—Springfield, Ill.	1430	209.7	250
WCCO—Minneapolis, Minn.	740	405.2	5000
WCDA—Brooklyn, N. Y. (WRST, WBRS, WCGU)	1420	211.1	500
WCFL—Chicago, Ill. (WLTS)	620	493.6	1500
WCGU—Coney Island, N. Y. (WCDA, WBRS, WRST)	1420	211.1	500
WCLO—Camp Lake, Wisc.	1320	227.1	100
WCLS—Joliet, Ill. (WKBB)	1390	215.7	150
WCMA—Culver, Ind.	1160	258.5	250
WCOA—Pensacola, Fla.	1200	249.9	500
WCOC—Columbus, Miss	1300	230.6	250
WCOM—Manchester, N. H.	1260	238.0	100
WCOT—Olneyville, R. I.	1330	225.4	50
WCRD—Chicago, Ill. (WFKB & WPCC)	1340	223.7	500
WCSH—Portland, Me.	830	361.2	500
WCSO—Springfield, Ohio	1170	256.3	500
WCWK—Fort Wayne, Ind. (WOWO	1310	228.9	500
WCWS—Bridgeport, Conn. (Portable)	1490	201.6	100
WDAD-WLAC—Nashville, Tenn.	1330	225.4	1,000
WDAE—Tampa, Fla.	1120	267.7	500
WDAF—Kansas City, Mo.	810	370.2	1000
WDAG—Amarillo, Texas	1140	263.0	250
WDAH—El Paso, Texas	1280	234.2	100
WDAY—Fargo, N. Dak.	830	361.2	250
WDBJ—Roanoke, Va.	1300	230.6	250
WDBK—Cleveland, Ohio (WJAY)	1320	227.1	250
WDBO—Winter Park Fla.	1250	239.9	500
WDBZ—Kingston, N. Y. (WOKO)	1390	215.7	50
WDEL—Wilmington, Del.	1130	265.3	100
WDGY—Minneapolis, Minn. (WRHM)	1150	260.7	500
WDOD—Chattanooga, Tenn.	1180	254.1	500
WDRC—New Haven, Conn. (WCAC)	1090	275.1	250
WDWF—Cranston, R. I. (WBSO)	780	384.4	500
WLSI—			
WDWM—Newark, N. J. (WHAP, WMSG)	1270	236.1	500
WDZ—Tuscoa, Ill. (Daytime only)	1080	277.6	100
WEAF—N. Y. City	610	491.5	50,000
WEAI—Ithaca, N. Y. (WOAX)	620	483.6	250
WEAM—North Plainfield, N. J.	1250	239.9	250
WEAN—Providence, R. I. (WNAC)	1130	265.3	500
WEAO—Columbus, O. (WAIU)	1060	282.8	750
WEAR—Cleveland, O. (WTAM)	750	399.8	1000
WEBC—Superior, Wisc.	1240	241.8	250
WEBE—Cambridge, Ohio	1210	247.8	10
WEBH—Chicago, Ill (WJJD)	820	365.6	2000
WEBJ—New York, N. Y. (WJBI and WBBR)	1170	256.3	500
WEBQ—Harrisburg, Ill.	1340	233.7	15
WEBR—Buffalo, N. Y.	1240	241.8	200
WEBW—Beloit, Wisc.	1160	258.5	500
WEDC—Chicago, Ill. (WGES)	1240	241.8	500
WEEI—Boston, Mass.	670	447.5	500
WEHS—Evanston, Ill.	1390	215.7	100
WEMC—Berrien Springs, Mich.	1260	238.0	1000
WENR—Chicago, Ill, WBCN)	1040	283.3	500
WEPS—Gloucester, Mass.	1010	296.9	100
WEVD—Woodhaven, N. Y. (WATT and WGBB)	1220	245.8	500
WEW—St. Louis, Mo.	850	352.7	1000
WFAA—Dallas, Texas (WBAP)	600	475.9	500
WFAM—St. Cloud, Minn.	1190	252	10
WFBC—Knoxville, Tenn.	1280	234.2	50
WFBE—Cincinnati, Ohio	1220	245.8	250
WFBG—Antoona, Pa.	1070	280.2	100
WFBJ—Collegeville, Minn.	1100	272.6	100
WFBL—Syracuse, N. Y.	1160	282.8	750
WFBM—Indianapolis, Ind.	1330	225.4	250
WFBR—Baltimore, Md.	1330	225.4	100
WFBZ—Galesburg, Ill. (WRAM)	1210	247.8	50
WFCI—Pawtucket, R. I. (WNBX)	1240	241.8	50
WFDF—Flint, Mich.	860	348.6	100
WFHH—Clearwater, Fla.	820	365.6	500
WFI—Philadelphia, Pa. (WLIT)	740	405.2	500
WFIW—Hopkinsville, Ky.	1220	245.8	500
WFKB—Chicago, Ill. (WCRW)	1340	223.7	500
WFKD—Philadelphia, Pa	1460	205.4	10
WFLA—Boca Raton, Fla	1410	212.6	1000
WGAL—Lancaster, Pa. (WKJC)	1190	252.0	15
WGBB—Freeport, N. Y. (WEVD and WAAT)	1220	245.8	400
WGBG—Freeport, N. Y. (WAAT, WSOM)	1220	245.8	400
WGBC—Memphis, Tenn.	1080	277.6	15
WGBF—Evansville, Ind.	1270	236.1	250
WGBI—Scranton, Pa. WQAN)	1300	230.6	100
WGBS—Astoria, L. I., N. Y. (WAAM)	860	348.6	500
WGCP—Newark, N. J. (WNJ)	1070	280.2	500
WGES—Chicago, Ill. (WEDC)	1240	241.8	500
WGHP—Mt. Clemens, Mich.	1230	243.8	1,500
WGL—New York, N. Y. (WODA)	1020	293.9	500
WGM—Jeannette, Pa.	1440	208.2	50
WGMU—New York, N. Y., Portable (WRMU)	1490	201.6	100
WGN—Chicago, Ill. WLIB)	980	305.9	15000
WGR—Buffalo, N. Y.	990	302.8	750
WGST—Atlanta, Ga. (WMAZ	1110	270.1	500
WGWB—Milwaukee, Wisc.	1370	218.8	500
WGY—Schenectady, N. Y. (WHAZ)	790	378.5	30000
WHA—Madison, Wisc. (WLBL)	940	319.0	750
WHAD—Milwaukee, Wis. (WTMJ)	1020	293.9	500
WHAM—Rochester, N. Y.	1080	277.6	5,000
WHAP—New York, N. Y. (WDWM, WMSG)	1270	236.1	1,000
WHAR—Atlantic City, N. J. (WPG)	1100	272.6	750
WHAS—Louisville, Ky.	650	461.3	500
WHAZ—Troy, N. Y. (WGY)	790	379.5	500
WHB—Kansas City, Mo. (WOQ)	890	336.9	500
WHBA—Oil City, Pa.	1150	260.7	10
WHBC—Canton, Ohio	1270	236.1	10
WHBD—Bellefontaine, Ohio	1350	222.1	100
WHBF—Rock Island, Ill.	1350	222.1	100
WHBL—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WHBM—Chicago, Ill. Portable-Carrell)	1490	201.6	100
WHBN—St. Petersburg, Fla.	1010	296.9	10
WHBP—Johnstown, Pa.	1310	228.9	250
WHBQ—Memphis, Tenn.	1290	232.4	100
WHBU—Anderson, Ind.	1360	220.4	15
WHBW—Philadelphia, Pa. (WIAD)	1360	220.4	100
WHBY—West De Pere, Wisc.	1200	249.9	50
WHDI—Minneapolis, Minn (WLB)	1220	245.8	500
WHEC-WABO—Rochester, N. Y.	1180	254.1	100
WHFC—Chicago, Ill.	1390	215.7	200
WHK—Cleveland, Ohio (WJAY)	1130	265.4	500
WHN—New York, N. Y. (WQAO)	760	394.5	500
WHO—Des Moines, Iowa	560	535.4	5000
WHPP—New York, N. Y.	1450	206.8	10
WHT—Chicago, Ill. (WIBO)	720	416.4	5000
WIAD—Philadelphia, Pa. (WHBW)	1360	220.4	50
WIAS—Burlington, Iowa	630	475.9	100
WIBA—Madison, Wisc.	1250	239.9	100
WIBG—Elkins Park, Pa. Sunday, day time only)	680	440.9	50
WIBI—Flushing, N. Y. (WBKN, WWRL, WBMS)	1120	267.7	100
WIBJ—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBM—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBO—Chicago, Ill. (WHT)	720	416.4	500
WIBR—Steubenville, Ohio.	1200	249.9	50
WIBS—Elizabeth, N. J. (WTRC, WLBX)	1470	202.6	150
WIBU—Polynette, Wisc.	1380	217.3	20
WIBW—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WIBX—Utica, N. Y.	1260	238.0	150
WIBZ—Montgomery, Ala.	1300	230.6	15
WICC—Bridgeport, Conn.	1400	214.2	250
WIL—St. Louis, Mo.	1160	258.5	250
WIOD—Miami Beach, Fla.	1210	247.8	1000
WIP—Philadelphia, Pa. (WOO)	590	508.2	500
WJAD—Waco, Texas	670	447.5	500
WJAG—Norfolk, Nebr.	1350	222.1	250
WJAK—Kokomo, Ind.	1280	234.2	50
WJAM—Cedar Rapids, Ia. (KWCR)	780	384.4	100
WJAR—Providence, R. I.	620	483.6	500
WJAS—Pittsburgh, Pa. (KQV)	1110	270.1	500
WJAX—Jacksonville, Fla.	890	336.9	1000
WJAY—Cleveland, Ohio (WHK)	1130	265.3	500
WJAZ—Mt. Prospect, Ill. (WMBD)	1140	263.0	5000
WJBA—Joliet, Ill.	930	322.4	50
WJBB—St. Petersburg, Fla.	870	344.6	250
WJBC—LaSalle, Ill.	1320	227.1	100
WJBI—Red Bank, N. J. (WBBR and WEBJ)	1170	256.3	250
WJBK—Ypsilanti, Mich.	1360	220.4	15
WJBL—Decatur, Ill.	1410	212.6	250
WJBO—New Orleans, La.	1140	283.3	100
WJBR—Omro, Wisc.	1320	227.1	100
WJBT—Chicago, Ill. (WBBM, WAAF)	770	389.4	100
WJBU—Lewisburg, Pa.	1400	214.2	100
WJBW—New Orleans, La.	1260	238.0	30
WJBY—Gadsden, Ala.	1280	234.2	50
WJBZ—Chicago Heights, Ill.	1440	214.2	100
WJJD—Mooseheart, Ill. (WEBH)	820	365.6	1000
WJPW—Ashtabula, Ohio	1440	208.2	100
WJR-WCX—Pontiac, Mich.	680	440.9	5000
WJZ—Bound Brook, N. J.	660	454.3	30000
WKAF—Changed to WTMJ Milwaukee, Wis.			
WKAQ—San Juan, P. R.	880	340.7	500
WKAR—East Lansing, Mich. (WREO)	1300	230.6	1000
WKAV—Laconia, N. H.	1340	223.7	50
WKBB—Joliet, Ill. (WCLA)	1390	215.7	150
WKBC—Birmingham, Ala.	1370	218.8	10
WKBE—Webster, Mass.	1310	228.9	100
WKBF—Indianapolis, Ind.	1190	252.0	250
WKBG—Chicago, Ill. (Portable)	1490	201.6	100
WKBH—La Crosse, Wis.	1360	220.4	500
WKBI—Chicago, Ill.	930	322.4	50
WKBL—Monroe, Mich.	1460	205.4	15
WKBM—Newburgh, N. Y	1440	208.2	100
WKBN—Youngstown, O. (WMBW)	1400	214.2	50
WKBO—Jersey City, N. J. (WKBQ WBNY WFRL)	1370	218.8	500
WKBP—Battle Creek, Mich.	1410	212.6	50
WKBQ—New York, N. Y. (WLTH, WKBO, WBNY)	1370	218.8	500
WKBS—Galesburg, Ill. (WLBO)	1380	217.3	100
WKBT—New Orleans, La.	1190	252.0	50
WKBU—New Castle, Pa. (Portable)	1470	204.0	50
WKBV—Brookville, Ind.	1380	217.3	100
WKBW—Buffalo, N. Y.	1380	217.3	500
WKBZ—Ludington, Mich.	1500	199.9	15
WKDR—Kenosha, Wis.	930	322.4	15
WKJC—Lancaster, Pa. (WGAL)	1190	252.0	50
WKRC—Cincinnati, Ohio	900	333.1	500
WKY—Oklahoma City, Okla.	1040	283.3	150
WLAP—Louisville, Ky.	1120	267.7	30
WLB—Minneapolis, Minn. (WHDI)	1220	245.8	500
WLBC—Muncie, Indiana	1430	209.7	50
WLBF—Kansas City, Mo.	1430	209.7	50
WLBG—Petersburg, Va.	1400	214.2	100
WLBH—Farmingdale, N. Y. (Portable)	1490	201.6	30
WLBI—East Wenona, Ill.	1260	238.0	250
WLBL—Stevens Point, Wis. (WHA)	940	319.0	1000
WLBM—Boston, Mass.	1420	211.1	50
WLBN—Chicago, Ill. (Portable)	1470	204.0	50
WLBO—Galesburg, Ill. (WKBS)	1380	217.3	100
WLBP—Ashland, Ohio	1480	202.6	15
WLBT—Crown Point, Ind.	930	322.4	50
WLBR—Belvidere, Ill.	930	322.4	15
WLBT—Crown Point, Ind.	930	322.4	50
WLBV—Mansfield, Ohio	1450	206.8	50
WLBW—Oil City, Pa.	1020	267.7	500
WLBX—Long Island City, N. Y. (WIBS, WMBQ, WTRC and WLBX)	1470	204.0	250
WLBY—Iron Mountain, Mich.	1430	209.7	50
WLBZ—Dover-Foxcroft, Me.	1440	208.2	250
WLCI—Ithaca, N. Y.	1210	247.8	50
WLIB—Chicago, Ill. (WGN)	980	305.9	500
WLIT—Philadelphia, Pa. (WFI)	740	405.2	500
WLS—Chicago, Ill. (WCBD)	870	384.4	5000
WLTS—Chicago, Ill. (WCFL)	620	483.6	100
WLTH—Brooklyn, N. Y. (WKBQ, WKBO, WBNY)	1370	218.8	500
WLW—Cincinnati, Ohio	700	428.3	5000
WLWL—New York, N. Y. (WMCA)	810	370.2	1000
WMAC—Cazenovia, N. Y. (WSYR)	1330	225.4	500
WMAF—South Dartsmouth, Mass.	700	428.3	500
WMAK—Lockport, N. Y.	550	545.1	750
WMAL—Washington, D. C.	1310	228.9	100
WMAN—Columbus, Ohio	1280	234.2	50
WMAQ—Chicago, Ill. (WQJ)	670	447.5	1000
WMAY—St. Louis, Mo.	1210	247.8	100
WMAZ—Macon, Ga. (WGST)	1110	270.1	500
WMBA—Newport, R. I. (Portable)	1470	204.0	100
WMBB—Chicago, Ill. (WOK)	1190	252.0	500
WMBC—Detroit	1420	211.1	100
WMBD—Peoria Heights, Ill.	1460	205.4	250
WMBE—St. Paul, Minn.	1440	208.2	10
WMBF—Miami Beach, Fla.	780	384.4	500
WMBG—Richmond, Va.	1450	206.8	15
WMBH—Chicago, Ill. (Portable-E. D. Aber.)	1470	204.0	100
WMBI—Chicago, Ill. (WJAZ)	1140	263.0	500
WMBJ—Monesson, Pa.	1290	232.4	50
WMBL—Lakeland, Fla.	1310	228.9	50
WMBM—Memphis, Tenn.	1430	209.7	10
WMBO—Auburn, N. Y.	1360	220.4	100
WMBQ—Brooklyn, N. Y. (WTRC, WIBS, WLBX)	1470	204.0	100
WMBR—Tampa, Fla.	1190	252.0	100
WMBS—Harrisburg, Pa.	1280	234.2	250
WMBU—Pittsburgh, Pa.	1380	217.3	50
WMBW—Youngstown, O. (WKBN)	1400	214.2	50
WMBY—Bloomington, Ill. (WNBL)	1500	199.9	15
WMC—Memphis, Tenn.	580	516.9	500
WMCA—New York, N. Y. (WLWL)	810	370.2	500
WMPC—Lapeer, Mich.	1280	234.2	30
WMRJ—Jamaica, N. Y. (WTRL, WHPP)	1450	206.8	10
WMSG—New York, N. Y. (WHAP, WBNY)	1270	236.1	500
WNAB—Boston, Mass. (Changed to WASN).			
WNAC—Boston, Mass.	850	352.7	500
WNAD—Norman, Okla.	1250	239.9	500
WNAL—Omaha, Nebr. (KOCH, KFOX)	1160	258.5	250
WNAT—Philadelphia, Pa. (WRAX)	1040	263.0	100
WNAX—Yankton, S. D.	990	302.8	250
WNBA—Forest Park, Ill.	1440	208.2	200
WNBF—Endicott, N. Y.	1450	206.8	50

Station	Kc	M	Watts
WNBH—New Bedford, Mass.	1150	260.7	250
WNBJ—Knoxville, Tenn.	1450	206.8	50
WNBL—Bloomington, Ill. (WMBY).	1500	199.9	15
WNBO—Washington, Pa.	1420	211.1	15
WNBQ—Rochester, N. Y.	1480	202.6	15
WNBR—Memphis, Tenn.	1310	228.9	20
WNJ—Newark, N. J. (WGCP)	1070	256.3	500
WNOX—Knoxville, Tenn.	1130	265.3	1000
WNRC—Greensboro, N. C.	1340	223.7	500
WNYC—New York, N. Y.	560	535.4	500
WOAI—San Antonio, Texas	990	302.8	2000
WOAN—Lawrenceburg, Tenn.	1050	260.7	250
WOAX—Trenton, N. J. (WEAM)	1250	239.9	500
WOBU—Charleston, W. Va.	1120	267.7	50
WOBT—Union City, Tenn.	1460	205.4	15
WOC—Davenport, Iowa	850	352.7	5000
WOCL—Jamestown, N. Y.	1340	223.7	25
WODA—Paterson, N. J. (WGL)	1020	293.9	1000
WOI—Ames, Iowa; 5000, daytime, 6 to 6 (WSUI)	1130	265.3	2500
WOK—Chicago, Ill. (WMBB)	1190	252.0	5000
WOKO—Peekskill, N. Y.	1390	215.7	250
WOKT—Rochester, N. Y.	1430	209.7	500
WOMT—Manitowoc, Wis.	1350	221.1	50
WOO—Philadelphia, Pa. (WIP)	590	508.2	500
WOOD—Furnwood, Mich.	1150	260.7	500
WOQ—Kansas City, Mo. (WHB)	890	336.9	250
WOR—Newark, N. J.	710	422.3	500
WORD—Batavia, Ill. (WTAS)	1090	275.1	5000
WOS—Jefferson City, Mo.	760	394.5	500
WOW—Omaha, Nebr.	590	508.2	1000
WOWO—Ft. Wayne, Ind. (WCWK)	1310	228.9	1000
WPAB—Norfolk, Va.	1430	209.7	100
WPCC—Chicago, Ill., (WFKB, WCRW)	1340	223.7	500
WPCH—New York, N. Y. (WRNY).	970	309.1	500
WPDQ—Buffalo, N. Y. (WSVS)	1460	205.4	50
WPEP—Waukegan, Ill.	1390	215.7	250
WPG—Atlantic City, N. J. (WHAR)	1100	272.6	2500
WPRC—Harrisburg, Pa.	1430	209.7	100
WPSC—State College, Pa. (WBAK)	1000	299.8	500
WPSW—Philadelphia, Pa.	1480	202.6	50
WQAA—Parkersburg, Pa.	1390	215.7	500
WQAE—Springfield, Vt.	1200	249.9	50
WQAM—Miami, Fla.	930	322.4	750
WQAN—Scranton, Pa. (WGBI)	1300	230.6	100
WQAO-WPAP—Cliffside, N. J. (WHN)	760	394.5	500
WQJ—Chicago, Ill. (WMAQ)	670	447.5	500
WRAF—La Porte, Ind.	1440	208.2	100
WRAH—Providence, R. I.	1500	199.9	250
WRAK—Escabana, Mich.	1060	282.8	50
WRAM—Galesburg, Ill. (WFBZ)	1210	247.8	50
WRAV—Yellow Springs, Ohio	880	340.7	100
WRAW—Reading, Pa.	1260	238.0	50
WRAX—Philadelphia, Pa. (WNAT).	1040	283.3	250
WRBC—Valparaiso, Ind.	1260	238.0	250
WRC—Washington, D. C.	640	468.5	500
WRCO—Raleigh, N. C.	1380	217.3	250
WREC—Memphis, Tenn.	1180	254.1	50
WREN—Lawrence, Kans. (KFKU)	1180	254.1	750
WREO—Lansing, Mich.	1300	230.6	500
WRES—Quincy, Mass.	1380	217.3	50
WRHF—Washington, D. C. (6 a.m. to 6 p.m.)	930	322.4	150
WRHM—Minneapolis, Minn. (WDGY)	1150	260.7	1000
WRM—Urbana, Ill.; 1000 watts before 6 p.m. (WBAA)	1100	272.6	500
WRMU—New York, N. Y. (Portable)	1490	201.6	100
WRNY—New York, N. Y. (WPCH).	970	309.1	500
WRPI—Terre Haute, Ind.	1440	208.2	100
WRR—Dallas, Texas	850	352.7	500
WRRS—Racine, Wis.	930	322.4	50
WRSC—Chelsea, Mass.	1460	205.4	15
WRST—Bay Shore, N. Y. (WCDA, WBRS, WCGU)	1420	211.1	250
WRVA—Richmond, Va.	1420	211.1	250
WSAI—Cincinnati, O.	830	361.2	5000
WSAJ—Grove City, Pa.	1340	223.7	250
WSAN—Allentown, Pa. (WCBA)	1350	222.1	100
WSAR—Fall River, Mass.	1190	252.0	100
WSAX—Chicago, Ill.	1470	204.0	100
WSAZ—Huntington, W. Va.	1240	241.8	100
WSB—Atlanta, Ga.	630	475.9	1000
WSBC—Chicago, Ill. (WWAE)	1290	232.4	500
WSBT—South Bend, Ind. (WEMC)	1350	222.1	250
WSDA—New York, N. Y. (WARS, WBBC)	1320	227.1	250
WSEA—Virginia Beach, Va. (WTAR)	1140	263.0	250
WSIX—Springfield, Tenn.	1410	212.6	150
WSKC—Bay City, Mich.	610	491.5	250
WSM—Nashville, Tenn.	880	340.7	5,000
WSMB—New Orleans, La. (WAAT)	930	322.4	500
WSMK—Dayton, O.	1220	245.8	500
WSOE—Milwaukee, Wis.	1010	296.9	200
WSRO—Hamilton, Ohio	1100	270.1	500
WSSH—Boston, Mass.	780	384.4	100
WSUI—Iowa City, Iowa (WOI)	1300	230.6	100
WSVS—Buffalo, N. Y. (WPDQ)	1130	265.3	500
WSYR—Syracuse, N. Y. (WMAC).	1460	205.4	50
WTAD—Quincy, Ill.	1330	225.4	500
WTAG—Worcester, Mass.	1270	236.1	250
WTAL—Toledo, Ohio (WABR)	1040	283.3	500
WTAM—Cleveland, Ohio (WEAR)	1070	280.2	100
WTAQ—Eau Claire, Wisc.	750	399.8	3500
WTAR—Norfolk, Va. (WSEA)	1180	254.1	500
WTAS—Batavia, Ill. (WORD)	1140	263.0	500
WTAW—College Station, Texas	1090	275.1	3500
WTAX—Streator, Ill.	970	309.1	500
WTAZ—Lambertville, N. J.	930	322.4	50
WTHO—Detroit, Mich. (WAFD)	1360	220.4	15
WTFF—Washington, D. C.	1370	218.8	250
WTIC—Hartford, Conn.	1470	204	50
WTMJ—Milwaukee, Wisc. (WHAD)	650	461.3	500
WTRC—Brooklyn, N. Y. (WIBS, WMBQ, WLBX)	1020	293.9	1000
WTRL — Midland Park, N. J., (WIBI, WIBL, WBMS)	1470	204	50
WWAT—Chicago, Ill. (WSBC)	1120	267.7	100
WWJ—Detroit, Mich.	1290	232.4	500
WWL—New Orleans, La.	800	374.8	1000
WWNC—Asheville, N. C.	1090	275.1	100
WWRL—Woodside, N. Y. (WBKN, WJBI, WIBI, WBMS)	1010	296.9	1000
WWVA—Wheeling, W. Va.	1120	267.7	100
	770	389.4	100
KDKA—East Pittsburgh, Pa.	950	315.6	30000
KDLR—Devils Lake, N. D.	1300	230.6	15
KDYL—Salt Lake City, Utah	1160	258.5	100
KELW—Burbank, Calif. (KPPC)	1310	228.9	250
KEX—Portland, Ore.	1250	239.9	2500
KFAB—Lincoln, Nebr. (5000 before 7 p. m.)	970	309.1	2000
KFAD—Phoenix, Ariz.	1100	272.6	500
KFAU—Boise, Idaho (4,000 watts daytime)	1050	285.5	2000
KFBB—Havre, Mont.	1090	275.1	50
KFBC—San Diego, Calif.	1210	247.8	100
KFBK—Sacramento, Calif.	560	535.4	100
KFBL—Everett, Wash.	1340	223.7	50
KFBS—Trinidad, Colo.	1260	238.0	15
KFBU—Laramie, Wyo.	700	428.3	500
KFCB—Phoenix, Ariz.	1230	243.8	125
KFCR—Santa Barbara, Calif.	1420	211.1	50
KFDM—Beaumont, Texas	800	374.8	500
KFDX—Shreveport, La.	1270	236.1	250
KFDY—Brookings, S. Dak. (KMA)	760	394.5	500
KFDZ—Minneapolis, Minn.	1300	215.7	10
KFEC—Portland, Ore. (KFIF)	1400	214.2	50
KFEL—Denver, Colo.	1210	247.8	250
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFEY—Kellogg, Idaho	1290	232.4	10
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFH—Wichita, Kansas	1220	245.8	500
KFHA—Gunnison, Colo.	1180	254.1	50
KFHL—Oskaloosa, Iowa.	1410	212.6	10
KFI—Los Angeles, Calif.	640	468.5	5000
KFIF—Portland, Ore. (KFEC)	1400	214.2	50
KFIO—Spokane, Wash. (KEPY)	1220	245.8	100
KFIQ—Yakima, Wash.	1440	208.2	100
KFIU—Juneau, Alaska	1330	225.4	10
KFIZ—Fond du Lac, Wisc.	1120	267.7	100
KFJB—Marshalltown, Iowa	1210	247.8	15
KFJF—Oklahoma, Okla.	1100	272.6	750
KFJI—Astoria, Ore.	1200	249.9	15
KFJM—Grand Forks, N. Dak.	900	333.1	100
KFJR—Portland, Ore. (KTBR)	1060	282.8	100
KFJY—Fort Dodge, Ia. (KFMR)	680	440.9	100
KFJZ—Fort Worth, Texas	1200	249.9	50
KFKA—Greeley, Colo.	750	399.8	200
KFKB—Milford, Kansas	1240	241.8	1000
KFKU—Lawrence, Kansas (WREN).	1180	254.1	500
KFKX—Chicago. Ill.	570	526.0	2,500
KFKZ—Kirksville, Mo.	1330	225.4	15
KFLR—Albuquerque, N. M.	720	416.4	100
KFLV—Rockford, Ill.	1120	267.7	100
KFLX—Galveston, Texas	1110	270.1	100
KFMR—Sioux City, Ia. (KFJY)	680	440.9	100
KFMX—Northfield, Minn. (WCAL)	1270	236.1	500
KFNF—Shenandoah, Iowa (KMA)	1110	270.1	1000
KFOA—Seattle, Wash.	670	447.5	1000
KFON—Long Beach, Calif.	1240	241.8	500
KFOR—Lincoln, Nebr.	1380	217.3	100
KFOX—Omaha, Nebraska (KOCH, WNAL)	1160	258.5	100
KFOY—St. Paul, Minn.	1050	285.5	100
KFPL—Dublin, Texas	1090	275.1	15
KFPM—Greenville, Texas	1300	230.6	15
KFPR—Los Angeles, Calif. (KFQZ)	1290	232.4	250
KFPW—Carterville, Mo.	1140	263.0	50
KFPY—Spokane, Wash. (KFIO)	1220	245.8	250
KFQA—St. Louis, Mo.	930	322.4	50
KFQB—Ft. Worth, Texas	1150	260.7	1000
KFQD—Anchorage, Alaska	870	344.6	100
KFQU—Holy City, Calif.	1200	249.9	100
KFQW—Seattle, Wash.	1380	217.3	100
KFQZ—Hollywood, Calif. (KFPR)	1290	232.4	100
KFRC—San Francisco, Calif.	660	454.3	1,000
KFRU—Columbia, Mo.	1200	249.9	500
KFSD—San Diego, Calif.	680	440.9	500
KFSG—Los Angeles, Calif.	1090	275.1	500
KFUL—Galveston, Texas	1160	258.5	500
KFUM—Colorado Springs, Colo.	1270	236.1	100
KFUO—St. Louis, Mo. (KSD)	550	545.1	500
KFUP—Denver, Colo.	1320	227.1	100
KFUR—Ogden, Utah	1330	225.4	50
KFUS—Oakland, Calif. (KRE)	1170	256.3	50
KFUT—Salt Lake City, Utah	600	499.7	50
KFVD—Venice, Calif. (KGFJ)	1440	208.2	250
KFVE—St. Louis, Mo.	1280	234.2	1000
KFVG—Independence, Kans.	1330	225.4	50
KFVI—Houston, Texas	1260	238.0	50
KFVR—Denver, Colo.	630	475.9	250
KFVS—Cape Girardeau, Mo.	1340	223.7	50
KFWB—Los Angeles, Calif.	830	361.2	500
KFWC—San Bernardino, Calif.	1350	222.1	100
KFWF—St. Louis, Mo.	1400	214.2	100
KFWH—Eureka, Calif.	1180	254.1	250
KFWI—San Francisco, Calif.	1120	267.7	500
KFWM—Oakland, Calif. (1000 watts day time)	1270	236.1	500
KFWO—Avalon, Calif.	1370	218.8	250
KFWV—Portland, Ore.	1310	228.9	50
KFXB—Los Angeles, Calif.	190	252.0	500
KFXF—Denver, Colo.	1060	282.8	500
KFXH—El Paso, Texas	1240	241.8	100
KFXJ—Near Edgewater, Colo.	1390	215.7	15
KFXR—Oklahoma City, Okla.	1400	214.2	15
KFXY—Flagstaff, Ariz.	1460	205.4	25
KFYF—Oxnard, Calif.	1260	238.0	25
KFYR—Bismarck, N. Dak.	1250	239.9	250
KGA—Spokane, Wash.	1150	260.7	2000
KGAR—Tuscon, Ariz.	1280	234.2	100
KGBS—Seattle, Wash.	1480	202.6	100
KGBU—Ketchikan, Alaska	1310	228.9	500
KGBX—St. Joseph, Mo.	1040	283.3	100
KGBY—Columbus, Nebr.	1480	202.6	50
KGBZ—York, Nebr.	1410	212.6	100
KGCA—Decorah, Iowa	1480	202.6	10
KGCB—Oklahoma City, Okla. (KGFG)	1390	215.7	50
KGCH—Wayne, Nebr.	1020	293.9	250
KGCI—San Antonio, Texas (KGDR)	1480	202.6	15
KGCL—Seattle, Wash. KPCB)	1300	230.6	50
KGCN—Concordia, Kansas	1440	208.2	50
KGCR—Brookings, S. Dak.	1440	208.2	15
KGCU—Mandan, N. Dak.	1440	208.2	100
KGCX—Vida, Mont.	1230	243.8	10
KGDA—Dell Rapids, S. Dak. (Day time only)	1280	234.2	15
KGDE—Barrett, Minn.	1460	205.4	50
KGDJ—Cresco, Iowa	1480	202.6	10
KGDM—Stockton. Calif.	1380	217.3	10
KGDP—Pueblo, Colo.	1340	223.7	10
KGDR—San Antonio, Texas	1480	202.6	15
KGDW—Humboldt, Nebr.	1450	206.8	100
KGDX—Shreveport, La.	1410	212.6	250
KGDY—Oldham, S. Dak.	1450	206.8	15
KGEF—Los Angeles, Calif.	1140	263.0	500
KGEH—Eugene, Ore.	1490	201.6	50
KGEK—Yuma, Colo.	1470	204.0	10
KGEN—El Centro, Calif.	1330	225.4	15
KGEO—Grand Island, Nebr.	1460	205.4	100
KGEQ—Minneapolis, Minn.	1480	202.6	50
KGER—Long Beach, Calif. (KRLO)	1390	215.7	100
KGES—Central City, Nebr.	1470	204.4	10
KGEU—Lower Lake, Calif.	1320	227.1	50
KGEW—Fort Morgan, Colo.	1370	218.8	10
KGEY—Denver, Colo.	1490	201.6	15
KGEZ—Kalispell, Mont.	1460	205.4	100
KGFB—Iowa City, Iowa	1340	223.7	10
KGFF—Ava, Okla.	1460	205.4	25
KGFG—Oklahoma City, Okla. (KGCB)	1390	215.7	50
KGFH—La Crescenta, Cal. (KMIC)	1340	223.7	100
KGFI—Ft. Stockton, Tex.	1360	220.4	15
KGFJ—Los Angeles, Calif. (KFVD)	1440	208.2	100
KGFK—Hallock, Minn.	1340	223.7	50
KGFL—Trinidad, Colo.	1350	222.1	50
KGFM—Yuba City, Calif.	1420	211.1	15
KGFN—Aneta, N. Dak.	1500	199.9	15
KGFO—Terra Haute, Ind.	1470	204.0	100
KGFP—Mitchell, So. Dak.	1410	212.6	10
KGO—Oakland, Calif.	780	384.6	5000
KGRC—San Antonio, Texas (KGCI)	1360	220.4	50
KGRS—Amarillo, Texas	1230	243.8	150
KGTT—San Francisco, Calif.	1450	206.8	50
KGU—Honolulu, T. H.	1110	270.1	600
KGW—Portland, Ore.	610	491.5	1000
KGY—Lacey, Wash.	1230	243.8	50
KHJ—Los Angeles, Calif.	740	405.2	500
KHQ—Spokane, Wash.	810	370.2	1000
KICK—Anita, Iowa	650	461.3	100
KJBS—San Francisco, Calif.	1360	220.4	50
KJR—Seattle, Wash.	860	348.6	2500
KKP—Seattle, Wash.	1130	265.3	15
KLDS—Independence, Mo.	1110	270.1	1,500
KLIT—Portland, Oregon	1450	206.8	10
KLS—Oakland, Calif. (KZM)	1220	245.8	250
KLX—Oakland, Calif.	590	508.2	500
KLZ—Denver, Colo.	1120	267.7	250
KMA—Shenandoah, Iowa (KWKH and KFDY)	760	394.5	1,000
KMED—Medford, Oregon	1120	267.7	50
KMIC—Inglewood, Calif. (KGFH)	1340	223.7	250
KMJ—Fresno, Calif.	820	365.6	50
KMMJ—Clay City, Neb. (WCAJ)	790	379.5	500
KMO—Tacoma, Wash.	1180	254.1	250
KMOX—St. Louis, Mo.	1000	299.8	5000
KMTR—Los Angeles, Calif.	570	526.0	500
KNRC—Santa Monica, Calif.	800	374.8	500
KNX—Los Angeles, Calif.	890	336.9	500
KOA—Denver, Colo. (10,000 until 7 p. m.)	920	325.9	5000
KOAC—Corvalis, Ore.	1110	270.1	500
KOB—State College, N. M. (KWSC, KTW)	760	394.5	5000
KOCH—Omaha, Nebr. (WNAL, KFOX)	1160	258.5	250
KOCW—Chickasha, Okla.	1190	252.0	250
KOIL—Council Bluffs, Iowa	1080	277.6	1500
KOIN—Portland, Ore.	940	319.0	1000
KOLO—Durango, Colo.	1500	199.9	5
KOMO—Seattle, Wash.	980	305.9	1000
KOWW—Walla Walla, Wash.	1000	299.8	500
KPCB—Seattle, Wash. (KGCL)	1300	230.6	50
KPJM—Prescott, Ariz.	1400	214.2	15
KPNP—Muscantine, Iowa	1420	211.1	100
KPO—San Francisco, Calif.	710	422.3	1000
KPPC—Pasadena, Calif. (KELW)	1310	228.9	50
KPRC—Houston, Texas	1020	293.9	500
KPSN—Pasadena, Calif.	950	315.6	1000
KQV—Pittsburgh, Pa. WJAS)	1110	270.1	500
KQW—San Jose, Calif.	1010	296.9	500
KRAC—Shreveport, La.	1360	220.4	50
KRE—Berkeley, Calif. (KFUS)	1170	256.3	100
KRLD—Dallas, Texas	1350	222.1	500
KRLO—Los Angeles, Calif. (KGER).	1390	215.7	250
KROX—Seattle, Wash. (KRSC3	1420	211.2	50
KRSC—Seattle, Wash (KROX)	1420	211.1	50
KSAC—Manhattan, Kans.	900	333.1	500
KSBA—Shreveport, La.	1120	267.7	1000
KSCJ—Sioux City, Ia(KWUC)	1230	243.8	500
KSD—St. Louis, Mo. (KFUC)	550	545.1	500
KSEI—Pocatello, Idaho	900	333.1	250
KSL—Salt Lake City, Utah	990	302.8	1000
KSMR—Santa Maria, Calif.	1100	272.6	100
KSO—Clarinda, Iowa	1320	227.1	500
KSOO—Sioux Falls, S. D.	1430	209.7	250
KTAB—Oakland, Calif.	1070	280.2	500
KTAP—San Antonio, Texas	1310	228.9	10
KTBI— Los Angeles, Calif.	1040	282.3	500
KTBR—Portland, Ore. (KFJR)	1060	282.8	50
KTCL—Seattle, Wash.	1080	277.6	500
KTHS—Hot Springs, Ark.	880	340.7	750
KTNT—Muscatine, Iowa	1170	256.3	3500
KTSA—San Antonio, Tex. (formerly WCAR)	1130	265.3	2000
KTUE—Houston, Tex.	1410	212.6	5
KTW—Seattle, Wash. (KWSC, KOB)	760	394.5	1000
KUJ—Seattle, Wash.	1500	199.9	10
KUOA—Fayetteville, Ark.	1010	96.9	500
KUOM—Missoula, Mont.	800	374.8	500
KUSD—Vermillion, S. D.	620	483.6	250
KUT—Austin, Texas	1280	232.4	500
KVI—Tacoma, Wash.	1280	232.4	50
KVOO—Bristow, Okla.	860	348.6	1000
KVOS—Seattle, Wash.	1430	209.7	50
KWBS—Portland, Ore.	1500	199.9	15
KWCR—Cedar Rapids, Ia. (WJAM)	780	384.4	250
KWG—Stockton, Calif.	870	344.6	50
KWJJ—Portland, Ore.	1310	228.9	50
KWKC—Kansas City, Mo.	1350	222.1	100
KWKH—Shreveport, La. (KMA)	760	394.5	1,000
KWLC—Decorah, Iowa	1210	247.8	50
KWSC—Pullman, Wash.	760	394.5	500
KWTC—Santa Ana, Calif.	880	340.7	5
KWUC—LaMars, Iowa (KSCJ)	1230	243.8	1500
KWWG—Brownsville, Texas	1080	277.6	500
KXL—Portland, Ore.	1360	220.4	50
KYA—San Francisco, Calif.	970	309.1	500
KWY—Chicago, Ill. (KPKX)	570	526.0	2500
KZM—Oakland, Calif. (KLS)	1220	245.8	100

A THOUGHT FOR THE WEEK

IN trying to impress the other fellow with your knowledge of radio, don't forget that he may not be a brilliant conversationalist but a mighty good man when it comes to getting out of a set everything the builder put into it. Edison spends more time inventing things than he does to addressing scientific societies.

RADIO WORLD

The First and Only National Radio Weekly

Member, Radio Publishers Association

Radio World's Slogan: "A radio set for every home."

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY
(Dated Saturday of same week)
FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
145 WEST 45th STREET, NEW YORK, N. Y.
(Just East of Broadway)
ROLAND BURKE HENNESSY, President
M. B. HENNESSY, Vice-President
HERMAN BERNARD, Secretary
European Representatives: The International News Co. Breams Bldgs., Chancery Lane, London, Eng.
Paris, France: Brentano's, 8 Avenue de l'Opera

EDITOR, Roland Burke Hennessy
MANAGING EDITOR, Herman Bernard
TECHNICAL EDITOR, Lewis Winner
CONTRIBUTING EDITORS:
J. E. Anderson, Capt. Peter V. O'Rourke, and James H. Carroll

SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5½"	231 lines	150.00
⅓ Page, 3⅛" D. C.	231 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

An Original Theory Followed By Reisz

Mr. Reisz points out regarding loudspeakers that as long as the vibrating surface is stiff there will be sound figures on the surface, corresponding to natural frequencies of vibration, and that these indicate distortion. The stiffer the vibrator is, the more pronounced will the figures be, and the greater the distortion. Since some stiffness is necessary in cone and diaphragm types of speakers to bring out the higher frequencies, distortion is unavoidable, he says. One way of overcoming this is to distribute the driving force over the entire area of the vibrator so that the unit is closely coupled to the radiator. This is not practical with an electromagnetic unit, while it is relatively simple with an electrostatic one. Hence Mr. Reisz selected the electrostatic type and claims an even response from 30 to 10,000 cycles.

Words Newly Defined By Electrical Trade

To quicken progress in radio, various terms have been accurately defined by the standard-making body of the National Electrical Manufacturers Association, among which is a recent definition covering distortion. Some of the definitions follow:

Distortion—A change in wave form, as in passing through a circuit or transmission medium. A wave form may be distorted by (a) the presence in the output of components having frequencies not present in the original wave due to circuit elements having non-linear characteristics; (b) a change in the relative amplitude of the component frequencies due to variation in transmission efficiency over the frequency range involved; (c) a change in the relative phase of the component frequencies. Two or more of these forms of distortion may exist simultaneously.

Fading—The variation of the signal intensity received at a given location from a radio transmitting station as a result of changes in the transmission path.

Swinging—The variation in intensity of a received radio signal resulting from changes in the frequency of the transmitted waves.

Attenuation—The reduction in power of a wave or a current with increasing distance from the source of transmission.

Interference—The confusion of reception due to strays, undesired signals or other causes; also that which produces the confusion.

Radio channel—A band of frequencies or wavelengths of a width sufficient to permit its use for radio communications. The width of the channel depends upon the type of transmission.

Band of frequency—A continuous range of frequencies extending between two definite frequencies.

Uni-directional radio finder—A radio receiving device which permits determination of the direction (without 180 degrees ambiguity) of waves as received from a transmitting station.

Radio beacon—A radio transmitting station in a fixed geographic location which emits a distinctive and characteristic signal for enabling mobile receiving stations to determine bearings.

Observed radio bearings—The angular deviation from an arbitrary fixed line such as the earth's geographical meridian or the fore and aft line of a ship, of the direction of the incoming wave as determined by radio direction finder (without calibre direction).

Corrected radio bearings—An observed radio bearing to which the calibration correction has been applied.

True radio bearings—The angular deviation from true North at the point of observation of the chord of the great circle passing from the observer to a given transmitting station.

Broadcasting—The transmission of music, news, entertainment or other intelligence intended for general reception.

The use of socket power devices is considered in the new edition of the NEMA Radio Standards in the Battery and Socket Power Section. Among other standards are these:

"It shall be standard to mark socket power devices plainly with the name of the manufacturer, the rating of the primary supply or input in volts, frequency, and amperes or watts. The secondary output rating shall be stated in the accompanying instructions or on the device. It shall be standard to provide installation diagram or instructions with socket power devices."

Station Proud It Lets Advertisers Give Prices

Washington.

Direct advertising by radio—defined as the sale of goods through the medium of broadcasting, whether or not the price is announced—was discussed before the Federal Radio Commission by the owner of a station engaged in this pursuit. He described his activities as greatly in demand and overwhelmingly popular among Corn Belt farmers.

The witness was Earl May, president of the May Seed & Nursery Company, of Shenandoah, Iowa, operators of KMA, which had made application for a transfer from its present wave-length and power to conditions more favorable to its operation. KMA is now broadcasting on 1,110 kilocycles, using 500 watts of power, and sought a change to 710 kilocycles, using 2,000 watts daytime and 1,000 at night.

Farmers Like Talks

Mr. May said that the farm programs consist largely of advice relating to agriculture and horticulture, given in answer to written inquiries.

A large share of the program, however, is musical, he testified, the station employing six orchestras and spending from $30,000 to $35,000 annually on entertainment features. Farmers, however, like talks, he said, adding that perhaps the most popular broadcasts from KMA are sales talks relating to tires, overalls and paints.

"This is the most interesting thing we do," Mr. May replied when asked by William Jamieson, his attorney, to describe the direct advertising activities of the station. "One of our supporters declared to me that there is no difference between having the farmers listen to livestock quotations telling them what they can obtain for their goods from having to listen to what they must pay for the goods they want."

Found It Paid

The May concern devotes about 45 minutes daily to direct advertising of its goods, Mr. May asserted. Much time is sold, however, he said, to companies for similar direct advertising.

Last year, Mr. May stated, some 550,000 letters of commendation were received by the station. Scores of mail orders are received for products described via the microphone, but it was not until this year that the concern has begun to show a profit from its broadcasting activities, according to Mr. May.

Mr. May said he was constrained to go into the direct advertising field, after broadcasting only his firm name for about two years, when the American Society of Composers began to ask for royalty fees on the songs broadcast. Upon the suggestion of a paint salesman, he said, he began the experiment of broadcasting prices along with the description of goods. The result was the receipt of many more orders, he said.

Bureau Helps Correct Waves

Washington.

The Bureau of Standards is cooperating with stations in efforts to maintain service on the frequency assigned by the Federal Radio Commission, the Chief of the Electrical Division, E. C. Crittenden stated. The Radio Commission has asserted that in order to eliminate heterodyne interference it is of utmost importance that all stations stay on their wavelengths.

"We are ready," said Mr. Crittenden, "at the request of station owners, to calibrate piezo oscillators, frequency indicators, or frequency meters for use in maintaining a radio broadcasting station on its assigned wavelength. The public, in listening in, is as much concerned in a steady and unchanging frequency as the radio broadcasters themselves, though for different reasons. To the broadcaster it means living up to the rules set by the Radio Commission; to the receiver it means a clearer and better service."

Explains the Piezo Oscillator

The piezo oscillator, Mr. Crittenden explained, is a device which consists chiefly of a tube, an A and B battery, condensers, and a quartz plate. The quartz plate vibrates at a certain rate, varying according to its size. Hence it may be calibrated for a given speed of vibration and will retain this rate, keeping the broadcaster on his assigned frequency.

The Electrical Division is also engaged, Mr. Crittenden said, in furnishing the inspectors in the nine radio districts with instruments for checking up on the various stations broadcasting. Each district is supplied with a piezo oscillator for checking its own correction meters. The Division has calibrated nearly 60 frequency meters, frequency indicators and piezo oscillators, and is working at capacity along this line, it was stated.

Charges Nominal

Mr. Crittenden said:

"A nominal fee is charged for calibration. Instruments should not be sent to the Bureau for calibration without first writing and giving the call letters of the station and its assigned frequency and the type, make, and description of the device to be calibrated. Information as to the type and make of the device will assist in deciding whether the instrument can be accepted for test and may save returning the device to the maker for changes in construction. The Bureau can accept for calibration only instruments which are properly constructed and likely to maintain their calibration.

"Specifications for the piezo oscillator and for a frequency indicator can be obtained by addressing the radio section of the Bureau of Standards. A more sensitive resonance indicator has recently been devised for the Bureau's type B frequency indicator. The radio-frequency thermo galvanometer has been replaced by a crystal detector and direct current milliammeter. The latter combination shows smaller changes in frequency than the thermo galvanometer."

Many Seek Jobs As Radio Reporters

WGL which plans to appoint "radio reporters" in various parts of the state said that it had received many applications by telephone for appointment as official radio reporters. The station intends to organize a staff of reporters whose duty it will be to report any news which they may happen to be eyewitnesses of.

REGULAR AS CLOCKWORK

THE WBAL STRING quartet who broadcast every Wednesday evening from 7:30 to 8 P. M., E. S. T. from WBAL, Baltimore. Left to right, Michael Weiner, 1st violinist; Arthur Morgan, 2nd violinist; Samuel Maurice Stern, 'cellist, and Bernard Rosenthal, violist.

Excess Power Brings Penalty

Washington.

Ordering legal action against KWKH, Shreveport, La., for alleged violation of its allocation of last June 15, the Federal Radio Commission announced that it had also placed KMA, of Shenandoah, Iowa, on the wavelength of the Louisiana station. The two stations will divide time on the frequency of 760 kilocycles (394.5 meters).

The alleged violation of a power assignment by the Louisiana station was brought out in the testimony of W. K. Henderson, its owner during the course of a hearing on the application of KOIL, Council Bluffs, Iowa, for assignment to the 760 channel.

Mr. Henderson admitted on examination that he has been using 3,000 watts of power instead of the 1,000 authorized by the Commission. Accordingly, it was stated by Commissioner Sykes the station becomes open to prosecution under Section 32 of the Radio Act of 1927.

Much interest was attracted to the KMA case, the decision in which leaves WSUI free on its 710 channel, because of the testimony of its owner, Earl May, the president of the May Seed and Nursery Company. It was to the effect that the station was engaged in the direct sale of goods by radio, describing the commodities and stating prices.

Under the decision KMA is permitted to move off its present 1,110 frequency to 760, and to continue operation unrestricted except for the division of time with the Louisiana station. This must be arranged between the owners of the stations themselves, Judge Sykes said.

By action of the Federal Radio Commission the record of the hearing involving Station KWKH was referred to the United States Department of Justice with the request that the Department of Justice forthwith take the necessary steps for instituting criminal proceedings against Station KWKH, under Section 32 of the Radio Act of 1927.

Furthermore, in consideration of the fact that the action of KWKH in this respect does not appear to be in public interest, although testimony showed that this station has enjoyed great popularity, the Commission has ordered that the operation of KWKH be reduced to half time, effective at once, the order providing that KWKH shall divide time with KMA, Shenandoah, Iowa.

Debs Station is Now WEVD

The trustees of the Debs Memorial Radio Fund have been granted a license by the Federal Radio Commission for the operation of station WEVD, formerly WSOM of Woodside, L. I. The station will operate on a wave length of 245.8 meters and will divide time with stations WGBB of Freeport, L. I., and WAAT of Jersey City, N. J.

New Management Oct. 1

The station will not go under the complete control of the new management until the first of October, but at that time the fund will begin to broadcast programs of general interest with special stress on subjects pertaining to the labor movement and progressive and radical opinion. All phases of progressive opinion will be guaranteed expression over the station, it is stated.

Upton Sinclair, one of the trustees of the fund, deploring present conditions of broadcasting in this country said yesterday:

"Two or three days ago I subjected myself, out of a sense of public duty, to the ordeal of listening to a blow-by-blow portrayal of a brutal and degrading contest of two bruisers. To present such mental and moral poison as this to the masses of American people, all the leading broadcasting stations were hooked up and crowds of people swarmed to public places and stood upon street corners, wherever a radio set could be heard. At the same time, men and women who are devoting their lives to human welfare are regularly and systematically barred from the air, and in many cases have been shut off in the midst of their talk and permitted to go on without an audience.

Hopes to Do Much

"It will be the duty of WEVD to remedy this condition, and I hope we shall be able to teach our industrial and political masters that our people really desire something better than trash for their mental food."

CHAPPELL MANAGES WHAM

The new 5,000-watt broadcasting station WHAM, which is owned and operated by the Stromberg-Carlson Telephone Mfg. Company, will be under the management of Ernest E. Chappell.

Mr. Chappell came to WHAM after successfully managing the Onondaga Hotel Station WFBL in Syracuse.

THE RADIO TRADE

Atwater Kent Joins List of R.C.A. Licensees

From Information Bureau, Radio Corporation of America

The most important case in the history of radio patent litigation has ben settled, it is announced, by an agreemént signed between the Atwater Kent Manufacturing Company and the Radio Corporation of America. The agreement came as a result of negotiations carried on by A. Atwater Kent, and David Sarnoff, Vice President and General Manager of the Radio Corporation of America.

The licensing agreement, it is stated, provides for payment by the Atwater Kent Manufacturing Company to the Radio Corporation of America of royalties on sales of radio receiving sets manufactured by the Atwater Kent Manufacturing Company since January, 1923, when the latter organization began the production of tuned radio frequency receivers.

Based on 7½ Per cent.

The agreement also provides for the payment of royalties on future sales of such sets made by the Atwater Kent Manufacturing Company. The terms of royalties, it was announced, are based on the standard RCA licensing agreement of 7½ per cent.

Aside from the payment of royalties by Atwater Kent, and the freedom which it gives his company to go forward without being hampered by the lack of basic patents or the distractions of litigation, the licensing agreement will have no other effect upon the radio industry, which is on a vigorously competitive basis.

The two big rivals in the radio industry conducted their negotiations directly through Mr. Kent and Mr. Sarnoff.

"The licensing agreement," said Mr. Sarnoff, "simply enables both sides to spend more time selling receiving sets, and less in the courts.

"It is the policy of the Radio Corporation to encourage legitimate competition. We have never desired a monopoly in the sale of radio receiving sets, but have wanted to be compensated for basic invention and development.

"No restriction has been placed upon volume or prices of Atwater Kent. The only change in the situation between the two companies is that Atwater Kent pays a royalty to us upon his sale of receiving sets. There is ample room for legitimate competition in the sale of receiving sets and this licensing of Atwater Kent simply shows that we welcome such competition, so long as our patents are recognized and respected."

* * *

Kent's Letter to Trade

The Atwater Kent Co. sent out the following:

"To all Atwater Kent dealers and dealer prospects:

"Through negotiations conducted between Mr. David Sarnoff of the Radio Corporation of America and Mr. A. Atwater Kent of the Atwater Kent Manufacturing Company, the most important agreement relative to patents in the history of radio has been settled.

"By this agreement all patent litigation between these two companies ceases and all Atwater Kent dealers and prospective dealers, are saved harmless for both past and future on tuned radio frequency receivers.

"The Atwater Kent Company firmly believes the above action will assist and stabilize the whole radio industry, and the advantages derived from the agreement are shared both by the Atwater Kent Company and its dealers.

"Very truly yours,
"Atwater Kent Manufacturing Company,
"VERNON W. COLLAMORE."

CeCo Announces Two New AC Tubes

The C. E. Manufacturing Company, Inc., of Providence, R. I., announce further additions to their already extensive line by the introduction, of two new AC tubes operating directly on alternating current.

One type will be known as the M-26 and is a 1½-volt filament tube. This tube is best suited for radio and audio stages and shows a remarkable freedom from AC hum even under the most strenuous operating conditions.

The other new tube will be known as type N-27 and also operates on AC. This tube is of the separate heater type with a five-prong base carrying the cathode connection in the base itself. This tube is particularly suited for use as a detector although it may be used as an amplifier as well.

The heater filament draws 1.75 amps at 2.5 volts.

The general characteristics of these AC tubes follow closely those of the CeCo type A and vary only in operating conditions. For this reason CeCo types M-26 and N-27 may be used with superior results in any set specifying "A" tubes. The new AC tubes will also give excellent results in sets converted from battery to AC operation. Realizing that the AC tube of the low-voltage type is a relatively new development in the field, the C. E. Manufacturing Company, has spared no expense or effort in making the AC tubes superior in efficiency, long life and uniformity.

Ensco Enlarges Again

Steadily increasing business of the Engineer's Service Co., manufacturers of the famous Ensco three-foot cone kit and the remarkable Ensco unit, forced them to increase their space twice during the past few months. However, the phenomenal growth and the tremendous pace at which business grew has made an increase of practically thrice their former floor space necessary; therefore they have removed from their former quarters on the 14th floor at 25 Church street, New York City, to the seventh floor in the same building.

The quarters cover a new acoustical laboratory with every equipment for their staff of radio and acoustic engineers, under the direction of Clyde J. Fitch. A fine suite of executive offices, modernly laid out, are under the supervision of Fred Webb.

Engineers' Service Co. will be represented adequately at all the coming radio shows, New York, Boston and Chicago.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature.

Name .....
Address .....
City or town.....
State .....

Walter Weigel, 134 East College Ave., York, Pa.
Charles Fishman, 164-12 107th Ave., Jamaica, N. Y.
Hyman Hecht, 526 East 139th St., Bx., N. Y. City.
Willard F. Sutton, Box 341, Millbrook, N. Y.
August A. Bette, 534 10th St., S., Virginia, Minn.
M. H. Schafer, 254 Lockwood St., Providence, R. I.
R. N. Maxon, 1913 Second National Bank, Toledo, O.
H. E. Lennox, 11 Fountain Ave., Crafton, Pa.
Acme Battery Shop, 425 Division St., Perth Amboy, N. J.
John R. Eusbacher, 500 10th St., Brooklyn, N. Y.
David A. Dilworth, 244 West 4th St., Erie, Pa.
Johnson Radio Service, 115 Washington St., Trenton, N. J.
J. L. Campbell, 1111 Woodmont Ave., New Kensington, Pa.
H. L. Malotte, 1041 Ella Ave., Kansas City, Kans.
W. C. Stallard, 64 Exeter St., Portland, Me.
John R. Leonard, 570 West Rock Ave., New Haven, Conn.
A. Karsch, 1117 Blake Ave., Brooklyn, N. Y.
James F. Davis, 321 Plum St., Johnstown, Pa.
Charles J. Plever, 65 Garfield St., Matrona, Pa.
F. P. Jones, 1513 Vance Ave., Chattanooga, Tenn.
C. V. McAskell, 216 Hyde Park Place, Tampa, Fla.
William H. Wacek, Lock Drawer, 476, Jamestown, N. D.
Adolf Santer, 486 Park Ave., West New York, N. J.
John C. Stephens, 193 Main St., Orange, N. J.
Lucien Deschenes, Trois-Pistoles, Tem., Canada.
W. E. Sutherland, 16864 Prairie Ave., Detroit, Mich.
H. M. Casper, Kernersville, N. C.
Harry McArthur, 255 East Longview Ave., Columbus, O.
C. H. Young, c-o F. B. Keith & Co., 602 Walton Building, Atlanta, Ga.
W. E. Priddy Jr., 245 Oakland Ave., Huntington, W. Va.
W. H. Powell, 59 Boylan St., Newark, N. J.
Alfred Kraus, 9½ Nicholl Ave., Pt. Richmond, Calif.
G. A. Harvey, 1218 5th Ave., Huntington, W. Va.
C. A. Reiber, 7 Rhun St., Newark, N. J.
David Dixon, 291 Willis Ave., New York City.

Theatre of Wonders to Mark N. Y. Fair

Plans for the National Radio Week that will mark the annual Radio World's Fair, beginning on Sept. 19 in Madison Square Garden, are being rapidly rushed to completion. One of the most important events will be the forum to be conducted by noted leaders in the field of radio research and merchandising, a symposium that will interest every follower of broadcasting as well as the 250,000 visitors to the exposition.

The "Big Day" is Sept. 21, when amazing new scientific discoveries will be revealed in the "Theatre of Wonders," the principal feature of this year's Radio World's Fair, and that evening will occur the annual Radio Industries Banquet, with its feast of entertainment broadcast throughout the United States.

Last year National Radio Week was inaugurated by a big parade. This will not be held this year, but the honor guests of the exposition will be officially welcomed to the city by Mayor Walker.

Federal-Brandes Licensed by R. C. A.

Federal-Brandes, Inc., of Newark, N. J., manufacturers of Kolster radio receivers, has been licensed by the Radio Corporation of America to manufacture radio receivers and other equipment covered by patents owned by the Radio Corporation and associated companies, according to an announcement yesterday.

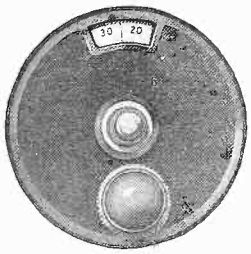
Some Kolster Claims On Compass Rejected

Washington.

Eleven of the claims in the patent application of Frederick A. Kolster relating to the radio compass were rejected by the Patent Office. The second Assistant Commissioner of Patents, M. J. Moore, upheld the decision of the Examiners-in-Chief affirming the decision of the Examiner finally rejecting claims 8, 9, 10, 11, 25, 26 and 34 and holding that claims 1, 2, 3 and 4 are devoid of patentability. The remaining claims were allowed in Patent 1637615 issued August 2, 1927.

Fifteen references were cited against the patent application showing that the use of a coil antenna for determining bearings was not new.

New Marco Dial Has Illumination



The Martin-Copeland Company, Providence, R. I., makers of the favorite line of Mar-Co Radio products, are now ready with their newest 1928 Mar-Co dial. The catalogue number of this dial is 302 for 0-100 and 303 for 100-0. It is built with the usual Mar-Co exactness and beauty of finish, is scaled with finer, more accurate divisions, giving quick and smooth action and speedy readability. Instead of one scale, there are two, perfectly and permanently synchronized. The first is calibrated in degrees and corresponds to the scale on previous Mar-Co dials. The second, however, is calibrated in tenths of a degree. The dial is illuminated from above, the bulb being furnished.—J. H. C.

Radio University

A FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th ST., New York City.

When writing for information give your Radio University subscription number.

I HAVE a 400-ohm potentiometer formerly used for varying the grid bias on a soft detector. Now I wish to use it as a volume control across the secondary of an audio transformer. Will this work?

(2) Can I use a 500,000-ohm variable resistor for a volume control? I have one on hand and want to make use of it. If it can be used as a volume control, where shall I put it in the circuit?

—OLAV FRANDSEN, St. Paul, Minn.

(1) The 400-ohm potentiometer is useless as a volume control in that position, but may be used in series with the RF B supply. The resistance of the potentiometer for a volume control should be about half megohm.

(2) A 500,000-ohm variable resistance of the rheostat type across the secondary of the transformer can be used as a volume control but it is not so good as a 500,000-potentiometer.

* * *

WHAT IS the best intermediate frequency to use in a Super-Heterodyne? I am planning to build a Super-Heterodyne but this problem has held me up. Your help will be greatly appreciated.

(2) How many intermediate frequency stages should be used?

(3) In some Super-Heterodynes the two detectors work with grid leaks and condensers. In others the grid bias method of detection is used. Which is preferable?

(4) Is it advisable to use regeneration in the first detector to increase the sensitivity?

—ELLIS BRUNSWICK, Tulsa, Okla.

(1) There is no one best intermediate frequency for Super-Heterodynes. The lower the frequency the greater the amplification, and vice versa. The lower the intermediate frequency the greater the selectivity will be. The reverse also is true. The higher the frequency of the intermediate amplifier the less image interference there is likely to be.

(2) Two stages of amplification beside the second input detector are enough for most purposes. If greater sensitivity is desired, three stages of amplification and a detector can be used, as in most of the popular Super-Heterodynes today.

(3) The grid condenser and leak method of detection is more sensitive than the grid bias method. On extra loud signals the grid bias method is preferable. Therefore many designers use the grid leak and condenser method for the first detector and the grid bias method for the second.

(4) Regeneration is not usually advissable in a well-designed Super-Heterodyne where an adequate number of tubes has been used to attain sensitivity and selectivity.

* * *

I AM building a B eliminator, using a full wave filament rectifier tube. I wish to have three variable outputs, one being for the audio tubes, another for the RF tubes and one for the detector. When installing, will it be necessary to connect 1 mfd. fixed condenser from each B plus output lead to the B minus post?

(2)—No provision is made in the diagram for a fuse. I wish, however, to install one. Could a 5-ampere type be used?

(3)—Some friends told me that I should place the condenser block away from the rectifier tube. Is this necessary?

GERALD CARDON, San Francisco, Calif.

(1, 2 and 3)—Yes, on account of the effect of the tube's heat on the wax in the condensers.

* * *

IN THE Aug. 20, issue, page 15, there is a circuit diagram employing a radio frequency choke coil Ch. What are the characteristics of this coil? Coils as high as 85 millihenrys have been recommended in this position, but it seems to me that this value is much too large. Will you give me your opinion?

SIEGFRIED BAUER, Milwaukee, Wisc.

The RF choke used has a natural period of 300 meters and an inductance of 3½ millihenrys. Radio frequency chokes of a larger inductance should not be used, for when a larger inductance choke is used in the plate circuit of the detector tube, while suppressing the RF currents, it will also offer an impediment to audio currents. This is highly undesirable, for it results in poor reproduction of the higher musical notes. It might also occasion violent squealing. Therefore select a choke having an inductance of less than 5 millihenrys (Ch.).

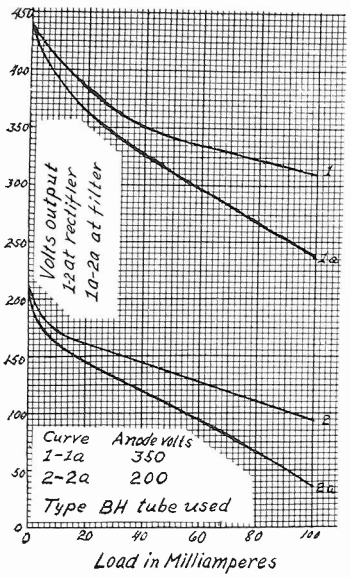


FIG. 562
Typical regulation curves of the BH Raytheon rectifier and filter. Requested by Patrick Feeny.

WHAT IS MEANT by the regulation curve of a B battery eliminator? Will you kindly publish the regulation curves of typical rectifiers?

—PATRICK FEENY, Boston, Mass.

The regulation curve of a rectifier or eliminator is a graphical representation of the voltage output for various current values taken from it, called load current. For example, the voltage when the current is 20 milliamperes may be 150 volts, and when the current is 80 milliamperes the voltage may be 75 volts. The regulation curve would pass through these points on the graph. Figs. 562 and 563 give typical regulation curves. (See p. 22).

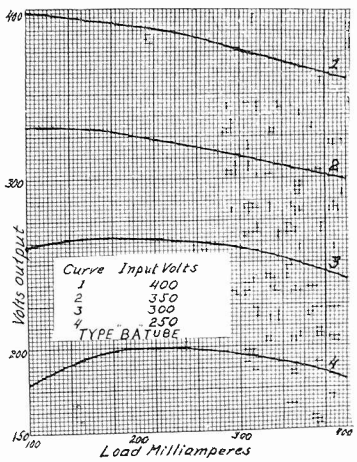


FIG. 563
Typical regulation curves of the Type BA Raytheon tube

TELL YOUR NEWSDEALER

to save you a copy for each week you are away on your vacation, so that when you return you will have a complete file of Radio World. If you require any summer numbers of this paper, send 15c for each issue desired to Circulation Manager, Radio World, 145 West 45th St., N. Y. C.

(*Concluded from page 21*)

WHICH IS BETTER, resistance coupling or impedance-resistance in an audio frequency amplifier?

(2)—Does resistance coupling give better quality than impedance-resistance coupling?

(3)—Which of the two types of coupling gives the greatest volume?

(4) Which of the two methods is more subject to motorboating?

—ERIC DAHLBERG, Chicago, Ill.

(1)—There is little to choose between these two types of amplification. Impedance-resistance does not amplify the lower tones quite as well as the pure resistance method of coupling.

(2)—On the whole, resistance coupling gives slightly better quality, when the circuit is working properly, and a good speaker is used.

(3)—The impedance-resistance gives more volume because the amplification per stage is greater in this type of circuit.

(4)—Pure resistance coupling is more subject to motorboating. The reason for this is that this type of circuit amplifies the low notes better, and it is on the low notes that motorboating is most troublesome.

* * *

WHEN I disconnect the B battery lead to the radio frequency tube the signals still come in with good volume, but when I disconnect the antenna the signals go away down. What causes this and what can I do to stop it?

(2) When I turn the tickler up in my Diamond of the Air there is a loud whistle. This starts long before the volume is loud enough to satisfy. The circuit is also very sensitive to body capacity. What causes this misbehavior of the receiver and what can I do to correct the trouble?

(3) How many amperes should there be in a 45-volt B battery?—ELBERT JONES, Olympia, Wash.

(1) The signal strength in this case is due to electro-static coupling between the first and second stages. Some of the coupling is due to the capacity between the grid and plate of the first tube and some is due to the capacity between the tuning condensers and coils. It is not detrimental unless it causes uncontrollable oscillations in the receiver. If it does, a neutralizing condenser between the grid of the detector and the grid of the first tube will help.

(2) These are the usual symptoms of an open grid. The grid circuit may not be properly connected to the filament circuit, or the grid leak may be defective. If the grid leak has too high resistance the circuit will behave the same way.

(3) Batteries are not rated by the number of amperes, as this does not mean anything. They are rated in volts and in ampere-hours. A fresh B battery rated at 45 volts usually measures 46 or 47 volts. When the reading is down to 37 volts it may not be advisable to keep the battery in the circuit. When an ammeter is connected directly across the battery terminals of a fresh dry cell B battery the reading should be about 30 amperes. It does not affect the reading how many cells are short-circuited in this way. One cell gives 30 amperes and 100 cells give the same reading. When a dry cell battery is "down" the reading on the ammeter might be as low as a few milliamperes. Never test a dry cell battery with an ammeter. Use a high-resistance voltmeter and measure the voltage when the battery is working, or immediately after it has been working for some time.

How Many Tubes for A Super-Hetrodyne?

We have heard of Super-Heterodynes from three to twenty-four tubes. Circuits of this type having less than six are freaks. Circuits having tubes counted by the score have been built by freaks. Circuits having from six to twelve tubes are more or less practical, depending on the details of the design. The Victoreen Super-Heterodyne had eight tubes in the beginning, it has eight tubes now, and it will no doubt have eight tubes in 1929, 1930, etc. It would be a simple matter to drop a tube from this circuit. It would be equally simple to add one or two tubes. But what is not so simple is to change the circuit and gain anything thereby. The circuit can drop a tube and be less sensitive, it can add a tube or two and still be less sensitive than it is now. Besides, adding a tube or two would upset the delicate equilibrium. The designers have gone very carefully into the question of improvement by changing the number of tubes. They decided to leave the number of tubes at eight and retain the equilibrium and the optimum practical sensitivity.

Just why cannot the number of tubes in a practical Super-Heterodyne be increased indefinitely? There are many reasons. One is the static or noise level. Another is the limit determined by the tubes used. Still another is the limit set by the listener. And still another is the limit set by the inherent tendency of multi-stage circuits to oscillate as they see fit.

The useful sensitivity in any case is set by the noise level. Suppose we set out DX hunting on a particularly propitious evening. Weak though the noise may be when listening to local stations there is some about even on the best day. When we increase the sensitivity of the set until a station four thousand miles away is tuned in, the noise comes in with it. The noise may be louder than the signal. If the signal cannot be interpreted through the noise there is no point in listening to it. Hence we tune in some closer station, and much of the sensitivity of the set is of no use.

The tubes used in the last stages of the receiver can only handle a certain amount of power. Hence there is no point in increasing the sensitivity of the set just to get more volume. Again, if we increase the size of the tubes to handle all the set will give them, the limitation comes with the listeners. They can only stand a certain amount.

The principle limitation lies in the tendency of multitube sets to oscillate. Although there are many methods of stopping oscillation in amplifiers, none of these is applicable to an unlimited number of tubes. Do what you will, the multitube circuits oscillate. The only way to stop multitube amplifiers from oscillating is to reduce the amplification of each tube to a point where the total amplification in the circuit is about the same as it would have been with fewer tubes in the circuit, correctly adjusted. The advocates of a multiplicity of tubes add a tube to boost amplification and then they are forced to add something else to do away with as much gain as was contributed by the extra tube.

The objection to the use of high voltages on the ground that they are difficult to obtain holds no longer, now that eliminators are available. It is no more difficult to make an eliminator delivering 400 volts than one delivering 200 volts. They are made and they will soon be regarded as standard.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD: 1926-1927:

1926

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.

Oct. 23—The 5-tube P. C Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard by Lewis Winner.

Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.

Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson.

Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.

Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.

Dec. 4—The regenerative 5-tube Set, by Cap. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack.
Winner's DC Eliminator, by Lewis Winner.

Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson.

Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3) The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat, by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack.

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.

Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt P. V. O'Rourke. The 5-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.

Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.

Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gribben.

Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard, (Part 2)

Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.

Mar. 26—The Universal, by Herman Bernard, (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.

April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 3-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)

April 9—A 5-tube Shielded Set, by Herbert E. Hayden. The Power Compact, by Lewis Winner. The Nine-in-Line Receiver, by Lewis Rand. (Part 2.)

April 16—The Schoolboy's Set, by Wally Frost. The Melo-Heald 11-tube Set, by Herbert E. Hayden. The Nine-in-Line Circuit (Part 3), by Lewis Rand.

April 23—The Melo-Heald Set, by Herbert E Hayden (Part 2). The Nine-in-Line, by Lewis Rand. (Conclusion). How Frequencies Are Cut-off, by J. E. Anderson.

April 30—A 1-tube Portable, by Jasper Jellicoe. A Ship Model Receiver, by Smedley Farnsworth. A Double Three Foot Cone, by W. H. Sinclair.

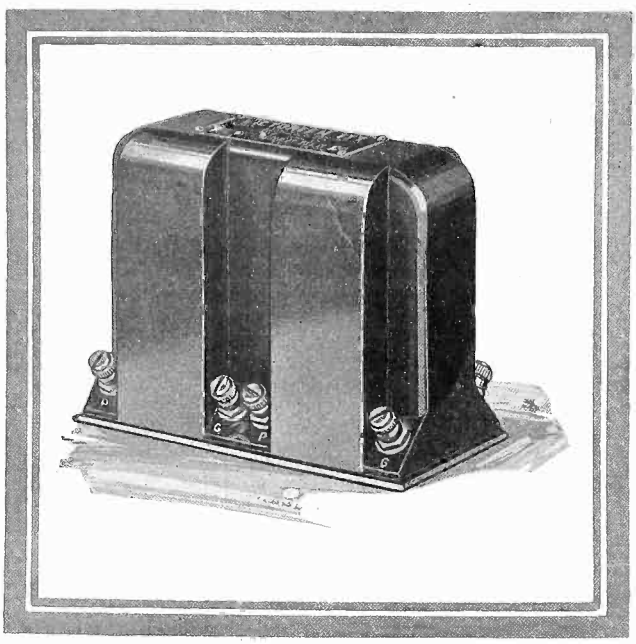
May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Superheterodyne Sets, by John L. Barrett.

May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).

May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. A Low-Pass Filter, by J. E. Anderson.

May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

Any copy, 15c. Any 7 copies, $1.00. All these 32 copies for $4.00, or start subscription with any issue. Any 7 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed. RADIO WORLD, 145 West 45th Street, New York City.



A New Intimacy With Your Favorite Stations

Reception so amazingly faithful as to feel the musicians' presence is the newest achievement from the laboratories of Victoreen.

Perfect reproduction throughout the entire musical scale, from the deep throated bass notes of the pipe organ or bass viol to the higher harmonics of the violin, a clarity of tone vividly true to the original rendering—these are no longer hopes, but accomplished facts in the new

VICTOREEN 112—Audio Transformer Unit

This compact unit, combining two Audio stages, using 2 "112" Tubes with plate voltages up to 400, may be incorporated in practically any radio set with vastly improved results.

Truly, it is unfair to judge your set until this remarkable unit is installed.

Price $22.00 at Your Dealers

1928 Victoreen blue prints showing proper installation of the 112 Audio unit now ready for free distribution.

The GEORGE W. WALKER Co.
MERCHANDISERS OF VICTOREEN RADIO PRODUCTS
2825 CHESTER AVENUE CLEVELAND OHIO

SUPER QUALITY RADIO PARTS

Victoreen