RADIO BROADCAST

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DECEMBER, 1925
Vol. VIII, No. 2

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BEHIND THE EDITORIAL SCENES

THE new and enlarged RADIO BROADCAST has met with almost universal favor and its reception was even more hearty than the publishers had dared hope. In New York City alone, the supply of the November number was exhausted four days after it was placed on sale. Copies of the number are so rare that we haven't more than three copies in the editorial offices for our own use. Letters from readers all over the country have been most generous in praising the appearance and contents of the November number.

ROBERT H. MARRIOTT, whose article, "How Radio Grew Up" leads this issue, is one of the old men of wireless in the United States. He was the first president of the Institute of Radio Engineers, was one of the first radio inspectors to be appointed after the radio law of 1912 was passed. For a long time he was expert radio aide at the Bremerton Navy Yard, Washington, and is now a consulting radio engineer in New York. . . . Edgar Felix, who writes about short waves in this number, was for several years publicity representative of station WEAF in New York. Glenn H. Browning, who with his inseparable technical partner, Mr. F. H. Drake, has become nationally known for the Browning-Drake receiver, describes a great improvement over the early model in this number. Both Mr. Browning and Mr. Drake are familiar figures around the famous Cruft laboratory at Harvard University, where much of their work has been done. The valuable current periodical surveys, made by E. G. Shalkhauser, the first of which appeared in our November issue, are continued in this number. Many readers have written us saying that these condensed surveys of the important articles appearing in this magazine and in our contemporaries are of great value to them.

THE January RADIO BROADCAST will contain an article by Arthur H. Lynch telling how to build "RADIO BROADCAST's Universal Receiver." The set he describes is an unusual and very efficient combination of standard parts and it is doubtful if there is any receiver its superior in point of sensitivity and quality. It is not a "freak" outfit in any sense. Kendall Clough of Chicago will have an article about the principles of audio amplification which is of particular interest. The author weighs and casts aside some of the commonly accepted theories of amplification. We believe the article will attract a great deal of attention. Mr. John Wallace of Evanston, Illinois, will from now on write the "Listeners' Point of View." With his central location, Mr. Wallace is able to hear broadcast offerings in almost every part of the United States and Canada. Our new broadcast critic is an unusually versatile person, for he is a writer of great charm and not a little wit, as well as an artist of considerable ability. In his college days, his drawings and humorous "pieces" appeared in the Cornell *Widow*.

THE advertising pages of the magazines of the "Quality Group," that is, the *Atlantic Monthly*, *Harpers*, *Review of Reviews*, *Scribners*, and the *World's Work* now contain only the announcements of those radio manufacturers whose products have been tested and approved by the Laboratory of RADIO BROADCAST. Readers of those magazines who are not well versed in matters radio have the privilege of calling on the technical staff of this magazine for help and advice.

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Radio IS marching forward, this season as before. But it is marching in a new direction.

Quality of Reception.

That is the big, new theme. And the new Jewett Receiver is its inspiration.

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Mere words cannot describe this new Jewett Quality of Reception. You must *hear* and understand.

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The Jewett Superspeaker Console

—A handsome cabinet with Superspeaker performance.

The Jewett Cone

—Faithful in tone and pitch regardless of heat, cold, or dampness. Semi-adjustable.

The Jewett Vemco Unit

—Makes a loud speaker out of your phonograph.

The Jewett Parkay Cabinet

—Puts the amateur on a par with the most exclusive cabinet worker.

The Jewett Micro-Dial

—Makes tuning 50 times as accurate. Fits any standard receiver.

The Jewett Superspeaker Highboy

—Houses any standard Radio set and all batteries. Superspeaker built in.

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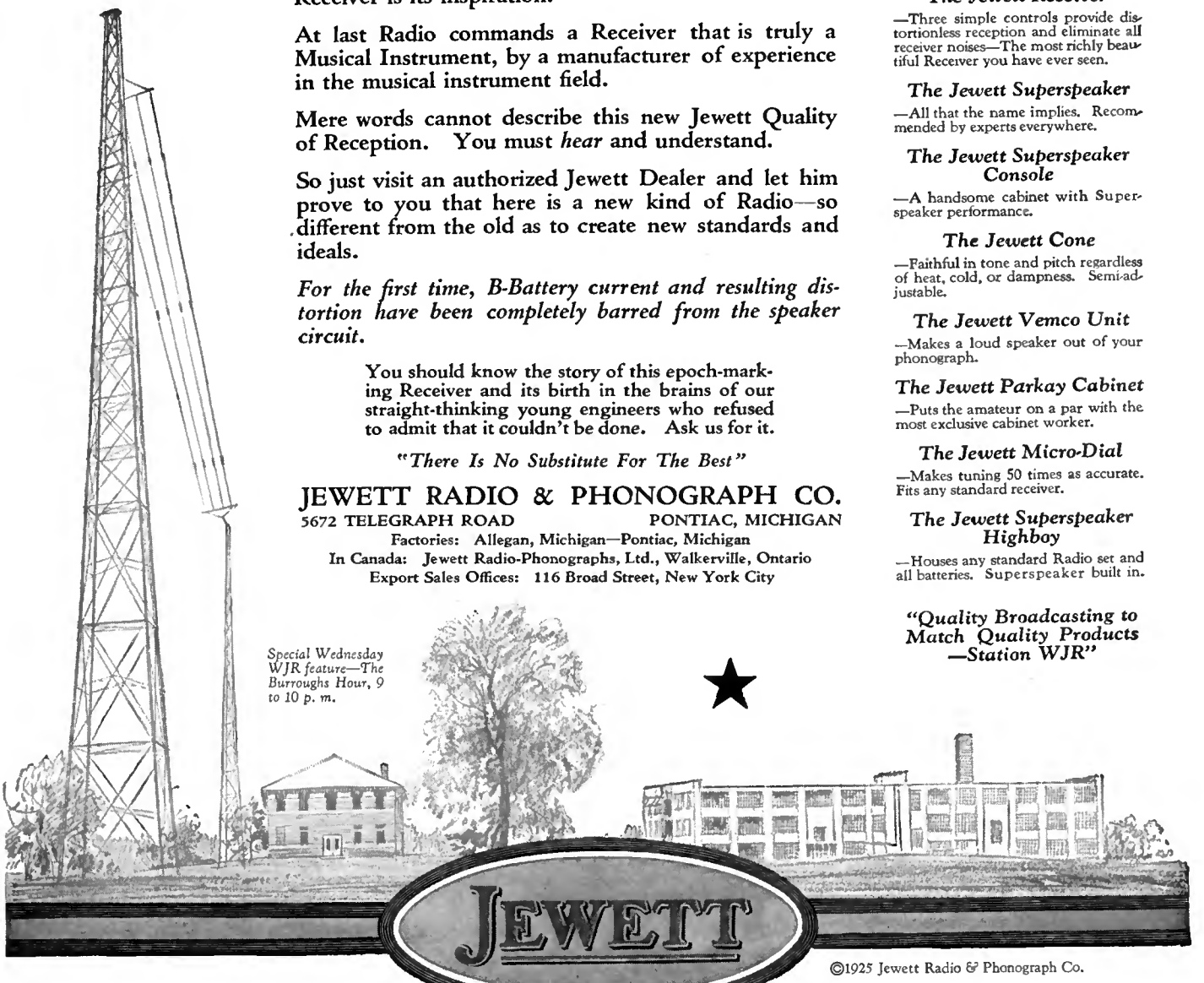

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RADIO ENTERS THE CLUB

The installation at the Cornell Club in New York City. The Western Electric super-heterodyne with peanut tubes is shown in the top view at the left. A four-tube amplifier below intensifies the energy which is supplied to the loud speakers on the panelled walls of the various rooms. Employees of the Club are shown listening to the first test of the equipment. A public address system is also installed. Microphones pick up the speeches which are carried to all parts of the club through the loud speakers

RADIO BROADCAST

VOLUME VIII NUMBER 2

DECEMBER, 1925

How Radio Grew Up

Many Little Known Facts About Radio Development are Related—Here Is the First of a Series of Articles on This Subject Written by a Pioneer in Wireless

By ROBERT H. MARRIOTT

First President Institute of Radio Engineers

REPEATEDLY during the last one hundred years, radio has been referred to as new, which has had the result of making people come to the conclusion that it must be new. This is, of course, very confusing, and is due no doubt to the fact that certain inventions and inventors have been overrated while others have been forgotten. Human love of fairy tales makes it easy for a man or a corporation with money to refer to a certain individual as the great one who has done all of the wonderful things that have been done. Money getters, too, take advantage of that love of fairy stories to fill their pockets.

Haywire, halos, and haymakers have characterized many of the early careers in radio. Inventors and would-be inventors built haywire apparatus. Promoters built press agent halos around the alleged inventors and their haywire products. Some of the hay went to develop radio and a lot of it went to whoever received the stock jobber's money. Sometimes promotors became so extravagant in the claims about an invention that the inventor himself would be found to disclaim some of the things that he was purported to have done, and to give the credit to others. Such a procedure was, of course, just what the promoters wanted, and they immediately got their press agents and after-dinner speakers on the job, in order that they might tell how modest and generous the inventor was, and thereby stud his halo with the pearls of modesty and generosity.

Homage is due to many rather than to a few. Many radio developers have received little compensation for their work in the past and they are not in a position to collect now. The public owes a debt to many people which it cannot pay. Some of those people need the money, others do not; some are dead while those still alive do not expect to realize anything on their past labors.

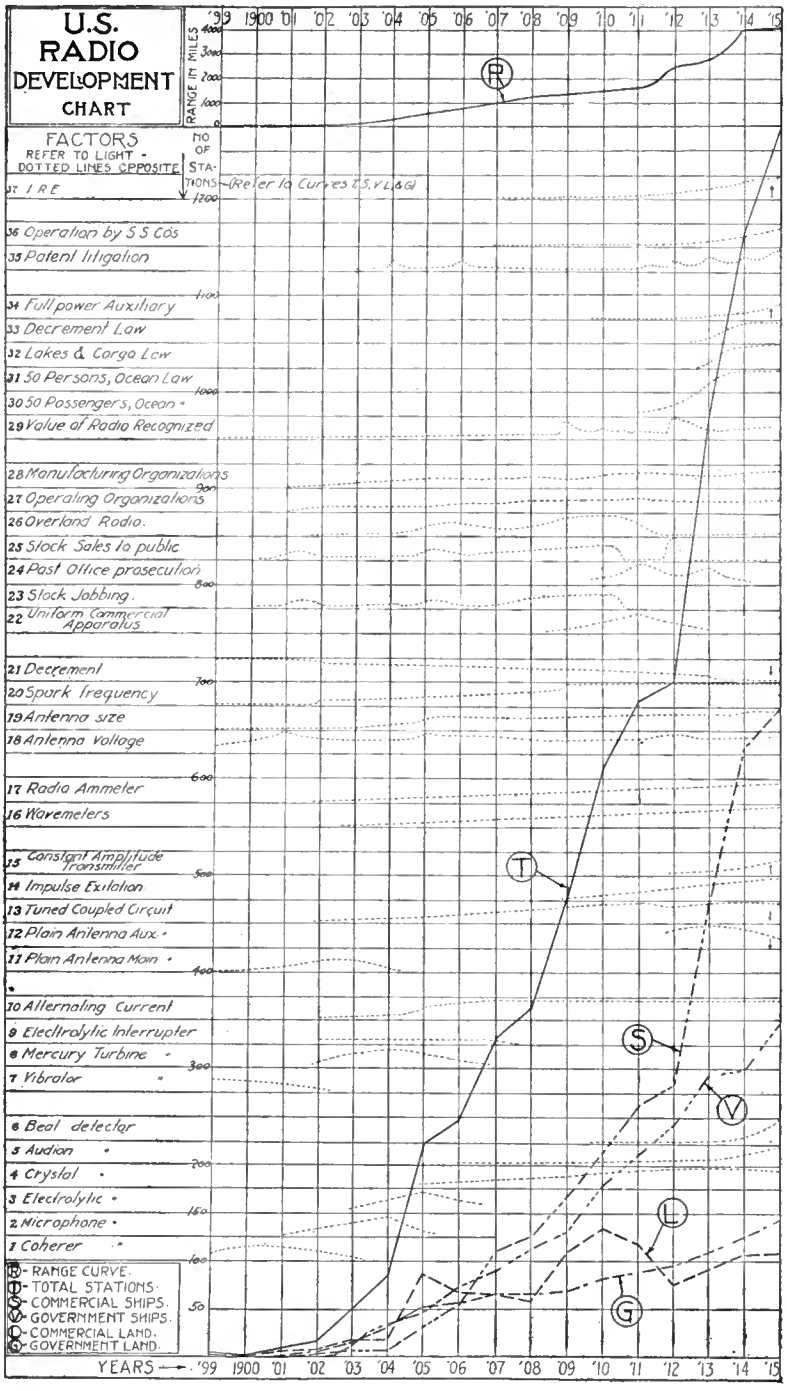
A PORTABLE SET, 1901 MODEL

Mr. Marriott operating a portable transmitting set. Note the ground plate on the floor. With an outfit about the same size as this, using vacuum tubes as the radio generating device, signals are being sent by amateurs using code, for tremendous distances. The Laboratory of RADIO BROADCAST recently communicated with the U. S. S. *Seattle* as she was leaving Tahiti in the Pacific ocean. A five-watt tube was used as a transmitter for this remarkable communication

The changes in radio development may often be traced to unexpected causes. For example, the United States Prohibition Act seems to have played a somewhat important rôle in the recent stimulation of radio broadcasting. Volstead's unintentional creation of laborious home brewing and the attendant substitution of inconvenient bootleggers for bar tenders, has apparently been an important step in the development of radio, because it suddenly has shut off from the public a very convenient means of spending their money. Now these baffled people are looking for other outlets. Broadcast receiving has supplied that demand, and its problems present a new field in which alcohol-free brains may engage.

Not only is radio history valuable as a thing of interest, as educational, and as a precedent for use in planning the future, but it is valuable in other ways. I was recently examined and cross-examined for three days about historical radio devices, for evidence in a radio suit. I believe the suit was for several millions of dollars. At any rate the amount was so interesting that two lawyers and an expert traveled across the United States and back to get my testimony.

The lawyers' questions and my answers in that testimony took up more words than I am using in this whole series of articles. The testimony was relative to only a few historical devices which had their origin from 1899 on, while I am striv-



HOW WIRELESS DEVELOPED

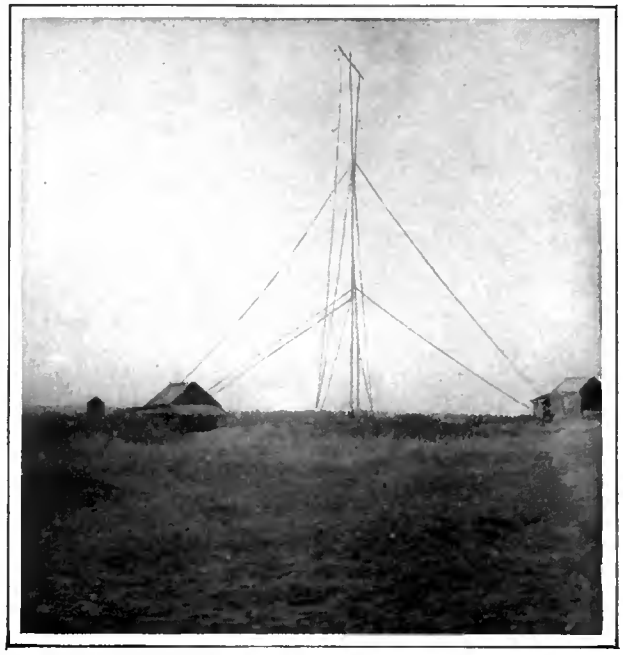
One of a number of charts presented by Mr. Marriott in a paper published in the *Proceedings of the Institute of Radio Engineers* for June, 1917, showing graphically the rise and decline of the various radio factors. For example, the electrolytic detector, No. 3 in the charts, came into use about 1902, was the leading detector about 1905 and then gave way to crystal detectors, No. 4

ing in these articles to outline the more interesting points in the development of radio since about 1790.

Starting on our outline of radio history then, we find that Galvani got a "radio kick" out of frogs' legs even before 1790; De Salva wrote a recipe for a "wireless" in 1795; Morse built a "wireless" which worked across narrow bodies of water in 1842; Maxwell wrote a theory for radio in 1867; Loomis patented a "wireless" in 1872; Hughes made and used a radio in about 1879, but he only let a few friends in on it; Professor Dolbear patented one in 1886; Hertz made a tuned radio system according to Maxwell's recipe in 1886, and that development led others in our radio of today.

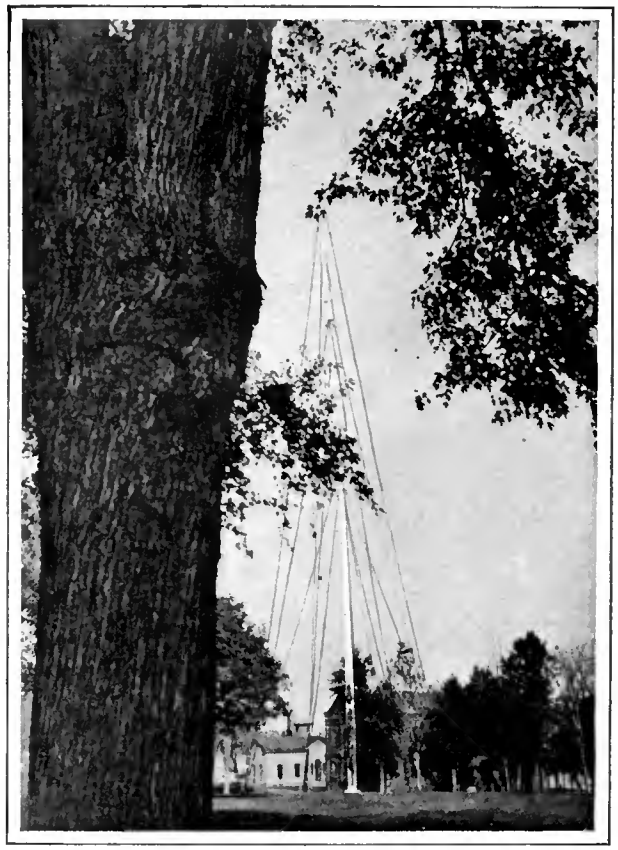
MARCONI EXPLOITS RADIO

RADIO had been thus brewing since the 18th century. By 1895 it was ready for exploitation, by which I mean that it was ready for sales engineers, exploiters, promoters, advertisers, and others. Marconi demonstrated the more or less academic radio instruments to some politicians, army men, and money getters at this time. He played the part of a demonstrator and sales engineer. A money getting company was then formed



A VERTICAL ANTENNA

About the year 1900, vertical antennas were quite popular for land stations, but as wireless became more general and the installations more elaborate, the flat top horizontal type was almost universal. It is interesting to note that now, for short wave transmissions, amateurs and others are returning to the vertical antenna



AT ANNAPOLIS

How the wireless towers looked when the picture was taken on October 25, 1902. On this day, some history was made, for, using this equipment, the Navy made its first record of about 50 miles by wireless from this equipment to a ship. Fifty miles, with the equipment known then was an extraordinary distance

which, in attempting to obtain a monopoly, set out to advertise to everybody that Marconi was the inventor and that they owned that patent on wireless which entitled them to a monopoly in America and other places. That was not, of course, true, but he did advertise wireless and to him is due the credit for having started the development of radio in many different parts of the world.

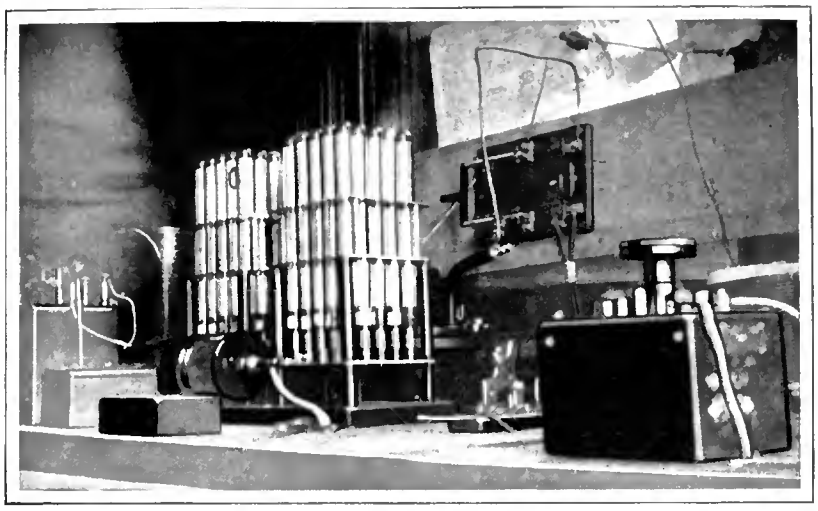
By 1900 radio had edged itself into the market as a mild public service. It continued as a tonic and stimulant for business, for military purposes, and for life saving. To obtain plenty of radio equipment for recent war purposes greater quantities of money and effort were suddenly put forth. In 1921 a radio by-product called broadcasting began to take on. Now it is a principal product, a product that sold for about $350,000,000.00 last year. That is a very brief outline of some of the more important events in the history of radio.

Luigi Galvani was an Italian anatomist and he got the kicks from frogs' legs when he put them near an electric spark. Nowadays we would call his spark maker a radio transmitter while the detached frogs' legs acted as the radio detector. Therefore he must be credited with having made a genuine radio experiment one hundred and thirty-five years ago. The distance between the spark gap and legs must have been only a few inches or, at most, a few feet, and at that time the whys and wherefores probably were not realized.

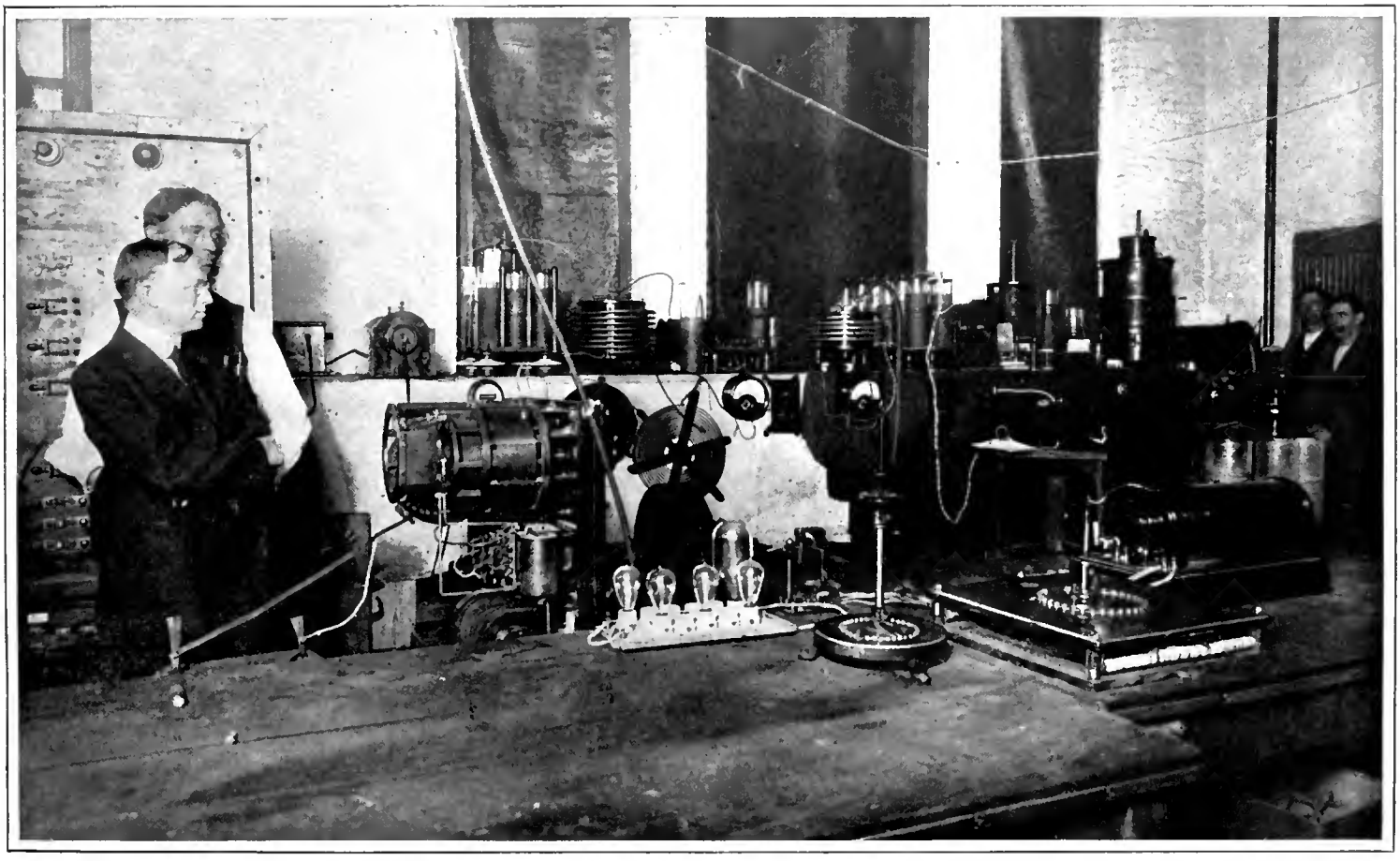
On December 16, 1795, De Salva, a Spanish physicist, read a paper before the Academy of Sciences at Barcelona in which he said: "One could, for example, arrange at Mallorca an area of earth charged with electricity, and at Alicante a similar space charged with opposite electricity, with a wire going to, and dipping into, the sea. On leading another wire from the sea shore to the electrified spot at Mallorca, the communication between the two charged surfaces would be complete, for the electric fluid would traverse the sea, which is an excellent conductor, and indicate by the spark the desired signal."

If Salva's scheme had worked as he said, it would have been wireless, but not radio. He specified for the flow of a direct current from one station to the other, rather than waves composed of combined magnetic fields and condenser fields such as are radiated from one radio station to another. However he had the idea of establishing wireless communication. Therefore the idea of wireless communication by electrical means must be at least one hundred and thirty years old.

In 1831, Faraday demonstrated electro-



INTERIOR OF THE OLD ANNAPOLIS STATION



A GALLERY OF TRANSMITTING APPARATUS

In use between 1899 and 1915 set up in the Brooklyn Navy Yard. Mr. Marriott, at the left in the photograph, was the expert witness in a case tried before a United States judge in 1915. In the foreground, to the right, is a ten-inch induction coil, with separate vibrator. This was connected directly to the antenna and was popular until about 1906. Various kinds of glass jar transmitting condensers can be seen. The inductances, of large wire, are "oscillation transformers" and coupled the oscillating circuit, consisting of spark gap and condenser, inductively to the secondary circuit which had taps leading to antenna and ground. This is a most unusual historical photograph

magnetic induction. He showed that making current start and stop in one circuit would cause currents to flow in a circuit parallel to it, although there be no connecting wires between the two circuits. That was a kind of wireless, but it is not classed as the kind of wireless we call radio.

Professor Samuel F. B. Morse, of the United States, telegraphed across narrow bodies of water in 1842, by installing a ground return transmitter circuit along one bank and a ground return receiver circuit along the other, without any wires between the sender and receiver. His, again, was not radio communication but it was wireless communication. He not only had the idea of communicating without using wires between the transmitter and receiver, but he did actually telegraph with success that way. The currents between the points at which he connected his transmitter are supposed to have wandered across the stream and through the wire that connected the two points of ground or water contact of his receiver. That was a kind of wireless that worked, and it worked more than eighty years ago.

The electromagnetic theory, which is our present accepted theory of radio wave propagation, is said to have originated with William Clerk Maxwell, a noted Scotch physicist in about 1867, and it was published shortly after that time.

LOOMIS UTILIZES STATIC FOR SENDING

JULY 30th, 1872, patent number 129,971, was issued to Mahlon Loomis, dentist, of Washington, District of Columbia. The following is quoted from the patent.

What I claim as my invention or discovery, and desire to secure by Letters Patent, is—The utilization of natural electricity from elevated points by connecting the opposite polarity of the celestial and terrestrial bodies of electricity at different points by suitable conductors, and, for telegraphic purposes, relying upon the disturbance produced in the two electro-opposite bodies (of the earth and atmosphere) by an interruption of the continuity of one of the conductors from the electrical body being indicated upon its opposite or corresponding terminus, and thus producing a circuit or communication between the two without an artificial battery or further use of wires or cable to connect the coöperating stations.

Stating the Loomis claim briefly and in present day language; if you put up an antenna where it will get atmospheric charges, and interrupt the flow of current from the antenna to ground, you can send messages. If the atmospheric voltage is high enough so that the sparks from antenna to ground will jump a gap of one inch, it would be possible to send messages more than a hundred miles to a present day receiver. However, the atmospheric voltage is not reliable for telegraphing, because conditions vary widely in different locations and at different times. Unless you use a sensitive galvanometer you might be unable to detect any voltage on your antenna, the day you read this. On the other hand, it is not a safe thing to try, carelessly, because you might get too much voltage, especially just before a rain storm.

That arrangement as described by Loomis, has worked for me many times in years past and in fact I am experimenting with such a device at present. I am using the system to find out things about the unidentified noises that interfere with radio receiving, and about fading and static. The one I am working with now is interrupted by a little copper water wheel. When the voltage is low the current only discharges from the antenna through the longest paddle of the wheel. When the voltage is high it jumps to all four. Some of us can hear it click at our receiving stations and get an idea of what is happening in the atmosphere.

An observer might record the area and movement of high voltage atmosphere by setting up numerous Loomis antennas, with clock operated spark gaps having differently timed interruptions, in a large circle around him and his receiving apparatus. Weather scientists may find this suggestion useful.

From observations made with this kind of an arrangement, it seems that some of the interference one hears on a broadcast receiver is probably due to the atmosphere charging insulated conductors to such a high voltage that the charge jumps over to earth in one spark which produces a click, or many sparks, that produce grinding, buzzing, or sizzling noises. The conductor in question might be a guy wire, fence wire, power wire, or something else. If electric power follows those pilot sparks to earth, you may hear an alternating current or commutator hum. Falling rain may contribute both voltage and moisture, causing a power circuit to leak over insulators.

I am not an inveterate story reader, but so far as I know, fiction writers have overlooked the possibilities of the Loomis antenna. All their hero or heroine needs for wireless salvation are the right weather conditions, an elevated conductor and the radio code. The villain might even grab the conductor and get a static knock-out. Loomis was away ahead of his time. His patent was not only for communicating without wires, but for taking the electricity to do it with from the atmosphere. He apparently did not reason according to the radio theory, but the idea he patented certainly works that way. He wanted to make static send messages. He probably imagined wonderful possibilities "via static," but I daresay he didn't go so far as to imagine then that the new baby across the street was destined to make money from automobiles; move (he might even fly) to Southern California to a place called Los Angeles and there buy a winter home for a fabulous sum, retire and spend his time playing Mah Jongg or working cross word puzzles, and maybe even drinking home brew while listening to Washington jazz delivered without "wires," in 1925.

"HIGH POWERED" EQUIPMENT—IN 1903

The ten-inch induction coil which was standard during the early years of wireless as the transmitter. Nothing was simpler than the circuit used. About twenty volts was supplied to the primary of the coil and some eighty or a hundred thousand volts were produced between the electrodes the operator is adjusting. Ships and shore stations alike used the coils and sharp tuning was unknown. Those were the days when no one knew exactly what wavelength he was using and didn't care. The few wavemeters in existence were objects of curiosity in almost inaccessible laboratories

FIG. 1

A collection of modern tubes, nearly all of which are designed for the second audio stage where so much distortion due to overloading now occurs. The power tubes illustrated in this photograph are Western Electric 216-A, UX-112, UX-210, UX-120, UV-202, Cleartron, and Heliotron. The small "peanut" tube is the Western Electric "N" tube, and in the photograph are two tubes designed for resistance-coupled amplifiers, the Daven "MU-20" and the High Constron. Daven also makes a power tube known as the Daven "MU-6."

Tubes: Their Uses and Abuses

How to Use the Standard and the Latest Tubes to Attain High Quality in the Radio Receiver—Some Little Known But Easily Applied Facts of Increasing Importance About Audio Amplification

By KEITH HENNEY

Director, **"Radio Broadcast"** *Laboratory*

THE development of the vacuum tube has placed in the hands of engineers and scientists—and radio listeners—one of the most versatile and useful devices that has resulted from man's ingenuity. The applications of the vacuum tube device are so diverse and so important that it is indeed the modern "Aladdin's lamp."

Vacuum tubes in the early days were not what they are to-day. Any one who remembers trying to hook up two of the old "tubular" tubes into a two-stage amplifier knows that. Amplifiers in those days were practically unknown. Tubes did nothing but oscillate, and quite often not much of that. All receiving was done by "beats," that is with the tube oscillating and the circuit tuned so that a slight difference of frequency existed between the incoming signals and those generated in the tube itself. Operators read the signals by these difference notes.

Tubes were not pumped (as highly evacuated) as hard as they are to-day. No two were alike. Some had grids on the outside of the glass bulb. Often amateurs used a complicated system of permanent magnets placed about the tube so that the electrons would be drawn from the filament at a faster pace. All in all, modern radio listeners have a lot to be thankful for.

Tubes to-day are fairly uniform. If you buy a 5-volt tube you know that its characteristics will be such and such within fairly narrow limits. This means that you can interchange tubes with out "spilling the beans." Some manufacturers of tubes take particular precautions to have their tubes all alike and in RADIO BROADCAST Laboratory, a consignment of tubes from one manufacturer have been tested that were all alike—all twelve of them—and they were not specially picked, either.

Tubes in radio communication serve several special purposes, but to the listener there are two services which are of paramount importance, detection and amplification. And like all delicate apparatus, there are certain conditions under which they must be operated to get best results. It is the purpose of this article to deal with those best operating conditions and to attempt to point out a few noteworthy ideas in the design of radio receiving equipment that utilizes vacuum tubes as the central piece of apparatus.

SINCE the basic patents on the vacuum tube expired some months ago, there has been feverish activity among many manufacturers, and many new names have appeared on the market. The result is that a goodly number of experimenters are a bit at sea; tubes with capabilities quite beyond any of the previous well known types are available and many fans are groping for real information about them. The far sighted manufacturers who brought out the new tubes, the power type in especial, deserve much praise, for they have added infinitely to the acoustical refinement of radio. This article, we believe, contains some suggestions which will be highly valued by those experimenters who follow them. It is a plea, in short, for our audio amplifiers to be properly planned. By far the greatest number of radio experimenters use every tube they have in the conventional way: 90 volts on the plate and the rated filament voltage. The author, who by the way, knows a great deal about high quality in audio circuits, shows how the amplifier can be correctly planned—which appears almost to be a new idea.—THE EDITOR

HOW THE TUBE OPERATES

IT IS not necessary for the reader to know much of the theory of vacuum tube operation. It is sufficient if he knows that within the glass tube there are three metallic elements, a filament which lights up when you turn on the A battery, a grid which acts as a controlling valve for the plate current which flows from the third element, the plate, around through the B battery and back to the filament.

The filament emits electrons, according to the language of the physicist, but in ordinary terms, these building stones of all matter are actually boiled off the metallic filament when it is heated to a certain temperature.

These electrons are negatively charged and move toward the positively charged plate with a certain velocity depending on various controlable factors.

The grid is situated between the filament and the plate and is made of a mesh arrangement so that the electrons can go between its meshes

on their way toward the plate. If the grid is negative it repels electrons and less plate current flows; if it is positive, it draws more electrons from the filament out into the space of the tube and the plate current increases. In this way the grid is essentially a controlling element.

DETECTOR THEORY AND PRACTICE

THE theory of detection is complicated and will not be described here. It is only necessary to say that 45 volts on the plate of the detector is about the correct value with modern highly pumped tubes; that the grid return should be connected to the positive side of the filament; that for grid condenser-leak detection, the proper values seem to be about .00025 mfd. capacity and two megohms, although other values may be used; that there is little use in using a C battery detector unless very powerful signals are to be received, say in the second super-heterodyne detector.

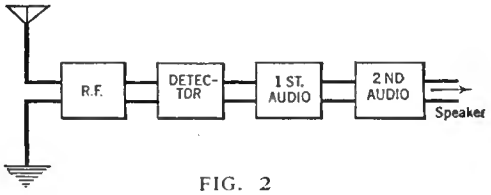


FIG. 2

Signals from an antenna go through several electrical devices before they finally emerge from a loud speaker. This illustration shows the path of these signals. At the input and output of each amplifier the voltages and power levels differ, increasing as the signal approaches the loud speaker

Often a detector that will not work on 45 or even 22½ volts B battery will work very well indeed on 12 or thereabouts. If regeneration is not smooth, that is, if advancing the tickler, or the condenser in capacity feedback systems, is accompanied with growls and low frequency clicking noises, the trouble lies in too much tickler, wrong grid leaks, or too much B battery. The tube should slide into operation without fuss, and if it does not, something is wrong. With low loss receivers, not much tickler is needed. The higher the resistance of the coil into which regeneration is being introduced, the more tickler will have to be used and the more erratic will be the operation.

There is one point that may be mentioned here. It is a common statement that there is no necessity for low loss circuits in regenerative receivers since the addition of regeneration reduces the resistance of the circuit. Regeneration does reduce the effective resistance, making tuning sharper, and receiving more selective. If the receiver suddenly begins to oscillate after the regeneration has been set say when a crash of static comes along, or some loud signal, the operator can look for a high resistance circuit in which the tuning is broad until much regeneration is added. Then it is time to read up on low loss circuits.

The use of low resistance grid leaks, say one half megohm, will improve the quality of music received but on the other hand, low valued grid leaks will cause some loss in volume—which may be made up in the audio amplifier.

Various methods of obtaining regeneration in a detector circuit have been described (see RADIO BROADCAST for October) and all produce the same results. Increased signal strength, increased selectivity, and, if it is pushed too far, decreased quality.

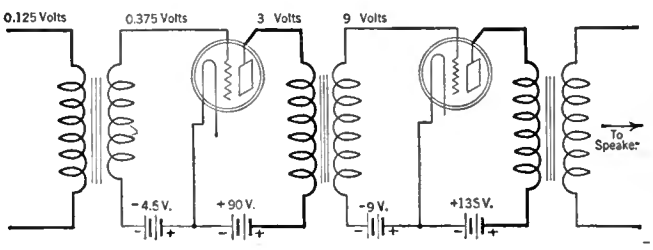


FIG. 3

A two-stage audio amplifier and the voltages that must appear at various points along the circuit if the full output of the last tube is to be delivered to the loud speaker. If lower voltages are delivered the volume will be "down." If more than nine volts peak are applied to the grid of the last tube, overloading will occur and a cone type loud speaker will, in popular parlance sound, "awful"

AMPLIFIERS: RADIO AND AUDIO

THERE is little that one can do to a detector tube or detector circuit beyond what has been mentioned above. When it comes to amplifiers, however, there is much to be said, and many false notions to be discussed.

There are two kinds of amplifiers in the usual radio receiver, those which are working at very high frequencies, and those which work at low audible frequencies, and there is a league and a half of distance between them.

In the first place there are two things to consider, voltage, and power amplification. These are two different things, and until quite recently little attention has been paid to the difference between them. Now that we have semi-power tubes appearing on the market from several tube manufacturers, we shall be able to plan our amplifiers with a little more engineering and a little less guess work.

Fig. 2 is a diagrammatic method of showing a receiver with its component parts. We shall begin at the loud speaker and work up toward the antenna circuit.

The speaker requires power—and there is a certain amount of power that is required by every good one to give a good, well-behaved sound. For example, the Western Electric 216-A tube, which until recently was the only semi-power tube available, has an output of .06 watts under the proper operating conditions, and if this is placed upon a good speaker, plenty of volume will result. Such volume will not be sufficient for a large auditorium, it will not be heard a mile or so up the street, nor will it drive any one out of the house—but who nowadays wants such volume?

Let us say, then, that a good signal requires .06 watts and since this figure represents power, the last tube in the receiver should supply power. Now there is an expression, due to Van Der Bijl, which amplifier designers seem to have overlooked, that says that the power output of any tube will be as follows.

$$\text{power} = \frac{(\text{mu} \times \text{input voltage})^2}{8 \times \text{plate impedance}}$$

Now, using this formula, let us figure out the maximum power obtainable from several tubes under the usual operating conditions, namely, 90 volts B battery, minus 4.5 volts C battery, and assuming that the input voltage peak is just equal to the C battery voltage. In other words we are working

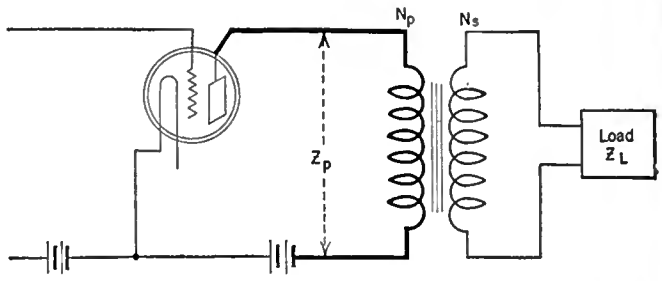


FIG. 5

Transformers are used to "match" impedances. In the case shown here, for maximum transfer of power from tube to load, the turns ratio of the transformer $\frac{N_p}{N_s}$ must be $\sqrt{\frac{Z_p}{Z_L}}$

the tube up to the limit of distortionless amplification.

Under these conditions the following table gives the power obtainable,

3-VOLT TUBE	5-VOLT TUBE	UX 112
.0066	.0135	.0184

Thus it is seen that none of the tubes ordinarily used will give sufficient output to operate a loud speaker at the desired level of .06 watts.

The following table gives the powers obtainable from tubes under conditions of greater input and plate voltages.

B-VOLTS	INPUT	5-VOLT	UX-112	216-A
90	4.5	.0135		
90	6.0		.0328	
135	9.	.058	.118	.059
157.5	10.5		.185	

From this table it may be seen that sufficient power is not obtainable for satisfactory reception with a 5-volt tube until 135 volts are used on the plate and until 9 volts are placed upon the input to the last tube. Under the same conditions, the newer 5-volt, one-half ampere filament tubes, such as the UX-112, and similar tubes for the same purpose, will deliver nearly twice as much power as is actually needed, and with 157.5 volts on the plate and 10.5 volts C bias will have an output that is still more favorable.

These figures mean that it will not be necessary to crank up a receiver to the top notch to hear the average level of an orchestra; and to endure distortion, or to turn down the set when a player bangs down on his kettle drums unexpectedly, or when the orchestra rises to a maximum output level.

In other words, a receiver properly operated with one of these semi-power tubes in the last stage may always be somewhere short of the overloading point, and the range in volume, without the distortion due to overloading, will be much greater. For practically the first time in radio broadcasting reception it is possible to avoid overloading distortion without going to the bother of installing power tubes and high voltage

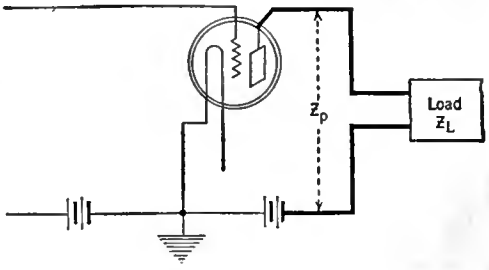


FIG. 4

The last tube in a receiver must deliver power to the load which is usually a loud speaker. If the impedances of the tube, Z_p, and the load, Z_L are alike, maximum power will be delivered

TABLE I

TUBE	USE	PLATE VOLTS	GRID VOLTS	PLATE RES.	POWER OUTPUT WATTS
WD-11	Amplifier / Detector	90	4.5	14000	.0057
UV-199	Amplifier / Detector	90	4.5	15000	.0066
UV-201-A	Amplifier	90	4.5	12000	.0135
UX-112	Detector	135	9.0	11000	.058
	Amplifier	90	6.0	8800	.033
		112.5	7.5	8400	.054
		135	9.0	5500	.118
		157.5	10.5	4800	.185
UX-120	Amplifier	135	22.5	6600	.101
216-A	Amplifier	135	9	6000	.059
UX-210	Amplifier	90	4.5	9700	.015
		135	9	8000	.071
		157.5	10.5	7400	.105
		250	18	5600	.41
		350	27	5100	1.08
		425	35	5000	1.84
Daven MU-6	Amplifier	120	7.5	6100	.0625
Cleartron	Amplifier	120	7.5	6260	.0312
Goldentone	Amplifier	120	7.5	5570	.058

B batteries. Tube builders who have had the initiative to bring out these new tubes deserve a large vote of thanks from the part of the radio public that really enjoys high quality.

In Fig. 3 is the conventional two-stage audio amplifier with the voltages marked as they appear at various points, considering that 9 volts at least are to be used as a C bias on the last tube, and that transformers of 3 to 1 ratio are used, and that the amplification factor, "Mu", of each tube is 8. It is seen that .125 volts must appear across the primary of the first audio frequency transformer, this must be the output voltage of the detector.

At the present time, nearly everybody has his receiver too near the point where the C battery voltage on the last amplifier is exceeded by strong signals. On a cone speaker this is signalized by a peculiar rasping, scraping, or rattling, and the user of the speaker believes the fault lies there when the trouble really exists in his amplifier. No loud speaker can be operated at sufficient volume from a 3-volt tube without overloading. This fact cannot be avoided.

One method of avoiding the semi-power tube problem is to use two 5-volt tubes in parallel in the last audio amplifier, that is, with their grids and plates connected together. From the above formula, the resultant output power with negative 4.5 volts on the grid and 90 volts on the plate is .027 watts and with 135 volts B battery and 9 volts C battery, the result is .117 watts. In other words, a single UX-112 will equal two 5-volt tubes in parallel.

All of these figures assume that the detector is turning out .125 volts—and if it does not, of course the C volts assumed above will not be available, and the power output will drop.

IMPEDANCE CONSIDERATIONS

THERE are other considerations in the audio amplifier end of a receiver that are important. One is the impedances of the loud speakers used with respect to the plate impedances of the tubes used. The layman need not know what these terms mean, but it is not difficult for him to see their importance. Fig. 4 represents a tube working into a load of some sort, say a loud speaker. Now it is an axiom among electrical power workers that any device will put the maximum power into a load when the impedances of the two are alike. When these impedances differ, the power drops.

Now, the impedance of a tube varies with the B battery applied, dropping as the battery voltage increases. The impedance of a loud speaker is under control of the designer, he can make it have, at a given frequency, practically any desired impedance. Therefore, let him design it so that the impedance of the speaker and that of the tube are alike, or as an engineer would say, let them "match" the impedances. This sounds easy but it is not.

The difficulty lies in the fact that the impedance of the loud speaker differs with each frequency, so that the designer must pick out some particular frequency and match his impedances there.

Suppose that a manufacturer desires to place on the market a very high grade loud speaking device. He makes a number of experimental models and finally finds one that seems to be worth producing. He measures its impedance at various frequencies, finding that at low frequencies it has a low impedance and at high frequencies it becomes very high in impedance.

Then he selects a number of people to listen to the device, people who know music and who have a feeling for tone value. He starts at the low frequencies, matches his speaker to the tube impedance at say 200 cycles by means of transformers, as in Fig. 5. Then he matches the impedances at higher frequencies, and asks his audience to say which of the many impedance matches seems the best.

Perhaps they decide upon a certain impedance, knowing that the answer must be a compromise, for if the device is matched at 100 cycles the tube will transmit to the speaker a maximum of power at 100 cycles but very little at 10,000 cycles, and vice versa.

For example, the nominal impedance of the 540-AW Western Electric speaker happens to be in the neighborhood of 4000 ohms, and for the best transfer of power from tube to cone, the output impedance of the tube should be about 4000 ohms. Thus the UX-112 tube with 157.5 volts on the plate has an impedance of 4800 ohms, a good impedance match, while a UV-199 tube with 90 volts on the plate has an impedance of 15,000 ohms, a terrible match—all of the low frequencies would be lost no matter how good the transformers are.

From the standpoint of quality then, tubes should be worked below the overloading point, that is below the place where the available C battery voltages are exceeded, the loud speaker should have the same nominal impedance as the power tube, and the output tube should have sufficient power output to actuate the speaker

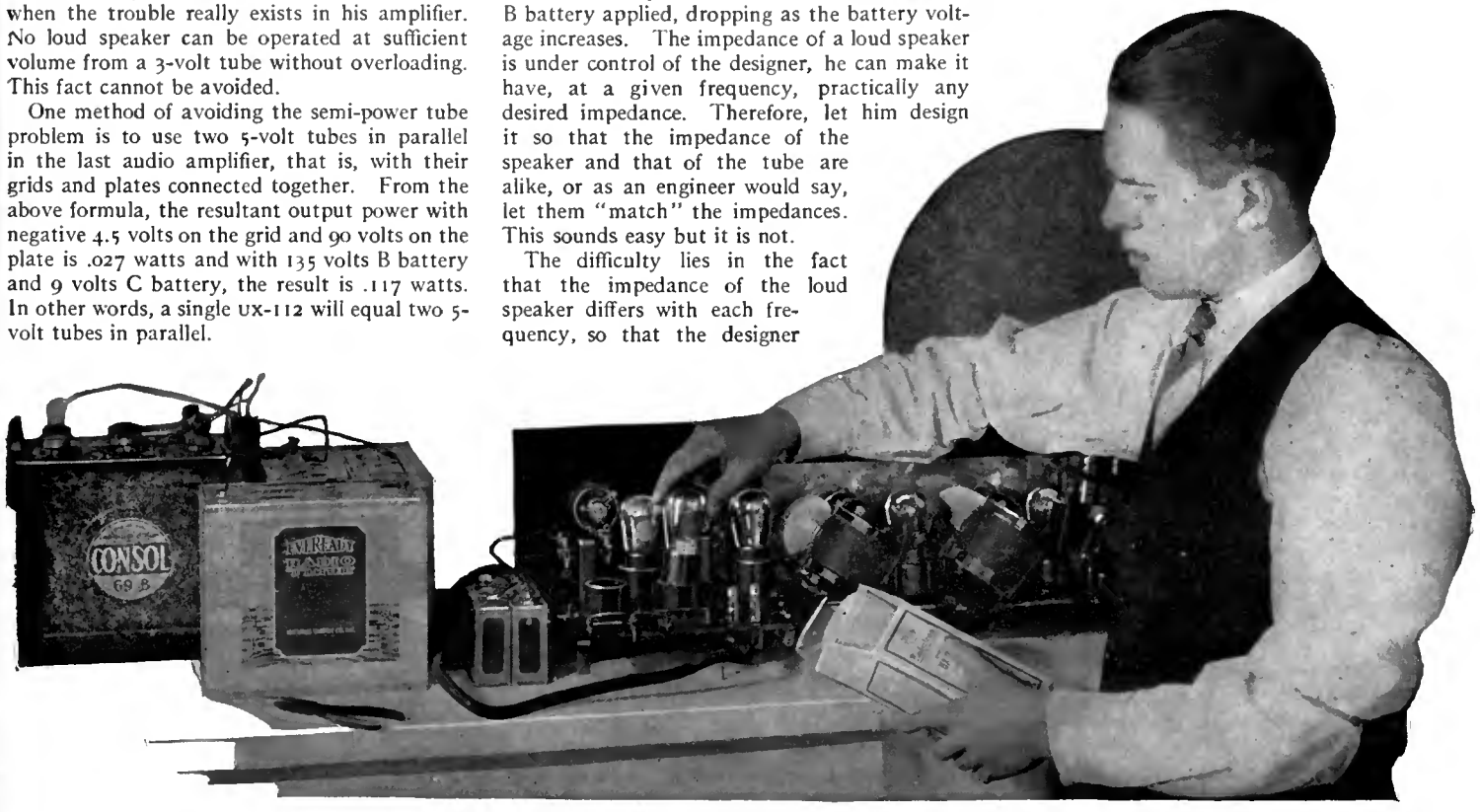


FIG. 6

As shown in the table of tube characteristics in this article, one UX–112 will have approximately the same output as two UV–201-A tubes in parallel. In receiving sets such as the Freed-Eisemann illustrated here power tubes may be used in place of the two parallel tubes ordinarily used.

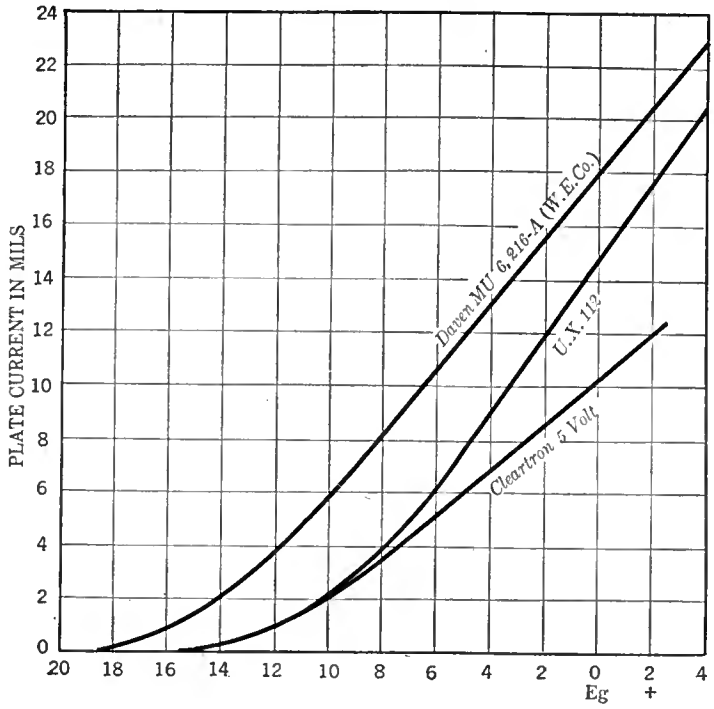


FIG. 7

Curves showing the relation between grid volts and plate current of three power tubes. These curves were made at a plate voltage of 120, and show that a C bias of about 7½ could be used on the Daven MU–6 and the 216–A while for the Cleartron, and the UX–112, a bias of about 6 would be required at 120 volts of B battery

without forcing. Goodness knows what the impedance of loud speakers now on the market may be. There is no standard, for there has been no standard in tubes. Many people try to work cone type speakers on 3-volt tubes, and it cannot successfully be done without some distortion. Manufacturers of speakers should set upon some value of nominal impedance, say 5000 ohms and stick to it. Otherwise some careful designer should bring out an output transformer which will connect a high impedance loud speaker with a low impedance tube, and a low impedance speaker with a high impedance tube.

At the present time, the best combination for a transformer-coupled amplifier seems to be a standard 3- or 5-volt tube for the first audio amplifier, and a semi-power tube in the last amplifier. Since the amplification of 5-volt tubes is considerably above that of dry cell tubes, those who wish the best in quality and volume should use the larger tubes. As a final tube, the UX-112, the 216-A, the Daven MU-6, the Cleartron semi-power tube, the Heliotron power tube—all are excellent choices for that last audio stage. And of course for good quality, good transformers must be used.

TRANSFORMER RATIOS

THERE are several strange ideas prevalent regarding the ratios of transformers. There is no reason why good transformers must be low ratio affairs. In fact one of the best transformers on the market has a comparatively high ratio and for several years before the present broadcasting era, the telephone industry had a high ratio transformer with an essentially flat characteristic.

The difficulty is expense, and until people will pay for high ratio, high quality transformers they will have to be content with low ratio high quality ones.

With regard to the overloading of tubes, there is no difference whether a high ratio transformer comes before a low ratio instrument or not. It is overall amplification that causes overloading, and it is seldom indeed that the first audio amplifier overloads. From the standpoint of quality, however, the prevailing system of having high ratio transformers first and low ratios second is wrong. High ratio transformers will probably have a lower primary impedance than will low ratio instruments. A detector has a high plate impedance while an amplifying tube has a much lower impedance. If these impedances are to be matched at all, the higher impedance transformer (low ratio) should come next to the detector.

RADIO-FREQUENCY AMPLIFIERS

IT IS probable that the standard practice of using 90 volts B battery and negative 4.5 volts C battery is about correct for radio frequency amplifiers. It is true that somewhat greater amplification will result from the use of higher plate voltages, but at the same time it is more difficult to control such an amplifier. As a matter of fact, a five-tube set, with two stages of radio-frequency amplification which are working properly will have all the voltage amplification that can be handled. If a potentiometer controlled amplifier is used, and many of the tuned "r. f." sets use this means of stabilizing, a large B battery current will be drawn when the potentiometer is swung to the positive side. There is no remedy for this, since such sets cannot under existing patent arrangements use C batteries and cannot be neutralized.

RESISTANCE-COUPLED AMPLIFIERS

AS LONG as radio constructors were limited to the usual 3- and 5-volt tubes, resistance- and impedance-coupled amplifiers were not to be advised. Due to the high resistances used as coupling devices, the voltage actually on the plates of tubes is very low, and no amplifier tube will work satisfactorily unless a certain voltage is maintained on the plate. This meant that at least double the ordinary B voltages must be used.

High "Mu" tubes, however, are a distinct boon to resistance-and impedance-coupled amplifiers. Curves taken by Mr. G. H. Browning are illustrative of the effect of using these new tubes and may be seen in his article on the Browning-Drake receiver in this number of RADIO BROADCAST.

Owing to the very high plate impedance of these tubes, they will not act as power amplifiers at all, and in the third stage of a resistance- or impedance-coupled audio amplifier a semi-power tube should be used. To get the same amplification—and the same power into a speaker—from such an amplifier as is obtainable from a good two-stage transformer-coupled amplifier, at least three stages must be used, the last of which should be a semi-power tube as indicated before.

Unless large capacities are used as the coupling units, at least 0.1-mfd., the low frequencies will be dropped out and the user is no better off than if he had used transformers.

Two "high Mu" tubes have come to the Laboratory of RADIO BROADCAST which may be recommended. These are made by Daven and by Cleartron. The former are known as "MU-20" tubes and the latter as the "High Constron." Both have an amplification constant of 20, have proven to be very uniform, and have a plate impedance at 90 volts B of about 30,000 ohms. Daven tubes are designed to operate on 6 volts without the use of rheostats. Since storage batteries retain their voltage output until nearly discharged, the full 6 volts is obtainable.

These high impedance tubes cannot be used, with profit, in a radio frequency stage of present receivers. Their field is in the usage discussed above, and Mr. Browning's curves show conclusively that they are of great value in this connection.

OTHER POWER TUBES

THE UX-120, a dry cell tube to be used to feed into loud speakers, has an amplification factor of 3.3, a plate impedance of 6600 ohms, and should be used with a plate voltage of 135 and a negative C bias of 22½ volts. The power output under these conditions should be .1 watt which is sufficient for high quality high volume operation, but owing to the curved characteristic of this tube it is doubtful if this power output may be approached. This will be an excellent tube for use in super-heterodynes which at present use the ordinary 3-volt tube which has not the output required.

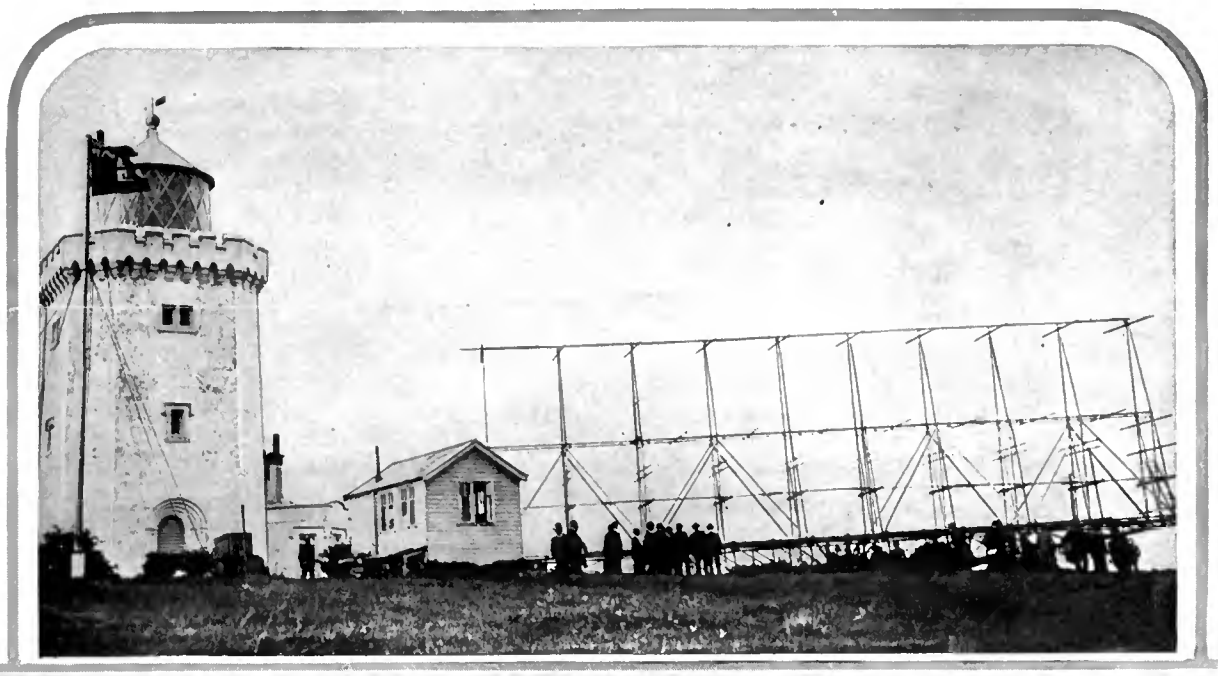
The UX-210 tube is essentially a power tube and should be operated from a source of alternating current by means of a step down transformer, as was described in November RADIO BROADCAST by James Millen. Only where considerable power is desired should this tube be necessary. In the Laboratory it has proved to be an excellent transmitting tube, and more than 30 watts have been applied to it without difficulty.

At the present time, the proper arrangement of tubes in a five-tube set seems to be as follows, 3- or 5-volt tubes for everything but the last where a UX-120, a UX-112, Daven MU-6, Cleartron 112, Heliotron power tube, WE 216-A, Seagull type P, or Goldentone, should be used. If more power is desired, two tubes may be used in parallel, two may be used in a push-pull arrangement, or the UX-210 type may be used.

In a future article the new Radio Coporation ballast and rectifying tubes will be described.

The data given in the table in this article must not be misunderstood. It gives the maximum undistorted power in watts that certain tubes will deliver under certain conditions, those conditions having to do with the plate voltage used and the variation in grid volts being applied to the tube. If these grid volts are not applied, less power will be delivered.

For instance, there is an idea prevalent, since the appearance of semi-power tubes, that the substitution of such tubes for standard 3- or 5-volt tubes will result in a marvelous increase in volume. Such is not the case although some increase will be noted due to the lower output impedance of these tubes over these in standard use. Under the same operating conditions, a standard tube and a semi-power tube will deliver about the same power. The great advantage of the newer type of tube is that it will handle more power, that is, a greater input voltage and corresponding greater output, than the 3- or 5-volt type. In other words, the substitution of a 112 type or 210 type tube will enable the user to use greater voltage amplification up to the last stage and by the proper use of C, and B batteries, distortion due to overloading will be less likely to result.



THE MARCH OF RADIO

By J. H. Morecroft
Past President, Institute of Radio Engineers

What Is the Matter With the Naval Radio Service?

ONLY a short time ago radio had one of the best opportunities in its history to prove its worth to the mariner in distress—and failed. It is not in a spirit of cynical criticism that we bring up this incident but rather with the purpose of inquiring whether something cannot be done to prevent similar occurrences in the future.

The whole country was enthusiastic several months ago over the idea of our naval aviators hopping from California to Hawaii. Three of the planes were to go, but due to mishaps only one made a serious attempt at the long flight. This trip had been planned very carefully and it seemed as if nothing could happen to prevent the goal being reached. Destroyers were used to mark the course and were ready to render assistance should the planes come to grief; every two hundred miles along the two-thousand mile course a destroyer or a supply ship was stationed to give the planes the proper direction and to record their progress.

The radio equipment of these planes was supposed to be of the very best. With a sending radius assumed to be in the hundreds of miles, and reliability of operation never before attained (as the description of the radio outfits specified), it was confidently assumed that the operators of these seaplanes couldn't help knowing exactly where they were, and could keep in constant communication with the marking vessels. The radio signals were to be used for compass bearings as is the case every day with hundreds of ocean-going ships, and altogether the planes were considered as safe as though they were close to their own home port.

One of the planes had mishaps and had to give up the trip after covering a short distance, another never even started. The third flying boat however, *PN-9 No. 1*, in charge of Commander Rodgers, got well away and picked up the first of the marking ships almost on schedule. The wind was not quite as favorable as had been hoped, so that the speed was considerably less than that reckoned on. Thus the gasoline supply was not quite sufficient to cover the two thousand miles and Commander Rodgers decided to come down near the *Aroostook*, two hundred miles from the end of his trip, to renew his gasoline supply.

And now, probably the only time during his trip that the radio channel was really needed, it failed. The radio compass bearings should have enabled the *PN-9 No. 1* to proceed at once to her supply ship, but the plane missed her completely. The compass bearings indicating that the *PN-9 No. 1* was south of the *Aroostook*, her commander flew north until his gasoline supply gave out and he had to drop to the ocean. The plane's position was then calculated by her commander as fifty miles north of the *Aroostook*.

Having thus failed in its important work of keeping the plane on her course, the Naval radio now scored an even worse failure. With no gasoline to run her engines, the only thing the Commander of *PN-9 No. 1* could logically do was to call for help and supplies. It is exactly in emergencies of this kind that radio is supposed to be the mariner's most useful agency, but this failure was nothing short of dismal. Only fifty miles from the waiting patrol ship, the *PN-9 No. 1* was for some inexplicable reason helpless as far as radio communication was concerned. And to add, to its ignominious failure, radio served to agonize the souls of the crew by letting them hear all of the radio messages with which the air was filled. Gradually, their receiving set told them, the searchers were giving up hope of finding them; each succeeding day their would-be rescuers were becoming more discouraged and evidently soon would give up the search. And all this time their rescuers were only a couple of hundred miles away!

RADIO PICTURES OF THE CALIFORNIA–HONOLULU AIR FLIGHT

Sent from Honolulu to New York on Sunday, September 13, by the Ranger photoradiogram system. The distance is 5116 miles. Left: Commander John Rodgers of the *PN–9 No.1* as he looked when he landed at Liuhui, Kauai Island, after his rescue from the disabled plane shown in the view above. The ship was adrift for nine days, owing to failure of radio compass bearings when the ship was only about 200 miles from her goal. When she landed on the sea, there was no emergency transmitter to signal the rescue vessels. The operator of the plane was forced to hear all the conversations relating to the rescue work

There is no good reason why a single circuit regenerating receiver could not have been used as a transmitter for the short distance to be covered, if no other means were at hand. But why wasn't there a transmitter which would work if the plane was forced down? According to the plane's commander, a perfect landing on the ocean was made and nothing happened to interfere with the radio apparatus performing as it was intended to do. Why didn't it perform? Was there no emergency apparatus able to operate if the plane was forced down?

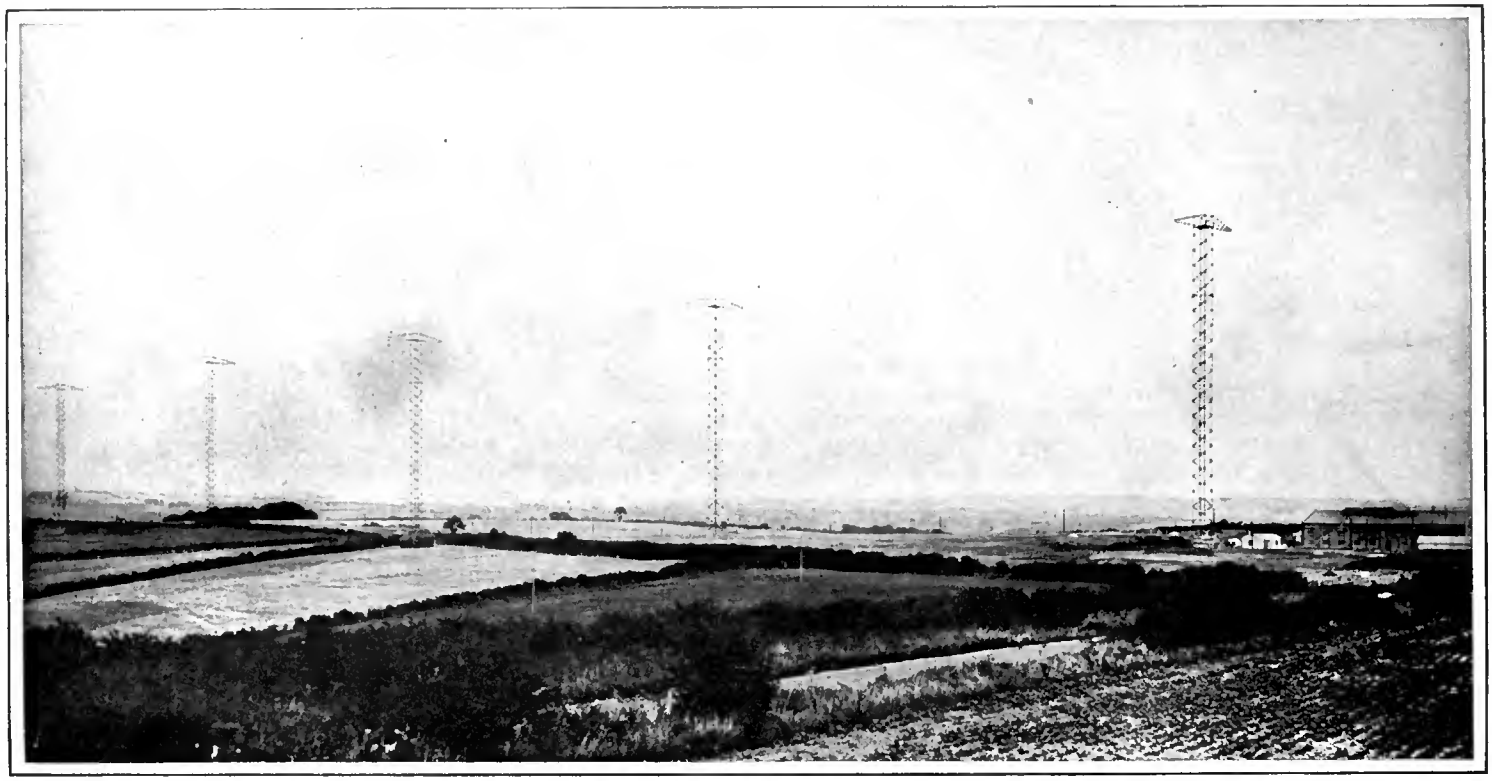
Favorable weather and fortunate winds enabled these trans-air travellers finally to reach land after nine days of hazardous drifting in their tiny craft. And with that loyalty to the service which the Navy officer feels to be his first duty, Commander Rodgers stated that "there was no failure of material at any time in the air or the water."

We are not under the restraint that Commander Rodgers is, and we can say frankly that there was a failure, one of the worst that radio has scored. Some explanation should be forthcoming from those responsible in the Naval Radio Service for this blot on their reputation.

It transpired in the hearing which followed the disaster several years ago, when six Naval destroyers were wrecked off Point Arguello, that the compass bearings given to the leading destroyer by the Naval radio station were incorrect. The radio weather intelligence furnished the *Shenandoah* on her recent disastrous trip was incomplete or entirely lacking—to which one might lay a large share of the blame for the failure of her navigating officers to avoid the storm which destroyed the ship. Listeners who have heard the way in which sos traffic has been handled recently around the New York territory have observed that the Naval stations have handled that traffic in a singularly inexpert fashion. Taken all in all, there are unmistakable signs that there is something radically wrong with the Naval Radio Service. Who is to blame?

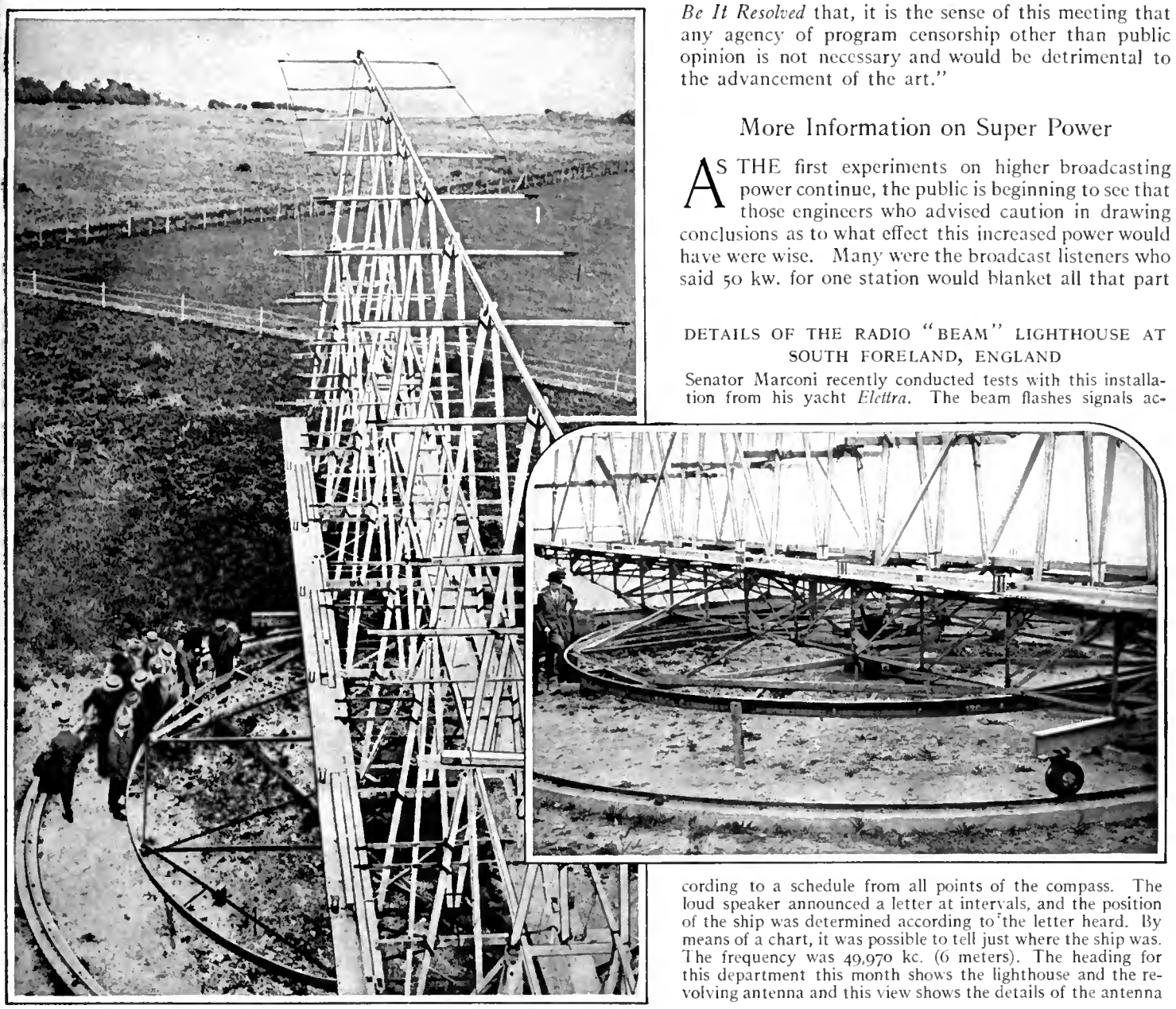
National Association of Broadcasters

ALTHOUGH the average broadcast listener probably knows nothing about it, their purveyors of entertainment have been organized for some time. The National Association of Broad-



THE NEW MARCONI DIRECTIONAL BEAM STATION AT DORCHESTER

About 120 miles from London. This is a new and exclusive photograph published for the first time in the United States. The picture shows five of the masts which are 277 feet high, and 750 feet apart. The masts are at right angles to the direction in which communication is to be established. The cross arm at the top is 90 feet across. The antenna wires, which are not yet in place, will be attached to triatics at one end of the cross arm and the reflector wires to the other. The distance between the antenna wires, reflector wires, and the number and distance apart of the separate wires making the antenna and reflector will depend on the transmitting frequency used. The installation shown is expected to communicate with New York. Others now in process of construction and test will connect England with Australia and the Dominions. On a recent four-day test, Senator Marconi announced that he had been in uninterrupted communication with Australia, using the beam system



DETAILS OF THE RADIO "BEAM" LIGHTHOUSE AT SOUTH FORELAND, ENGLAND

Senator Marconi recently conducted tests with this installation from his yacht *Elettra*. The beam flashes signals according to a schedule from all points of the compass. The loud speaker announced a letter at intervals, and the position of the ship was determined according to the letter heard. By means of a chart, it was possible to tell just where the ship was. The frequency was 49,970 kc. (6 meters). The heading for this department this month shows the lighthouse and the revolving antenna and this view shows the details of the antenna

casters had its annual meeting this month and its transactions are indirectly of interest to us all. The object of the society is to promote generally the welfare of our broadcasting stations through various cooperative arrangements.

It was started by a small but active group in the Middle West, with the able Mr. Paul B. Klugh as Executive Chairman. Its activities proved so worth while that the membership rapidly increased and now it bids fair to justify its name.

Among the members elected at this meeting was WEAF, representing the American Telephone and Telegraph Company. When this company goes into an association of this kind it is undoubtedly a sign of its promised or accomplished success.

The question of broadcasting copyrighted material has been more troublesome to the National Association of Broadcasters than any other problem in their operations. At first the organization was averse to paying royalties for the privilege of putting music and songs on the air (the copyright law, of course, contains no proviso for such an exigency). Now this association has changed its point of view. Among other resolutions passed was one which would put the broadcasting of copyrighted material on the same basis as the mechanical reproduction of such pieces (by player piano and phonograph) in so far as royalties are concerned.

Another matter which received consideration was that of the method of introducing the paid features of the program. One of our congressmen has advocated the complete separation of paid channels from the others. That attitude seems unnecessary and inadvisable. The broadcasters took this view of the matter and decided that paid programs could be "gently" introduced.

On the question of censorship, the society declares that "*Whereas* it is universally agreed that the success of radio broadcasting is founded upon the maintenance of public good will and that no broadcasting station can operate successfully without an appreciative audience, and *Whereas* the public is quick to express its approval or disapproval of broadcast programs *Be It Resolved* that, it is the sense of this meeting that any agency of program censorship other than public opinion is not necessary and would be detrimental to the advancement of the art."

More Information on Super Power

AS THE first experiments on higher broadcasting power continue, the public is beginning to see that those engineers who advised caution in drawing conclusions as to what effect this increased power would have were wise. Many were the broadcast listeners who said 50 kw. for one station would blanket all that part of the broadcast range, that it would be impossible to receive other stations which sent signals of anywhere near the same frequency. Some months ago we got several petitions (with requests to sign) directed to Mr. Hoover, requesting that he prohibit broadcasting stations using a greater power than 5 kw. The petitions stated what troubles were to be encountered if the Department did not block this anticipated move by the "Trusts."

Schenectady has carried on many tests with a 50 kw. outfit, and at the time this is written, very few complaints have been received. Many replies have been received to questionnaires sent out, and they are still being classified and compiled. It is interesting to note that the public must be depended upon to answer the question as to how much power the broadcasting agencies should use. All questionnaires received should be carefully answered, for it is the facts in the compilation of these answers that Mr. Hoover will depend on to determine his future policy regarding high power stations.

Although many of the letters received by WGY are contradictory, the average listener seems to think that a 50 kw. signal is two or three times as loud as a $2\frac{1}{2}$ kw. signal. In the recent tests, the two powers were alternated so that repeated comparisons could be made and but few of the reports say that one signal is more than ten times as strong as another. As a matter of fact, theory would indicate that the 50 kw. signal is twenty times as strong as a $2\frac{1}{2}$ kw. signal, yet most of the listeners say it is about twice as strong. Probably the signal is actually twenty times as strong and the factor ten by which the average listener misses the truth is due to his lack of skill in comparing noises of different strengths.

The unexpected absence of complaint regarding interference by the high power channel has encouraged the General Electric engineers to continue their tests and the Department of Commerce has given WGY permission to use 50 kw. regularly on Saturday and Sunday evenings. If this much power is found to give to the broadcast listeners more trouble than benefit it will be discontinued, but it is almost sure that such will not be the case. A few listeners near the station who want to hear other stations thousands of miles away, whose frequency is nearly the same as Schenectady's, will of course report interference. This can be predicted without any further tests. But as radio broadcasting develops the complaints of the distance hound will fall upon less sympathetic ears. High quality reception for the most listeners is what radio must eventually supply and increased power, properly controlled, will help in the solution of this problem.

Canada as Our Instructor

WE MUST congratulate our Canadian friends on the way their governmental radio activities are conducted. It has been noted before in these columns that many radio questions were tackled in an intelligent and reasonable manner by our northern neighbors, even though some of their procedure (such as the licensing of receiving sets at one dollar a year) may not meet with our approval.

There has just come to hand a pamphlet put out by the Radio Branch, Department of Marine and Fisheries, Ottawa, which takes up the question of regenerative receivers. It is a circular letter addressed to all broadcast listeners and is written in a manner which will appeal to the average non-technical man. The letter starts with the paragraph "When using a receiver of the regenerative type for the reception of radio telephone programs, please avoid increasing regeneration to the point at which the receiver begins to oscillate, otherwise you will cause interference with neighboring receiving equipment." *Are you doing your best to observe this?*

The letter then proceeds to give an elementary, but clear and correct analysis of what regeneration is and why it causes interference, ending with easily followed instructions as to how to avoid spoiling neighbors' reception. With the government list of listeners available, as a result of the licensing feature of radio reception in Canada, this circular should reach the owners of nearly all the radio sets in that country and should do a deal of good.

The Facts About the Farmer and Radio

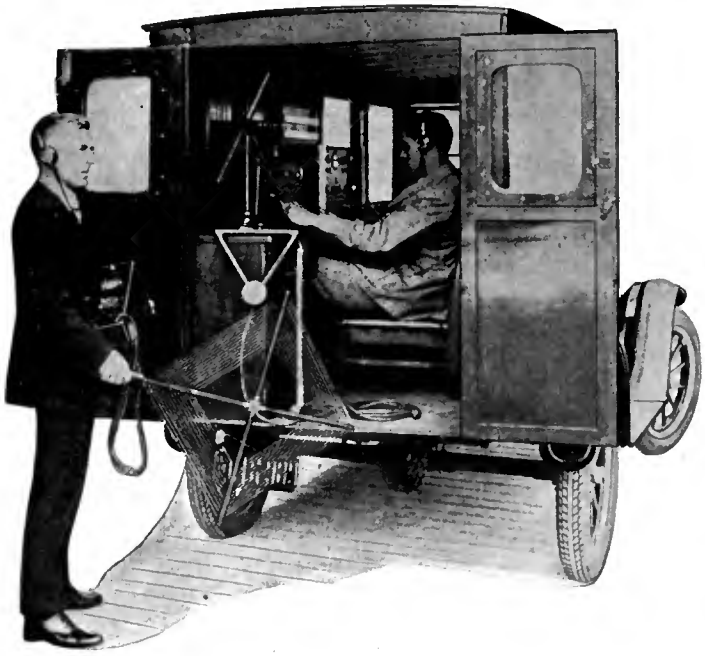
THE benefits which radio confers on the farmer have been represented to him repeatedly, but it is a fact that no one has really known whether the average farmer profited by broadcasting or not. A recent survey by the Department of Agriculture among the country's farms yields the information that there are 553,003 sets on farms, not as many as we had expected. This represents only $8\frac{1}{2}$ per cent. of the country's farms, so there is still a large virgin market for the active radio manufacturer.

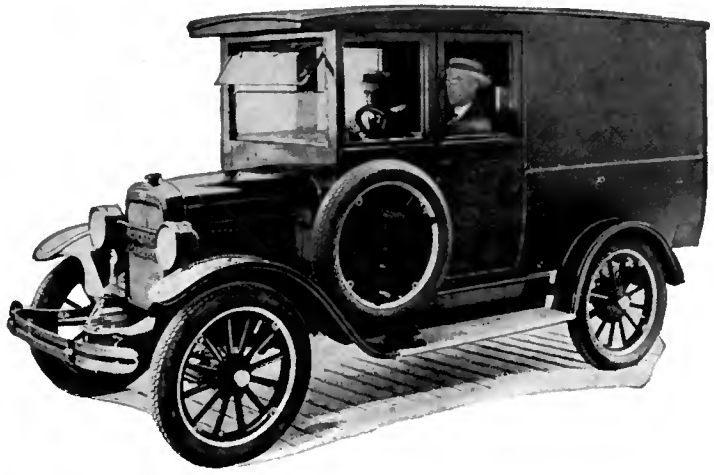
A questionnaire was sent out and the returns for the State of Pennsylvania have been sent us by Mr. George F. Johnson of the Department of Agriculture at Harrisburg. Of 343 answers received, two thirds used tube sets with loud speakers. To the question "Have market reports ever made or saved you money?" exactly half answered "Yes." and half "No." We hasten to encourage the promoter of "radio for farmers" after this answer, because while it looks at first as though radio was not functioning very well here; that is really not the significance of the return. That fifty per cent. of the farmers saved money from the information conveyed over the radio channel is incontrovertible evidence of its utility.

The Month in Radio

ENGLISH employment agencies are finding that domestic help appreciates radio possibly even more than does the mistress of the house. Basting the roast beef in tune with the wedding marches, or washing dishes to the time of modern jazz proves to be so appealing that the agencies are said to be actually classifying the vacant positions as radio and non-radio, much to the detriment of the latter.

THE first attempts experimentally to determine the proper allocation of frequencies to the various European stations resulted in ethereal pandemonium,





HOW THE CANADIAN RADIO SERVICE HELPS THE LISTENER

The "Inductive Interference" car maintained by the Radio Service of the Canadian Government. The annual license fee of one dollar, paid by every Canadian listener is used to maintain a corps of inspectors. A specially trained "induction squad" operates with this car to locate interference hard to detect by the ordinary methods. The car is especially made for this purpose, with a body of insulating material and carefully screened ignition system. Two special super-heterodynes, several portable receivers, a sledge hammer, condensers, and chokes form the equipment of the trouble car. The chokes and condensers are applied to cure trouble when found. The sledge hammer is often used to tap electric light poles in a suspected territory, and the trouble is quickly located by a listening inspector

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SENATOR C. C. DILL

Washington; United States Senator for Washington

"The organization of a Government Commission on Communications to act for the telephone, telegraph, and radio, such as has been proposed, would probably end in disaster for broadcasting. It would be the beginning of the end of freedom of action in the radio business. I also wish to emphasize the necessity of immediate action on the part of the United States Supreme Court to arrive at a decision regarding the broadcasting of copyrighted musical numbers. If it is decided that such broadcasting is done for profit, and therefore a fee is due to the publishers of the music, I intend to introduce a bill to regulate the payments, so that radio broadcasting will not be at the mercy of any one group of men."

according to a dispatch from London. About sixty stations going at once in an expanse of territory perhaps less than a quarter the area of our country proved too much. The interference was truly international. Newcastle, England, heterodyning with Gratz, Austria, and Norway stations beating with some in England, Germany and France, show us what a difficult question the Europeans have compared to ours. The radiophone center in Geneva was notified of all the interference and in the next test period changes will be made to keep the interfering stations farther apart in frequency.

THE research laboratory of the Westinghouse Company announces that the metal, thorium, is now available in such quantities that the filaments of vacuum tubes may be made of pure thorium instead of thoriated tungsten as is now the practise. The present tubes have a layer of thorium on the surface of tungsten filament, the layer being only about one atom deep. If the filament is improperly used, this thin layer of thorium disappears and the electron emission practically stops, the tube is useless. By considerably overheating the filament, without B batteries, a new layer of thorium will appear, this new thorium diffusing to the surface from inside the filament.

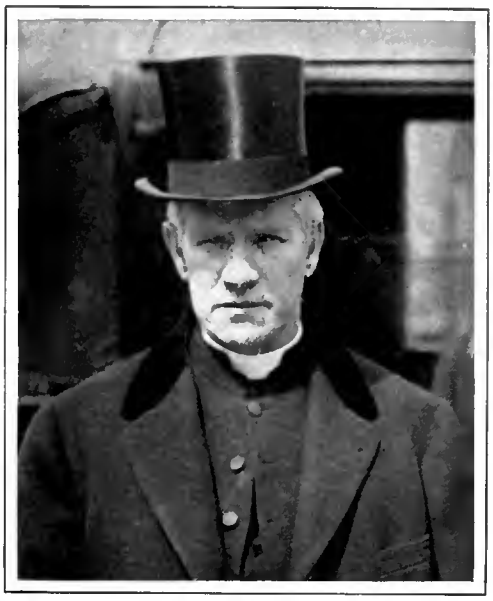
Now, it is announced, solid thorium filaments will soon be available. This is a real advance because the possibility of the disappearance of the thorium atom-deep layer no longer threatens. The new tubes will very likely have much longer life than the present ones and not be so sensitive to improper adjustments.

A RECENT discussion in the semi-popular press, having to do with the use of super-power, ventured the statement that if a 5 kw. station was audible on a crystal set at twenty-five miles distance, the 50 kw. station would be audible on the same crystal set for a distance of "several hundred miles." It seems that if we interpret "several hundred" as five hundred miles, the power of the 5 kw. station would have to be increased to at least 250 kw. to increase the crystal set range as much as the writer suggested—and then it would probably fall short. Schenectady's tests should soon give us some reliable information on this point.

ACCORDING to the Department of Commerce, Japan's long distance radio telegraph stations are to pass from the control of the government into the hands of a private company which expects to erect two new stations in addition to the two now in operation and that when their four stations are in operation the company will communicate directly with the United States, Germany, and France. With the 50 kw. of power which the new stations are to have it seems very unlikely that signals can be sent directly to Europe except under most favorable conditions. Most of the time one or two relay stations will undoubtedly be required if any reliability is to be obtained.

Interesting Things Said Interestingly

POWEL CROSLEY, Jr. (Cincinnati; president Crosley Radio Corporation): "Very few broadcasting stations are operating with any direct profit. No broadcasting station in the country is making money to-day. Some handle indirect advertising with some source of revenue; so far, I believe, no stations have been able to meet expenses with this income. Our own revenue at WLW from this source would not pay for the direction of the studio. We have a large investment in broadcasting equipment—whether it is profitable for us to broadcast is a question; whether the good will created by a broadcasting station justifies its continued existence is merely a matter of opinion. No one can check the results. If all broadcasting stations face an additional expenditure of from $5,000. to $50,000. per year, due to the royalties imposed by the Society of Composers, Authors and Publishers, and perhaps more, because no limit has yet been set—how many of these stations will continue? Imagine the feelings of a man who appreciates the seriousness of this situation, playing a gambling game in which no limits are set—where the more he pays the more he will have to pay—and you will appreciate how serious the situation is."



CARDINAL HAYES

New York; Speaking at the opening of station WLWL:

"Among the most recent and wonderful gifts of science comes the radio. As Cardinal Archbishop of New York, I congratulate the Paulist Fathers upon the great work they have undertaken in opening up station WLWL. *I congratulate also the people of this immense city and of this whole country of ours upon the inauguration of an enterprise so admirable. May I add that in the building of this station, the Paulists have shown themselves worthy sons of their founder, for nothing was more characteristic of the first Paulist, Isaac Hecker, than this readiness to utilize every new instrument of good. How his noble soul would rejoice to witness this scene, the dedication of the twin towers of steel that overlook the Paulist Church here at Fifty-ninth Street, as an agency for the spread of truth and wisdom. We who employ radio are responsible for our use of it. We must take care that we use it not for harm. But, further, we are strictly bound to use it for good, to make it fruitful. Whoever would be great, must serve. He who has power must turn it to the welfare of his fellows."*

GOVERNOR ALFRED E. SMITH (Albany, New York): "Radio broadcasting has revolutionized political campaigning. It makes it possible for a candidate to reach the by-ways of politics. The stay-at-home gets your message as clearly and intelligently as the man who is able to come out to the meetings. A great event can be recorded at the fireside. The opening of the extraordinary session of the New York State Legislature this year is an example. It brought to the people young and old an important lesson in civics and gave them exactly the procedure which occurs when a session of the Legislature is opened. Radio gives you the widest possible audience and also the benefit of public opinion. I have had occasion to use the radio on many important occasions including my inauguration as Governor and in making an appeal for public support of important and vital policies. Just as it has served my needs and opened up a tremendous avenue for political education, I am glad to have the opportunity to say so to the radio public."

A Five-Tube Receiver of Dual Efficiency

A Late Development of the Famous Browning-Drake Receiver Employing Impedance-Coupled Audio Amplification Producing the Highest Quality—Some Valuable New Data on Radio-Frequency Transformers and a New Method of Balancing Them

By GLENN H. BROWNING

QUESTIONS are frequently being asked concerning the necessary requirements of the ideal radio receiver. The answer pictures a set which is sensitive enough to receive great distance, gives perfect reproduction of the program being broadcast, tunes sufficiently sharp to separate transmitting stations, does away with interference, and accomplishes all this without batteries, tubes, or other trouble making devices. At the present time, our ideal seems far from the realm of realization, but at least we may take a step in the right direction, by scientifically investigating radio and audio frequency amplification.

The receiver to be described, which consists of one stage of balanced, tuned radio frequency amplification, regenerative detector, and three stages of impedance-coupled audio amplification, is still far from perfect, but it is sensitive enough to do DX work, selective enough to cut through locals, is properly designed for good quality reception, and does not radiate.

Let us consider the component parts separately. The tuned radio-frequency transformer is probably the most important part of the receiver, for into its development went almost a year of theoretical and laboratory work by Mr. F. H. Drake and the writer, with a result that a piece of apparatus was designed, which gave almost 90 per cent. of the amplification predicted by mathematical calculations.

Several interesting discoveries were made during this time, among which was the fact that the "turn ratio" of a tuned radio-frequency transformer was not so important as the resistance of the secondary circuit, and the relation between primary and secondary. It was also found that any capacity between these two windings tended to decrease the efficiency, so that the final design consisted of a "bunched" primary winding coupled closely to a low resistance secondary coil. Having designed the radio frequency part of the circuit, the question of regeneration was then encountered. As most radio fans know, regeneration is present in any radio-frequency amplifier to a greater or less extent, and the necessity of providing a method of controlling it arises sooner or later. A little experimenting showed that greater signal strength could be obtained by balancing the radio tube and regenerating on the secondary of the radio frequency transformer, rather than regenerating directly on the antenna tuning system. The former course, besides giving greater signal strength, has the added advantage that it does away with any radiation tendencies the receiver might otherwise have.

ALTHOUGH Mr. Browning has made few fundamental changes in the original design of the justly famous Browning-Drake receiver which was originally described in RADIO BROADCAST *for December, 1924, the reader will find that the receiver described here contains some distinct improvements which place this model in the vanguard of current receiver design. The improvements are in the audio circuit, and impedance-coupled amplification has been chosen. The four-tube model of the Browning-Drake receiver does frequently overload, but the set described below is almost free from that disadvantage. In this article, the author presents some interesting data on comparison between transformer-, resistance-, and impedance-coupled amplification, and suggests a new method of balancing the radio-frequency transformer. It should be read with much interest.*—THE EDITOR.

SELECTING THE AUDIO AMPLIFIER

IN CHOOSING an audio amplifier for the circuit, some experimenting was necessary, as one can use transformer, resistance-, or impedance-coupled systems with varying results. Two stages of, say, 4 to 1 transformers will undoubtedly give sufficient volume, but the quality or naturalness of the received program must, in some measure, be sacrificed.

Three stages of impedance-coupled amplification has as good quality as resistance, and, if properly built and operated, gives greater volume and does not require an abnormal B battery voltage. It was con-

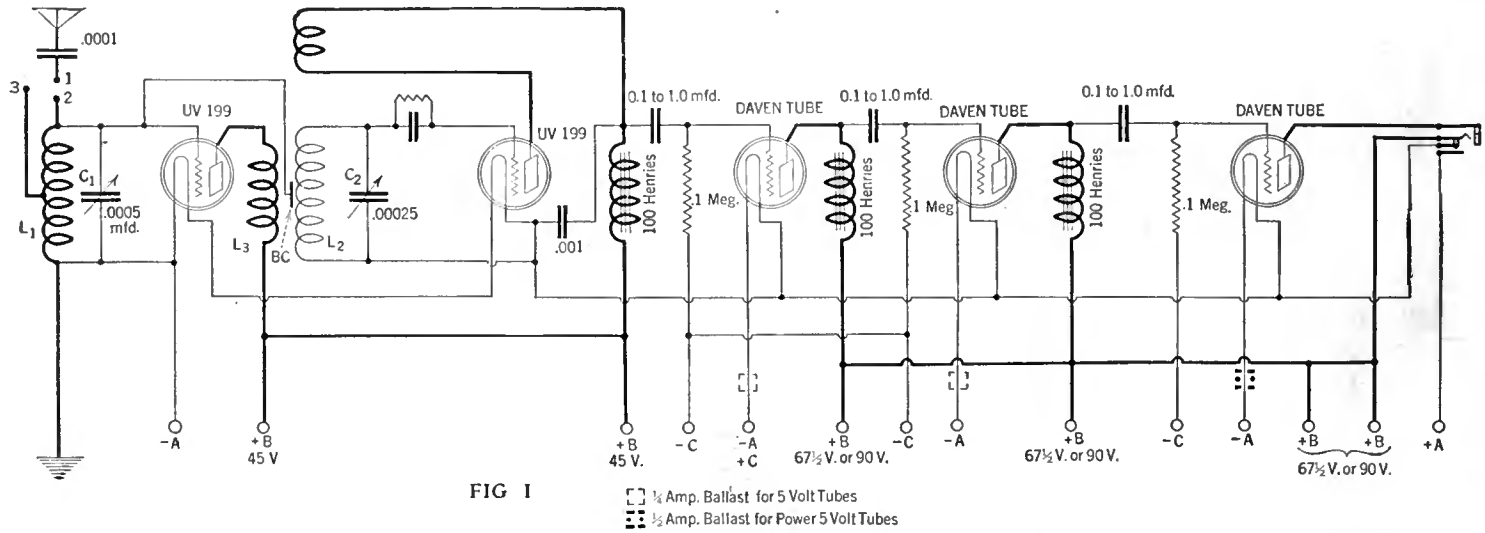


FIG 1

The schematic diagram of the circuit employed in the receiver. The several battery terminals of similar markings are paralleled and connected to the terminal of the indicated polarity of the battery in question. For instance, there are four minus A posts. This group is connected together as one terminal, thence connecting to the proper battery. The same holds true of the two plus B 45-volt terminals, and the three plus B 67½-volt or 90-volt terminals. However, in the case of the minus C battery terminals, the last audio stage will require more voltage than the first two

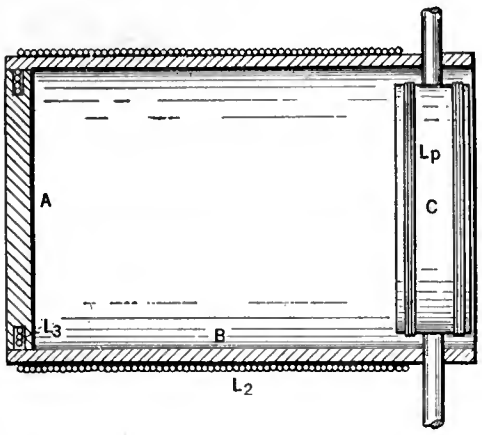


FIG. 2

Details of the winding of the radio frequency coupler. L3 is the primary; L2 the secondary, and Lp the variable tickler coil. The actual winding specifications are contained in the accompanying article

sequently chosen for the receiver to be described.

For those who are interested in laboratory measurements, a comparison between the three systems is shown in the accompanying chart, where signal strength is plotted for frequencies ranging from 100 to 10,000 cycles per second. It will be seen that the more constant the amplification for the frequencies shown, the better is the quality of the received signals.

The conclusion to be drawn from this data has lead us to choose three-stage impedance-coupled amplification with high-Mu tubes.

The parts listed below were used in building the set. Whether or not the builder follows the exact list given, he will need the parts listed below or their equivalent.

One panel—21 x 7 inches.

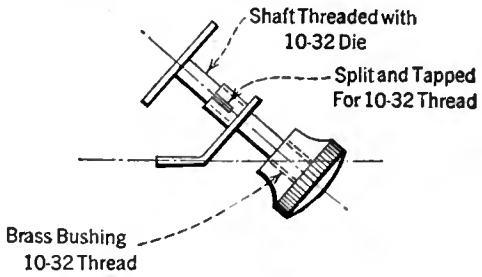


FIG. 3

Shows the mechanical arrangement of the balancing condenser plate and mount. It is to be mounted on the sub-panel in the rear of the radio frequency secondary coil

One sub-panel (bakelite) 18 x 7 inches.

One National Kit (containing the two variable condensers and Browning-Drake coils.)

Five Na-ald sockets (2 UV-199 and 3 UV-201A).

One Daven Leakandenser (the leak should have a resistance of 6 to 8 megs.)

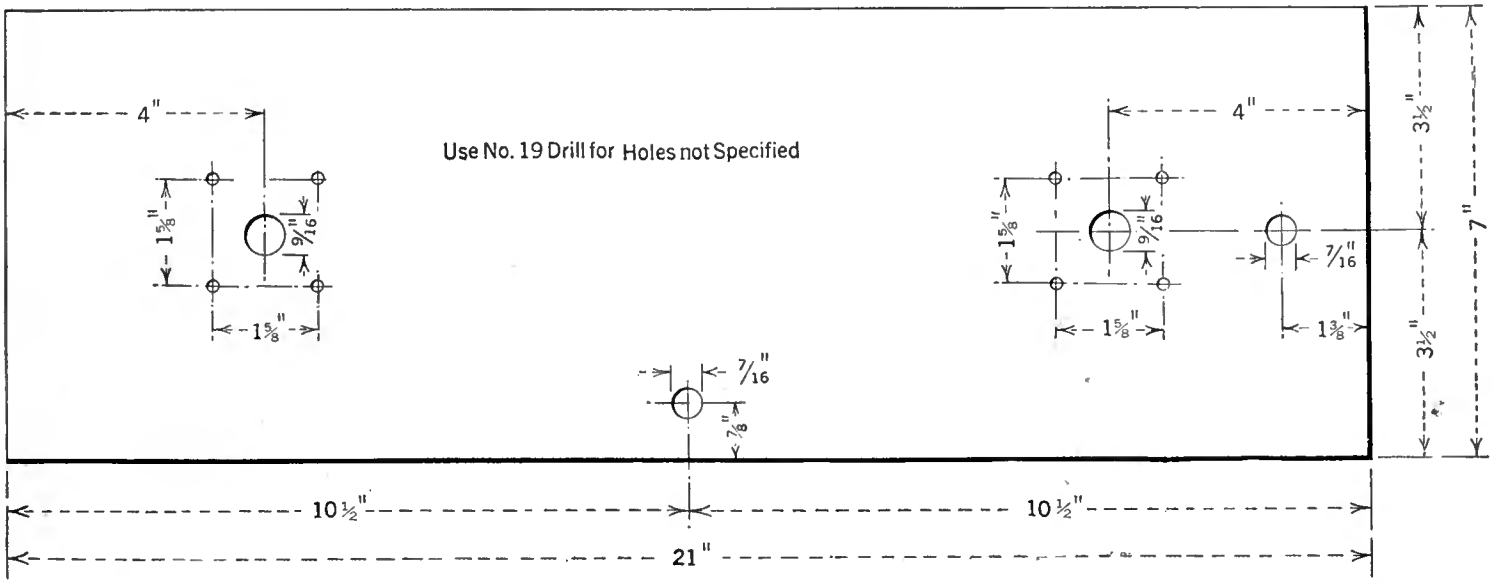


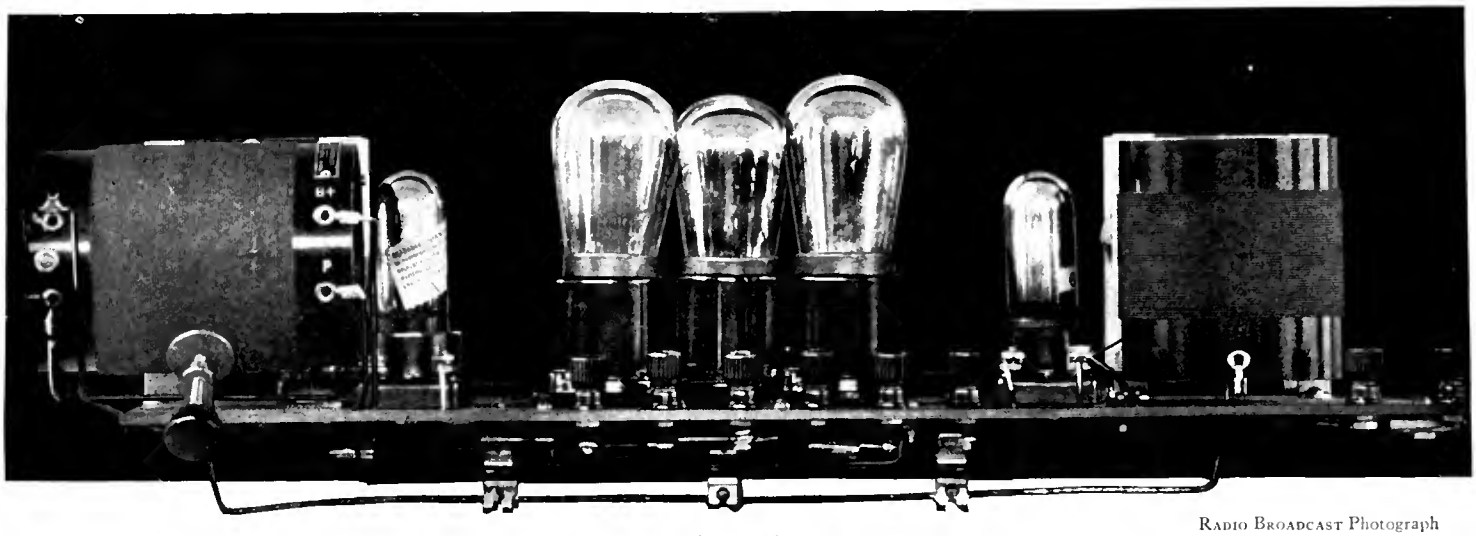
FIG. 4

The panel layout. There is room enough between the two tuning condensers to include a filament voltmeter which would not only add to the appearance of the receiver, but prove exceptionally advantageous in knowing the value of voltage delivered to the tubes

RADIO BROADCAST Photograph

FIG. 5

Looking down on the sub-panel, the position of the balancing condenser may be observed. Much of the wiring is below the sub-panel



RADIO BROADCAST Photograph

FIG. 6

The simplicity of assembly is evident from this view. Note that the two coil units are at right angles to each other and on the same plane. This is necessary to prevent uncontrolled oscillation

Three Daven .1 megohm grid leaks, and mounts.

Three 100-henry National chokes.

One Yaxley filament control jack.

One .001 mfd. fixed by-pass condenser.

One .0001 mfd. fixed condenser.

One balancing device.

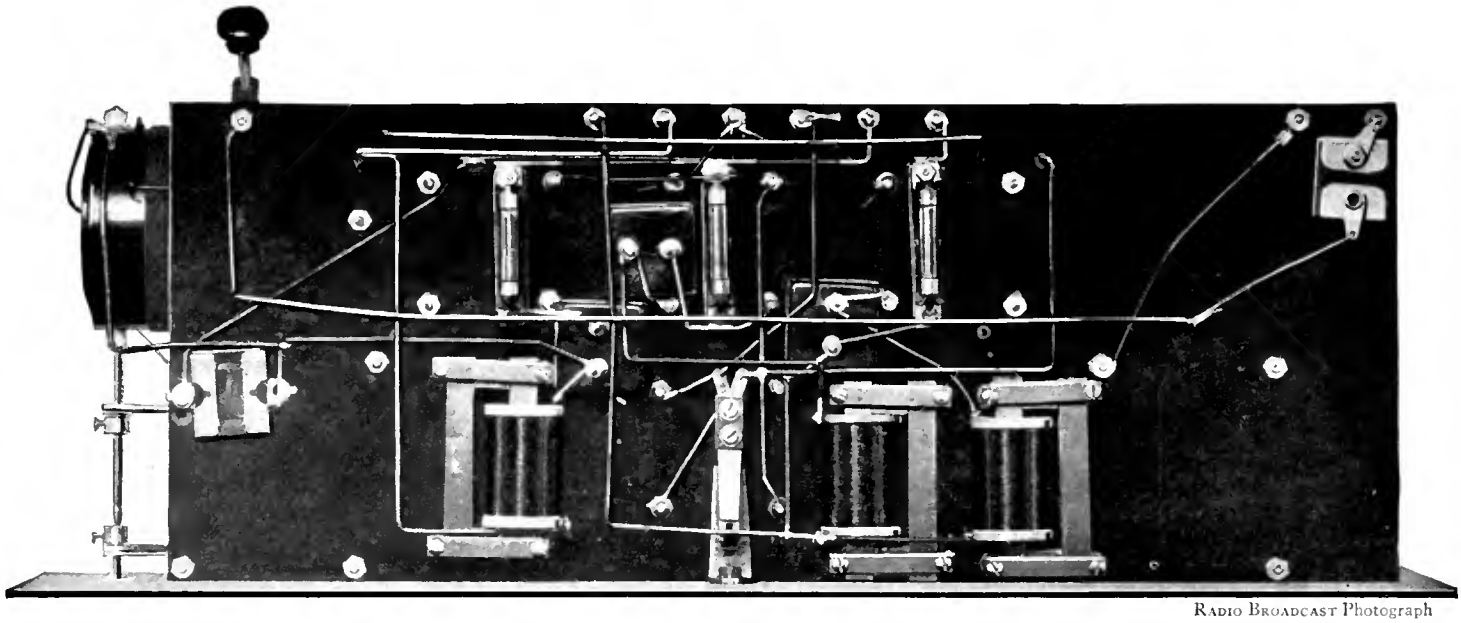
Nine binding posts.

RADIO BROADCAST Photograph

FIG. 8

The panel appearance of the completed receiver: simplicity itself

Fig. 1 shows the schematic diagram of the circuit used. The antenna tuning coil L1 consists of 46 turns of No. 20 d.s.c. wire on a three-inch bakelite form with a center tap taken off. The radio-frequency transformer, commercially familiar as the "regenaformer," consists of three windings, a primary, a low resistance secondary, and a rotor coil. The details of its mechanical construction are given in Fig. 2. The primary, L3, consists of 24 turns of No. 28 or 30 d.c.c. wire, wound in a groove and placed at the low potential end of the secondary coil (under the first few turns of the secondary at the filament end). The secondary, L2, is a single-layer solenoid made by winding 75 turns of No. 20 d.s.c. wire on a three-inch bakelite tube. As has been mentioned before, the resistance in this circuit is important, and a great quantity of data has been collected which would indicate that the resistance of a single-layer solenoid is somewhat lower than those wound in a so-called "low loss" manner. The rotor coil L_p is made up of 20 turns of No. 28 d.s.c. on a $2\frac{1}{2}$-inch form and so mounted that it may be rotated with respect to the secondary of the tuned radio-frequency transformer. The condensers chosen to tune the two circuits are of such construction as to separate the high frequency (short wavelength) stations considerably



RADIO BROADCAST Photograph

FIG. 7

An under-view of the sub-panel where most of the wiring is placed. Convenient holes in the sub-panel allow the passage of wires connecting parts above the sub-panel with those below it

more than the ordinary condenser, and their sizes are such as to cover a frequency spectrum from 600 kilocycles to 545 kilocycles (200 to 550 meters).

The construction of the choke coils is not described because of the difficulty of making them at home. The National 100-henry choke was used in the model described. However, any standard choke coil for audio frequency work may be employed, such as those made by Acme, the General Radio Company, AmerTran, and Thordarson.

CHOICE OF TUBES

IN EXPERIMENTING with the receiver, it was found that a UV-199 was much easier to balance than the larger tubes, and was consequently used as the radio-frequency amplifier tube. As most fans know, a UV-199 is also a good detector, so at the suggestion of Mr. Arthur Lynch, the two UV-199 tubes were put in series and three Daven six-volt tubes employed so that the set operates directly from a six-volt storage battery without the use of rheostats. Two Daven MU-20 tubes may be used in the first two stages of impedance with a MU-6 in the last stage. The constructor may use other tubes by placing the correct filament ballast such as Amperite, Brach, or Daven type in the battery leads of the respective tubes. A five-volt, ¼-ampere tube would take a ¼-ampere ballast, and a five-volt, ½-ampere tube would take a ½-ampere ballast, etc. The new power tube, UX-112, may be used in the last audio stage with about 135 volts on the plate and 9 volts C battery. A separate C battery binding post is provided so the last audio tube may have an independent bias battery. When the MU-20 tubes are employed in the two intermediate stages of audio, little or no bias is needed with 90 volts plate battery, but when higher voltages are used a C battery of 1½ to 3 volts should be employed for good quality reception.

Forty-five volts is recommended on both the radio-frequency amplifier and detector, as this voltage has been found more efficient on the detector and sufficient for the radio frequency tube. With 45 volts on a radio-frequency amplifier, no C battery is needed and the grid return is run directly to the negative side of the filament.

In laying out the apparatus so that the set would be compact, the tuning condensers are placed symmetrically on the panel with the tube sockets arranged as shown in the photograph, the radio frequency tube being the one on the extreme left with the detector on the extreme right, and the audio tubes between the two.

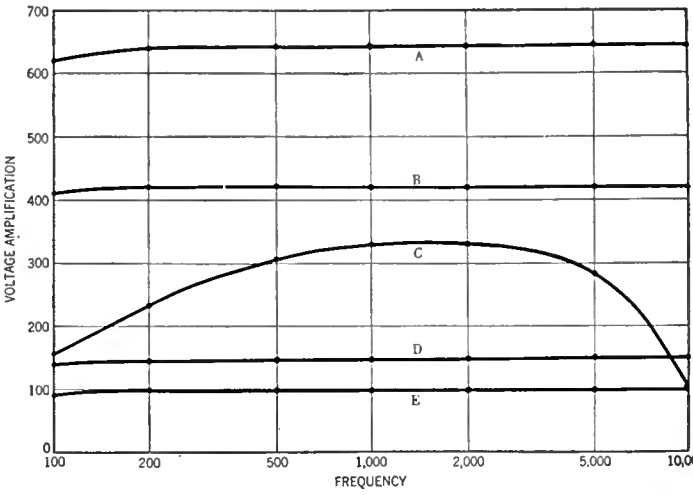


FIG. 10

Curves for various types of audio amplification compared in this article. *Curve A.* Three stages of impedance-coupled audio amplification, using two Daven MU-20 tubes and one Daven MU-6 in the last stage. One hundred-henry chokes, 1-mfd. condensers and 0.1 meg. grid leaks were used. *Curve B.* Three stages of resistance-coupled amplification, with two Daven MU-20 tubes and a Daven MU-6 in the last stage. In the plate circuit was 0.1 meg. resistance. The grid leaks were 0.1 meg. and 0.1 mfd. condensers were employed. *Curve C.* Two stages of transformer-coupled audio amplification were measured. The first transformer was a 6:1 and the second a 2:1 ratio. The tubes used had a voltage amplification of 8 which is standard for the 5-volt type of tube. *Curve D.* The curve of a three-stage impedance-coupled amplifier using tubes of a voltage amplification of 8; other constants the same as with curve A. *Curve E.* Three stages of resistance-coupled amplification, with similar constants. Curve B used with tubes whose amplification factor was 8

CONSTRUCTION DETAILS

THE balancing of the first tube is accomplished by placing a ⅞-inch metal disc, connected to the grid of the first tube, in the rear of the radio frequency transformer (about in the middle of L2) and moving it toward or away from the secondary winding. This method of balancing, though not generally known, is simple and effective. The details for constructing this balancing device are shown in the accompanying diagram, Fig. 3.

The drilling template for both front and sub-panel are shown, together with photographs of the complete set, so that there is little need for lengthy constructional details. However, the builder should be cautioned to keep his grid and plate leads as short as possible and well separated from each other. Most of the radio frequency leads are above the sub-panel, with the exception of the plate lead from the first tube to the primary of the radio-frequency transformer which is long, and should be kept well away from all other wires. The lead from the grid of the first tube to the balancing device should

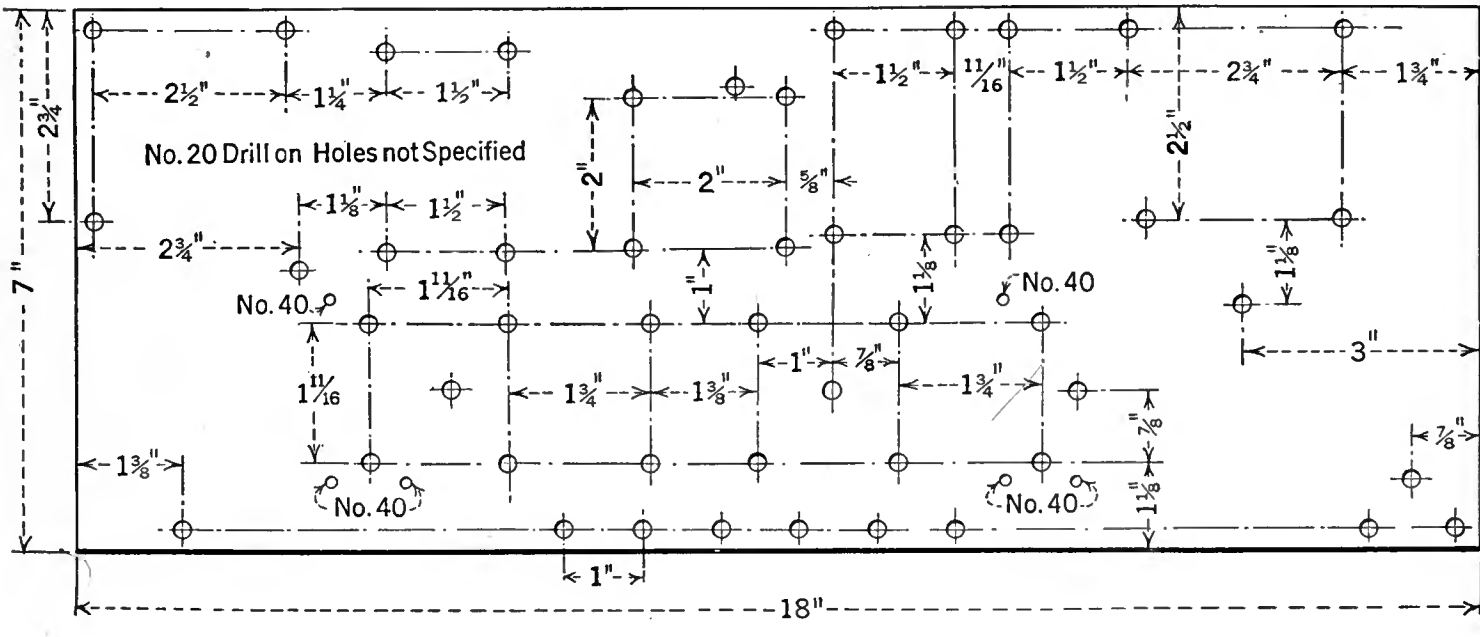


FIG. 9

The sub-panel drilling specifications which are self-explanatory. As you look at this layout the top is the front of the sub-base, and the bottom is the back which supports the binding posts, etc.

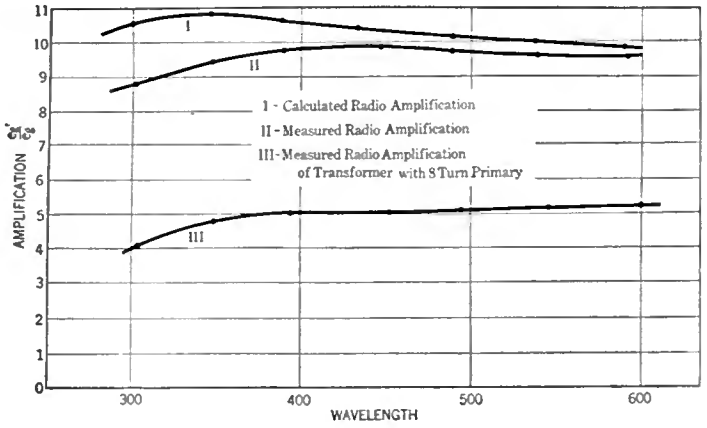


FIG. 11

Three curves which are both interesting and instructive. Note how approximately correct in comparison is the calculated and measured radio frequency amplification while manifestly the 8-turn primary is not as good

also be kept well away from other connections. A center tap is provided on the first coil, L_1, to be used with a long antenna of 100 feet or over, but as some antennas, which are even much shorter than this, have a large amount of capacity, it is well to make the connection from the .0001 mfd. condenser to the point of the coil which makes the two dial settings most nearly coincide at mid-scale. Only one jack is used, as most radio enthusiasts use a loud speaker except when tuning for extremely distant stations, and then it has been found that three stages of impedance-coupled amplification can be used conveniently with head phones. This is due to the fact that the noise which is apparent with transformer coupling, and which tends to draw comfortable reception of distant stations on the headphones, is absent with the impedance amplifier. Instead of using a filament switch, the jack is made to do double duty, so that placing the plug in the jack lights the tubes.

BALANCING AND OPERATING THE RECEIVER

THE first thing to do after the receiver has been constructed as shown, is to balance the first tube so that no radiation will occur, and in such a way that greatest signal strength will be obtained

Connect batteries, phones, and ground to the set, but do not connect the antenna. Turn the rotor or tickler coil to a point where placing a finger on the stator plates of the condenser, C_2, gives a loud "pluck" in the phone. This shows the secondary of the radio-frequency transformer is oscillating. Now rotate the coil until oscillations cease, as determined by the finger test. The first condenser should then be turned through its range, and if, at any setting of this condenser, the secondary of the radio-frequency transformer oscillates, the balancing device should be adjusted until this test is satisfactory, and the two tuning circuits are entirely independent of each other.

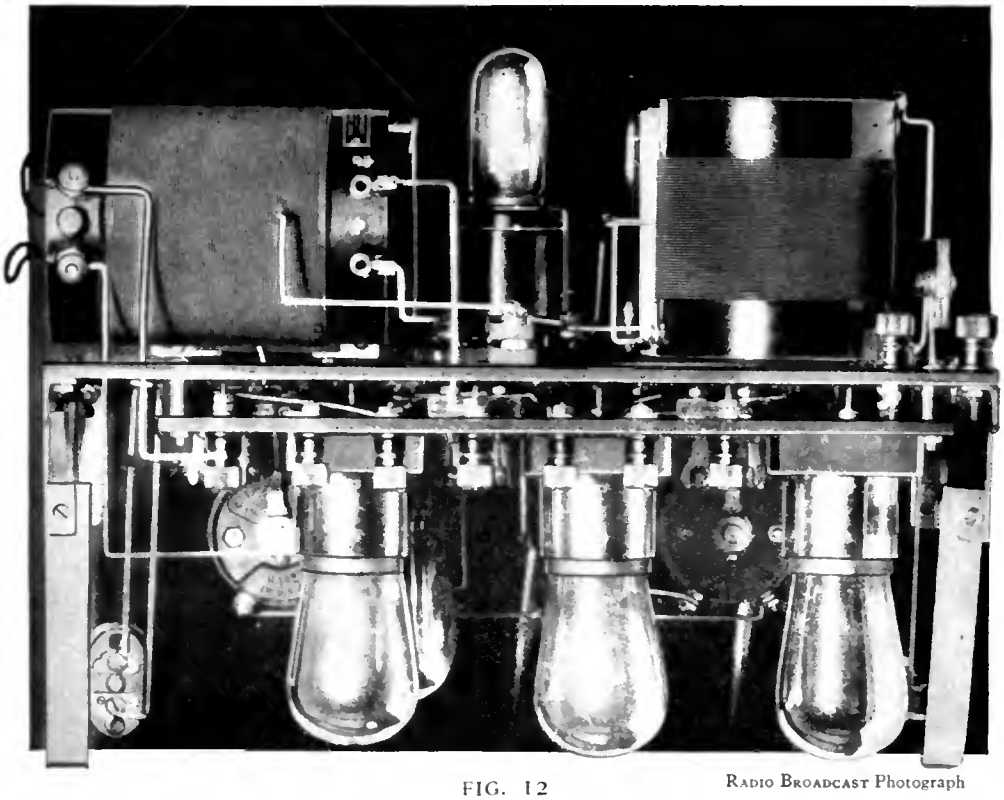


FIG. 12 RADIO BROADCAST Photograph

A compactly built modification of the Browning receiver, which could be made to fit in a phonograph cabinet as described in this magazine for June, July, and August 1925. This one employs resistance-coupled audio amplification. The amplifier units are situated below the sub-panel

A few notes on tuning may be helpful, though actually operating the set is the only way one can acquire the knack of doing DX work. If the set is performing normally, the volume coil, L_p, can be turned to such a position that placing a finger on the stator plates of the .00025 mfd. condenser gives a "pluck" in the receivers. This means circuit L_2, C_2, is oscillating. With the volume coil in that position, turn the dial of the .00025 mfd. condenser until this whistle is loudest and adjust the volume coil until the whistle disappears, and by slightly retuning, the station should come in. If the detector tube has a tendency to "snap" into oscillation instead of going in gradually, the resistance of the grid leak should be increased.

The receiver described is capable of extraordinary results, for not only is it a fine distance getter, but quality of the received concerts is almost above reproach. Combined with this is its non-radiating property, and the fact that an extremely short antenna of only ten or twelve feet of wire may be used with satisfaction.

Questions Concerning the Receiver Which Are Commonly Asked

Q. What is the trouble if the receiver tunes broadly?

A. The .0001 mfd. condenser in series with the antenna may be of incorrect value or an excessive amount of loss would give this effect. The blame might also be laid to poorly soldered connections to the two coils, L1 and L2.

Q. What makes the detector tube go into oscillation with a "snap" instead of going in gradually?

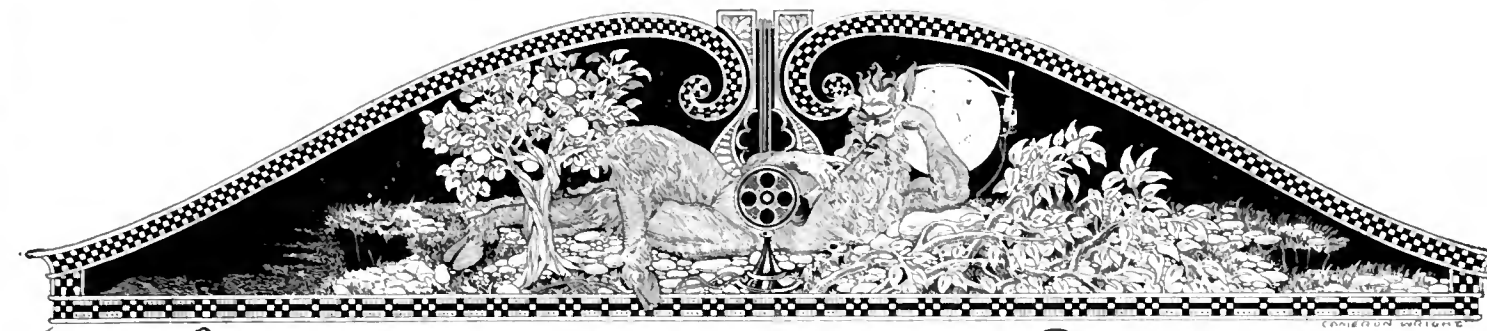
A. The grid leak is not the correct size. Try one whose resistance is higher. The grid condenser might be larger than .00025 mfd. (It is much better to use a condenser smaller than .00025 mfd. rather than one larger).

Q. What length and type of antenna works best with the receiver?

A. A 50 to 70-foot antenna is usually ample with as much of this vertical as possible. Very good results have been obtained with a piece of wire about 30 feet long extending from a pine tree down vertically to the receiver.

Q. Will the set work with a loop?

A. Yes; but even an antenna of fifteen feet located in the same room as the receiver has been found to give better results, and is easier to erect.



The Listeners' Point of View

Conducted by Kingsley Welles

Is the Popularity of Jazz Music Waning?

WHEN radio broadcasting was a novelty and one called in the neighbors to hear the voices coming in "right out of the air," little or no attention was paid to what the voices were saying. "Radio is a marvellous instrument, a tremendously potential medium, but what difference does it make if it is being used to give currency to worse than second-rate stuff," is about the gist of the very vocal objections made by these observers. George Jean Nathan, the rapier-worded dramatic critic of *The American Mercury* said in a recent issue of that green-jacketed organ of dissent:

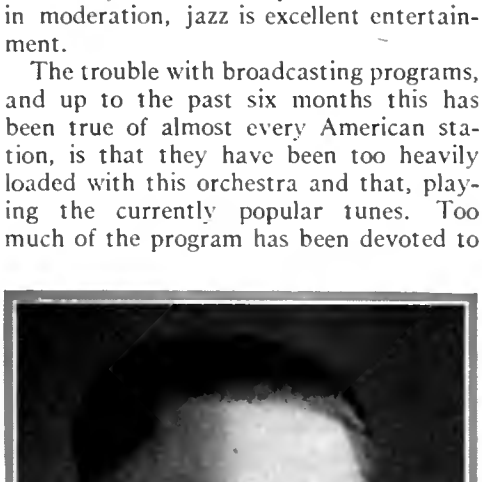
> Nightly the front parlors of the proletariat resound to the strains of alley jazz pounded out by bad hotel orchestras, to lectures on Swedenborgianism by ex-veterinary surgeons, to songs about red hot mammas, and Beale street melancholias by hard-up vaudeville performers. . .

Now all the criticism of radio programs made along these lines is true in that it is possible to hear the thing described from some radio station or other at one time or another. We should not judge broadcasting by that method any more than we should judge the thinking processes of the American citizenry by what we hear a chance street orator mouth. Broadcasting is not nearly as badly off as its hostile critics would have you think, and the aërial offerings of the radio season now upon us are daily justifying that belief.

"If it weren't for the constant stream of jazz flowing from nearly every broadcasting antenna," remarked a listener to us the other day, "I would enjoy radio a lot more. These jazz orchestras from every station in the country, all practically banging away at the same piece at practically the same time are much more than annoying." The trouble with a criticism such as this is that it groups all dance music as jazz, which is only true because we have no term which allows us to distinguish between the grades of jazz. We use the same term to describe the soft symphonic effects of Art Hickman, Ben Bernie, and Vincent Lopez as we use for the fifth rate Five Melody Kings of Four Corners, Oklahoma.

"I believe," writes D. M. Craig, of Lamar, Missouri, "that the universal condemnation of jazz is contrary to the true feeling of a majority of radio listeners, if all music is classified as jazz. Would these objectors want to stop the broadcasting of such organizations as those of Paul Whitman, Vincent Lopez, Jean Goldkette, and many others?" Decidedly not. While there are those who are utterly opposed to jazz whatever its origin, the more liberal among us recognize that jazz music has a very strong hold on a large percentage of the public of several continents, that it is not wholly as bad as it is pictured, and that, in moderation, jazz is excellent entertainment.

The trouble with broadcasting programs, and up to the past six months this has been true of almost every American station, is that they have been too heavily loaded with this orchestra and that, playing the currently popular tunes. Too much of the program has been devoted to dance orchestras, or to soloists who had nothing on their repertoire but whatever numbers were being sold in the music shops as "the latest thing" or, worse, to song "pluggers" in the employ of the music publishers. This practise of the broadcasters, we firmly believe, has shortened the life of many moderately good popular numbers, which otherwise might have retained popularity for a considerably longer time.



FRANK W. ELLIOTT

The new president of the National Association of Broadcasters, who succeeds Eugene F. McDonald, of Chicago. Mr. Elliott is business manager of station WOC at Davenport

Mr. Frank McEniry, of station KOA at Denver, in answering a recent inquiry of ours about this subject replied:

> On the whole, I believe listeners tire of jazz much more quickly than they do of the classical or semi-classical presentations. This belief is, of course, wholly a personal one, but it is based on a daily study of mail from our listeners. Here is an excerpt from the letter of a Western listener which seems typical of a great mass of mail we are receiving on the subject: "One cannot be unmindful of the lovely entertainment last evening; especially beautiful was the Floradora Sextet by the Municipal Band. Likewise, the same selection with the lullaby on the saxophone. It was such a relief from the slap-stick stuff one gets from many stations." That letter was from Charles G. Hickman of Forsyth, Montana.
>
> And here is another from Mrs. Walter Burk of New Plymouth, Idaho: "Almost without exception, we like the better class of music. Jazz ceases to have any appeal after the first two or three selections—it is all alike. . . ."

They are doing some good things at KOA, and by the time this magazine is in the hands of the reader, the competitive program of classical music as opposed to jazz music will have been given from that station. All the listeners will have a chance to express their opinion and a complete record will be made of the results. We hope to announce the findings in an early number. There should be some interesting letters after this contest.

Mr. Freeman H. Talbot, that able musician responsible for the programs of KOA set down some of his thoughts about the subject of jazz especially for this department. "For many years," he says, "music critics have been periodically announcing the death of jazz. Probably the

so-called music of jazz is largely responsible for the belief that it is moribund. To those who would shed no tears over its demise, jazz displays a most disheartening vitality. Phoenixlike, it arises fresh after each reputed annihilation." Mr. Talbot continues:

> Jazz has been called primitive, uncouth, banal. It has been charged with disrupting homes, weakening Church ties, and undermining the morals of the nation. Personally, I feel that jazz is not all bad—it is not clever enough for that. It may be banal, and at times it is discouragingly stupid, but it is not essentially bad. Lately, jazz has gathered to itself some notable defenders among the musically correct. Serious minded musicians have perceived under the battered and tattered appearance of jazz, evidence of a new vitality in music, a struggle after a new form of expression, crude as the hieroglyphics of Cubism, but genuine art, nevertheless.
>
> The moans, shrieks, cat calls and sobs of jazz will eventually disappear, but the vibrancy of its stimulating rhythms will remain to be caught some time by a master composer on a new work or series of works as revolutionary as the cacophonies of Wagner.

How do all these remarks apply to present programs? Well, they are some of the signs—if indeed any are needed—which show that the old preponderance of jazz on programs is greatly lessening. For some time, one of the two outstanding stations in New York City has had a rule, somewhat flexible, it is true, that no dance music can be broadcast until after ten thirty in the evening. Mr. Carl Dreher discusses this matter more fully on another page of this number. The fact that the musical parts of programs are being more devoted to more serious efforts by stations in nearly every part of the country except Chicago, simply means that there is less time left for jazz.

To mention a specific type of program which has brought improvement in its tone, consider some of the "indirect advertising" programs put on through the WEAF chain of stations. Here is what the director of broadcasting for that station, Mr. J. A. Holman, says about them: "Programs have been presented of a type that previously would have been considered impossible by radio—impossible in the sense that they assumed too high a degree of musical and general culture on the part of the radio audience. The public accepted them at their real value and enthusiastically availed itself of their educational activities. . . . No music was too "highbrow." For example, George Barrère's Little Symphony Orchestra presented a series of chamber music recitals, which while beautiful and perfect gems of instrumental music, are generally considered above the understanding and appreciation of the average music lover. The interesting fact is that the American public welcomed the innovation. . . ." The radio audience is not required to listen altogether to the sad stuff outlined by Mr. Nathan. The signs are unmistakable that the taste of the radio public is changing, and for the better.

A New Note in Broadcasting: Coöperation

TO MOST listeners in this country east of the Mississippi River who heard the broadcasting of the radio industries dinner from the Commodore Hotel not so long ago, it probably seemed as if very little was occurring except the presentation of an exceptionally fine purely entertainment program announced by the active Major J. Andrew White. A good program it was, too, with some of the Capitol radio family, the Happiness Boys, the shy Will Rogers, busy explaining why he was not there, Rudy Weidoeft, Vincent Lopez and his Orchestra, and several speakers, including Senator Dill. The radio lambs and lions, however, were lying down together and at executive sessions before and after the dinner, various associated organizations arrived at some decisions whose effect may be far reaching.

The National Association of Broadcasters, whose member-stations include a good proportion of the broadcasters of the country, elected Dr. Frank Elliott of station WOC at Davenport, president, succeeding E. F. McDonald, Jr., of station WJAZ.

And among other applicants, station WEAF, New York, was admitted to membership. This is somewhat important, because thus far, WEAF has played a lone hand in broadcasting. It probably means that broadcasters are going to coöperate to a greater degree than ever before, with inevitable benefit to the listener.

Ever since the first broadcaster was licensed, there has been a quarrel on between the owners of the radio stations and

REINALD WERRENRATH, MME. LOUISE HOMER, TOSCHA SEIDEL, AND A. ATWATER KENT

The Atwater-Kent Manufacturing Company has arranged a series of Sunday evening concerts given at 9:15, Eastern Standard time through WEAF, WCAP, WJAR, WEEI, WCAE, WSAI, WWJ, WOC, WCCO, WGR, WOO, KSD, and WTAG. The series presents some of the best-known artists familiar to concert-goers and is regarded by radio listeners as one of the real treats of the Fall and Winter radio season. There will be thirty concerts and the last will be given some time in May, 1926. Mr. Werrenrath, baritone, gave the first concert on October 4th, and was followed by Mr. Seidel, the well known Russian violinist. Mme Homer, the contralto of the Chicago Civic Opera Company, presented a popular program as the third concert of the series. Mr. Kent is shown in the photograph at the top

JEAN GOLDKETTE AND HIS LITTLE SYMPHONY ORCHESTRA—AT WJR

The photograph at the left shows one of the orchestras heard regularly from station WJR. Left to right: J. Schwatzman, cello; Gaston Brohan, bass; M. Shapiro, violin; Victor Poland, violin; Jean Goldkette, pianist and conductor; Joseph Gorner, violin. The Book-Cadillac Hotel is shown at the right and houses the Detroit studios of WJR-WCX. The transmitting apparatus of the two stations operating on 580 kc. (517 meters) is located at Pontiac, Michigan

the organization which claims to have control of most of the copyrighted musical numbers, both popular and more classical—the American Society of Authors, Composers, and Publishers. This Society to the outsider appears to have what amounts to a monopoly in the control of the performance of copyrighted music. And also to the outsider they seem to have exercised that control in a most arbitrary fashion. Whatever the merits of the disputes between the two opposed parties may be, the situation now seems to be that the broadcasters are unwilling to pay for a yearly license from the Society for the simple reason that they have no assurance that they will be fairly treated from year to year. The broadcasters have taken the sensible position (to use their own phraseology): "we desire to see that the writer of the songs as well as their assignees shall be paid a fair sum. . . . *Resolved*, that the principle involved in the reproduction of music by mechanical means now embodied in the present copyright law be extended to the reproduction of music by radio. . . ."

This means, simply put, that the listeners will benefit, for after the smoke of legal battle clears away, it will undoubtedly be possible for more stations to broadcast much good music which is barred to them now by the provisions of the copyright. It also means that radio is advancing toward a firmer and sounder basis, for there is no doubt that the dispute over payment and copyright has hampered the arrangement and presentation of programs.

Radio Plums for the Present Season

WHILE the optimistic estimate of Mr. W. E. Harkness of the American Telephone and Telegraph Company that the largest of the WEAF wire tie-ups reached sixty-five per cent. of the listeners of the United States may be viewed with the raising of an slightly doubting eyebrow, it is certainly true that the new concerts of the Atwater Kent Company which began on October fourth have jumped into immediate popularity with a great number of listeners. When the Victor and Brunswick Companies broadcast their concerts last year, the radio audience sat up before its assorted loud speakers and wondered if something new hadn't happened in broadcasting. It had. The tone of all broadcasting was raised and it is our belief that it will never be lowered. The first concert of the Atwater Kent series with Reinald Werrenrath, one of the best of American baritones, set the pace for the rest of the series. Other artists who will be heard in the thirty concerts, which begin at 9:15 P. M. Eastern Standard time, on Sunday evenings, are among the foremost opera and music stars of the world: Louise Homer, Edward Johnson, Mabel Garrison, Maria Kurenko, Salvatore de Stefano, Alexander Brailowsky, Leo Luboshutz, Charles Hackett, Florence Austral, Albert Spalding, Benno Moiseiwitch, Toscha Seidel, Felix Salmond, Vincente Ballester, John Powell, Eva Gauthier, Anna Case, Freida Hempel, Paul Althouse, Arthur Middleton, May Peterson, Paul Kochanski, Mischa Levitski, and Hulda Lashanska.

Then there are the concerts of the Victor and Brunswick Phonograph Companies which will be heard from the Radio Corporation group of stations, which will present other opera stars. It looks like an embarrassment of riches for the radio audience. Whatever the internal politics among the broadcasters and however strong the grimly competitive spirit, the listener is sure to benefit.

Learning, Via the Loud Speaker

THOSE who have a burning desire to increase their store of knowledge can accomplish a good part of that end by radio if they are so minded during the radio season now upon us. During the last two years, many radio "extension courses" have been offered over the air, and the State University of Iowa was probably the first higher educational institution to offer a regular air course, which was begun last year. Station WSUI, 620 kc. (484 meters) is broadcasting a course of lectures on Monday and Wednesday from seven thirty to eight fifty P. M., Central Standard time. On Mondays lectures on "Early Iowa History," "American Literature," "Iowa Flora" and "Population Problems" On Wednesdays WSUI offers lectures on "The Teaching of English," "Political Parties in the United States", and "Elementary Psychology." Actual university credit is offered to those radio listeners

who complete the requirements of the course. Full information can be secured from Edward H. Lauer, director, extension Division, State University of Iowa, Iowa City. In Pittsburgh, station KDKA will resume its extension courses in coöperation with the University of Pittsburgh and the Pennsylvania State College. In Springfield, WBZ is laying plans for another excellent series of extension lectures. In Oakland, KGO, is broadcasting regularly to the grade schools of the city according to a very well worked out and ambitious plan. Throughout the country, educational programs, most of them well planned out and presented can be regularly heard with little more trouble than a reference to the newspaper programs and the effort of revolving a dial.

THE AIR COLLEGE FACULTY AT WSUI

At the State University of Iowa, Iowa City. A series of lecture courses, of college standard are broadcast from WSUI throughout the winter, and college credit is given to those who comply with the requirements. Left to right: Edward B. Reuter, Frank Luther Mott, Bruce E. Mahan, Christian A. Ruckmick, Helen Williams, M. F. Carpenter, Kirk H. Porter, Bohumil Shimek, and Edward H. Lauer

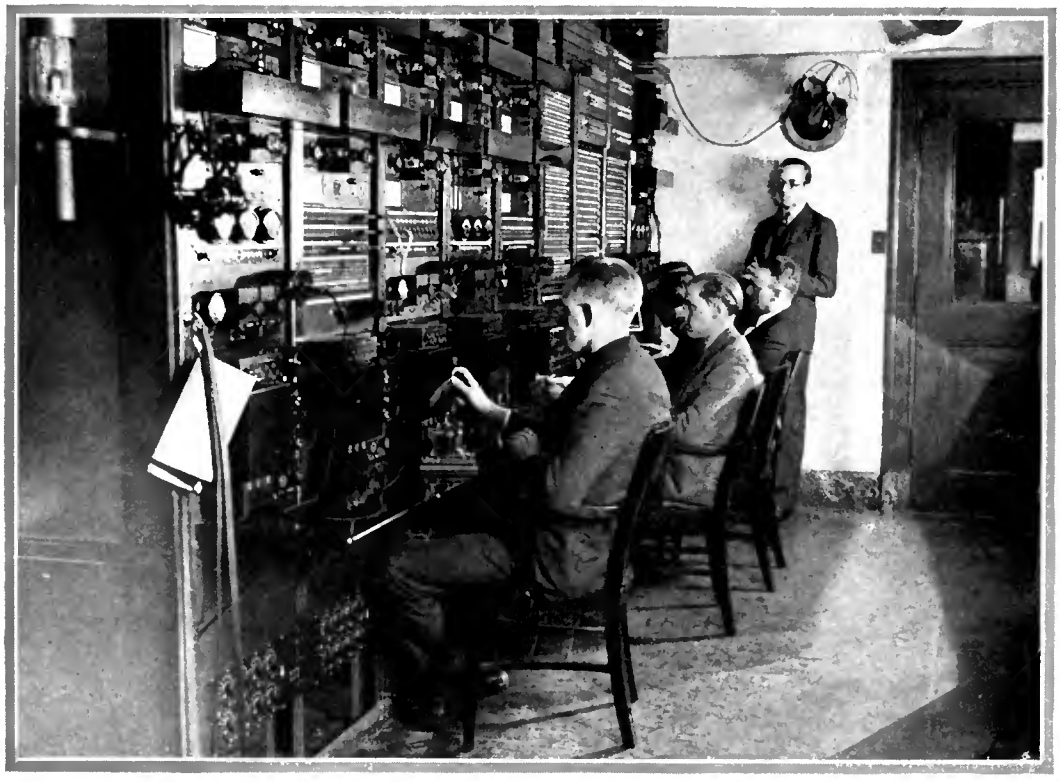
Why the Farmer Likes Radio

VERY early in its experience with radio in the broadcasting of economic information, the Department of Agriculture proceeded on the theory that radio broadcasting, when established as a regular part of the machinery of our present day living, would render a greater measure of service to the farmers than any other group or section of society," writes J. C. Gilbert, the Marketing Specialist of the Department of Agriculture. "The Department is firm in its belief that radio is a permanent fixture on the farm, as strongly entrenched, perhaps, as the Ford. The experts of the Department estimate that there are 553,003 radio sets in use on the farms of this country, as against an estimated total of 364,800 receivers in use in 1924. While most of us depend on radio broadcasting for entertainment and perhaps a bit of news, the farmer is growing to think of his radio set as a source not only of pleasure but of genuine profit.

One of the most interesting letters among a large number written by the farmers to show just what radio is doing for this interested class of listener was written by Fred Buchanan of Granger, Iowa who said:

> As early as 8:30 in the morning we get livestock market report and from 10 o'clock on, grain reports. The market reports will revolutionize the farming business. The farmer gets the news about markets right off the bat—he does not have to take the buyer's word for anything, and knows as much about them as the man at the principal market points. . . . If everything in broadcasting is cut out, save the market reports, for they are bread and butter to us out here.

The increasing number of radio sets on farms, suggests the Department of Agriculture, places a responsibility upon those who conduct broadcasting stations and those who have information to distribute. When half a million farmers turn a listening ear toward the broadcasting stations of the country, they expect to hear something worth while. They expect the weather reports, market reports, agricultural lectures, instruction



"WEAF AND TWELVE OTHER STATIONS. . . ."

The "speech input equipment" of the Bell System at 195 Broadway, New York where the program, originating at the WEAF studio is sent to the stations connected to it by wire. On some programs as many as thirteen stations—as far west as Davenport and St. Louis—are connected. At the control board shown, much of the wire "routing" is done. The second panel from the left contains the board on which the program comes from the microphones in the studio. The small hooded lamps are speech amplifier tubes, which increase the strength of the energy before it is sent out by wire to the distant broadcasting station. The three switchboards at the right take the programs for the various wire lines to the Middle West. Two complete "set-ups" are always maintained—one wire for broadcasting, called the red layout, and another, the "order wire," so that instructions can go out independently between the control office and the various stations. If the broadcasting line should go bad, it is possible to swing in the "order wire" and so the program continues without interruption. No other traffic goes out over the broadcasting wires—contrary to regular long distance telephone practise, some lines carrying many other telephone and telegraph messages

LOUIS WILEY

Business Manager of the New York *Times* who recently spoke over WMCA, New York. "The daily newspapers published in English on Manhattan Island," said Mr. Wiley, "exclusive of trade newspapers, have the astounding total daily circulation of 4,039,286 copies. The total is approximately twice the number of families in the entire metropolitan district. There is no other cohesive force, not even our schools, which is so important in the life of our community as the newspaper."

on various subjects from their agricultural colleges and experiment stations. The Kansas State Agricultural College at Manhattan, Kansas, station KSAC, ever since 1923 has taken the lead in broadcasting air courses for rural residents on agriculture, engineering, home economics, and general science. Those who have heard the lectures in these excellent courses will agree that they are well worth an hour's listening.

Broadcast Miscellany

IT IS sometimes fortunate that the radio artists do not hear all the remarks—well intentioned enough for the most part—made by the radio announcers. It was only the other night that a soloist failed to appear at a certain large station. "However," vocally beamed the announcer, "Mr. Edward Gumph, a very dependable artist, will entertain you." Memo for the desk pad: "Be sure to tune-in radio to-night to hear "dependable artist."

THE publicity man of WNYC was doing his best to drum up interest—on paper—about the broadcasting of recent municipal election returns from the station. Quoth he, "The first official election figures available will be heard from this station, since it will operate in conjunction with the Police Department. As votes are counted at the *poles*, each district reports to its Police precinct. . . ." Italics ours, or is it "our'n?" It is so hard to remember these days when spelling books are out of print.

LEO FITZPATRICK, the "Merry Old Chief" of the Kansas City Star station WDAF has left Kansas City and will now be heard from WJR, Detroit. He was the organizer of the phenomenally popular "Nighthawks" whose membership is said to reach 200,000.

NEXT to WGY, now licensed to use 50,000 watts on Saturday and Sunday nights, KDKA with a license to use as much as 10,000 watts is the most powerful broadcaster in the country. There are ten 5000-watt stations, WSAI, WLW, WOC, WCCO, WCBD, WORD, KOA, WOK, WHO, and WEAF. Stations WGY, and WTAM follow with 3500 watts each, and KFI and KGO each, with 3000 watts are next in power rating. Station WTAS and WJR-WCX use 2500 watts. There are now three stations employing 1500 watts, 25 using 1000, and seven with 750 watts.

THE present conductor of this department is relinquishing his duties with this number of RADIO BROADCAST because of his heavy duties in other departments of the magazine. His successor, Mr. John Wallace, of Chicago, a writer and critic of more than ordinary ability, will continue "The Listeners' Point of View" in the January number.

THE new station, WLWL, 1040 kc. (288.3 meters) operated by the Paulist Fathers, in New York went on the air with its first program not so long ago. A frankly religious station, operated by a branch of the Catholic Church, its first programs have been all that one could ask for in the matter of dignity and high quality. The work of WLWL is being watched with some interest by listeners in the Eastern part of the country. Those who can hear the station on its high frequency band are missing a rare treat if they do not hear the Paulist Choristers, frequently broadcast from this station, which is on the air between 8 and 10 P. M., Eastern Standard Time, on Sunday, Tuesday, and Friday nights.

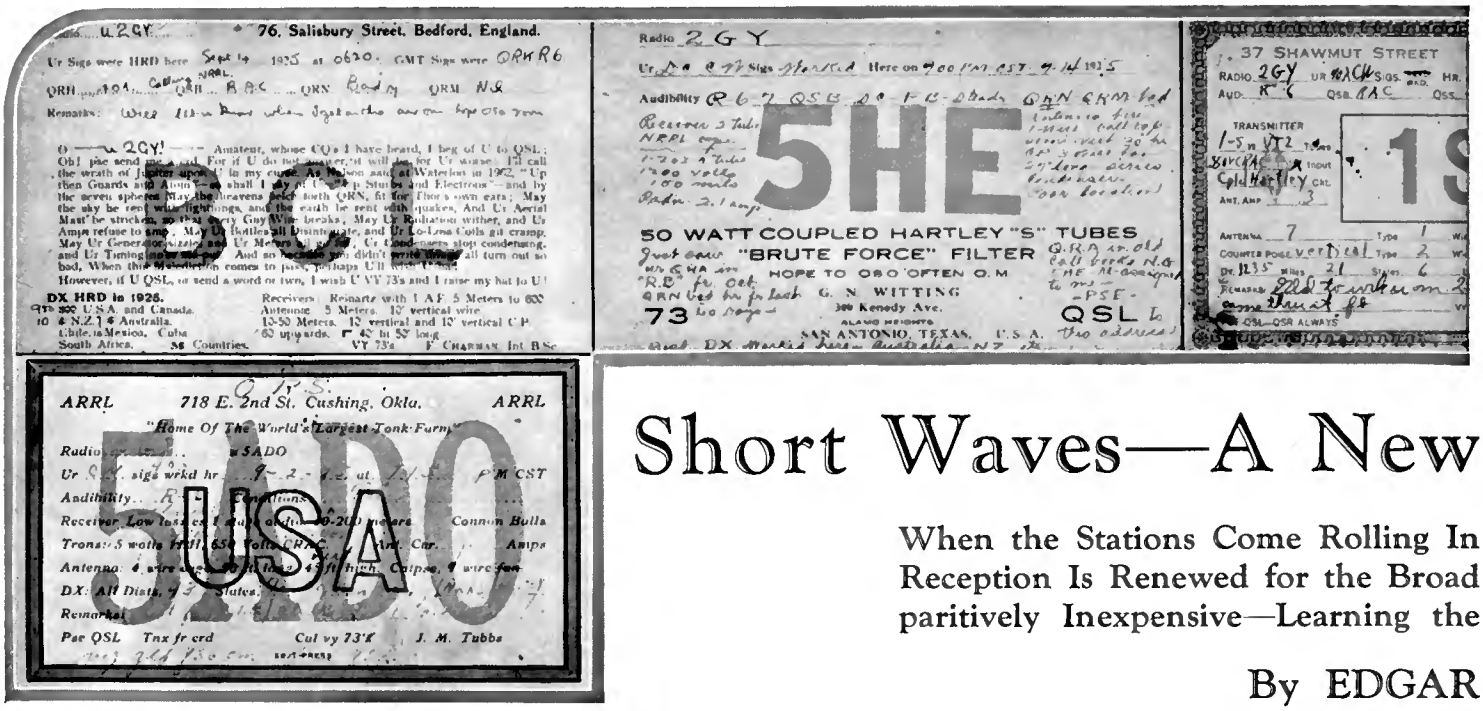
A NEW broadcasting station is scheduled for St. Louis which will be sponsored by sixteen firms in that city, the St. Louis *Globe-Democrat*, the Colin B. Kennedy Corporation among them. It will be a 5000-watt installation, located, as is the growing practise, a number of miles outside the city. This is the second large station to be installed by a group of business interests and operated coöperatively by them. The first station of this kind was the excellent WCCO, Minneapolis-St. Paul.

Nashville, Tennessee, has a new station, WSM, which took the air early in October on a frequency of 1060 kc. (282.8 meters).

IT IS reported that *Liberty* has bought the erstwhile WTAS at Elgin, Illinois and will soon come on the air with its own programs. It is to be hoped that the publishers of *Liberty* will be enabled to present programs of a better type than WTAS The mental level of WTAS is best indicated by their slogan, "Willie, Tommy, Annie, Sammy." The writer defies any one to distill sense out of that. *Liberty* is owned by the same group which publishes the Chicago *Tribune* and the new station, WLIB, will thus join WGN, making two stations in the Chicago area owned by the same interests.

THE COON-SANDERS "NIGHTHAWKS"

Frequently heard from station KYW, playing from the Congress Hotel in Chicago



Short Waves—A New

When the Stations Come Rolling In Reception Is Renewed for the Broad paritively Inexpensive—Learning the

By EDGAR

THE twirling dial has captivated the imagination of the world and the prophecy of the Arabian Magic Carpet has been more than fulfilled, as we flit from city to city, by a mere turn of our tuning control. The thrill of DX reception is still with us, but its captivating novelty, strangely enough, is already wearing off.

That the popularity of DX broadcast reception should occupy the center of the stage for so short a period in the interest of the average broadcast listener is surprising, when we consider the marvel of that scientific conquest. But it cannot be denied that those who have tasted a season or two of DX are to-day concentrating in the search for better quality of tone reproduction so that they may receive the local stations with truthful fidelity of recreation. The DX hound of yesterday is the stickler for high quality of to-day.

Not that we forget those proud moments "when the stations come rolling in," with the aid of a newly built receiver —when New York, Philadelphia, Pittsburg, Cleveland, Chicago, Minneapolis, Atlanta, Hastings, Denver, Los Angeles, Seattle, Oakland, Montreal and Mexico City were heard all in one evening! But even such accomplishments may become commonplace.

To him, who would again enjoy these thrills, we say, take heart, for short wave amateur transmission and reception has brought us new fields to conquer, more fascinating than the old. There is no exhausting the novelty of amateur communication until we have established personal friendships in every corner of the globe! The construction of a simple but efficient short wave receiver brings the whole world within range of the dial.

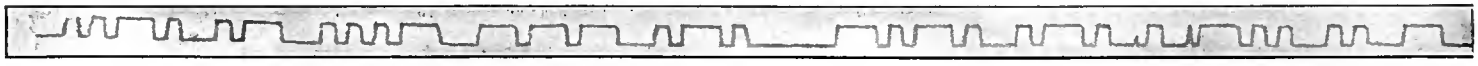
When the stations come rolling in on 7500 kc (40 meters), our magic carpet is not delimited in its journeyings to the confines of a mere continent. We begin at the remotest border of our broadcast DX range as the appetizer for an international evening. First, it's England, France, Belgium, Holland, Switzerland, Spain, and Italy. Slowly, we move on as the radio night advances, picking our way through myriads of American amateurs for the foreign stations to which our short wave receiver makes us host. Next, it is Brazil, Argentina, Chile, Alaska, Hawaii, as the shades of radio night advance westward. In the early morning hours, New Zealand, Australia, the Philippine Islands and Japan reward our zealous dial twisting. A diet fit for a DX king!

WHO "BOILED OWLS" ARE

NOR is it unusual, as the first inkling of fleeting time, to have the bright rising sun break into our international reveries and remind us that once more we must resume our daily tasks. For such is the lure of the new DX that its first tastes have led many a new recruit to sit attentive before his receiver the long night through. Such ardent devotees of the dial are rewarded with the honored title of "boiled owl"—a fitting designation for one whose long distance work has been unexpectedly interrupted by the rising sun. Increasing numbers of broadcast listeners are being intrigued into this fascinating field of radio reception, permitting, as it does, a much greater scope for their DX abilities. The requirements to admission are few. The receiver used is of a much less elaborate type than that needed for good broadcast reception. Two tubes at the most are usually employed. Tuning is so sharp on the high frequency (short wave) amateur bands, that but one tuning circuit is required. Another control adjusts regeneration, which plays an important part in short wave reception. There is nothing startling in the way of special equipment needed.

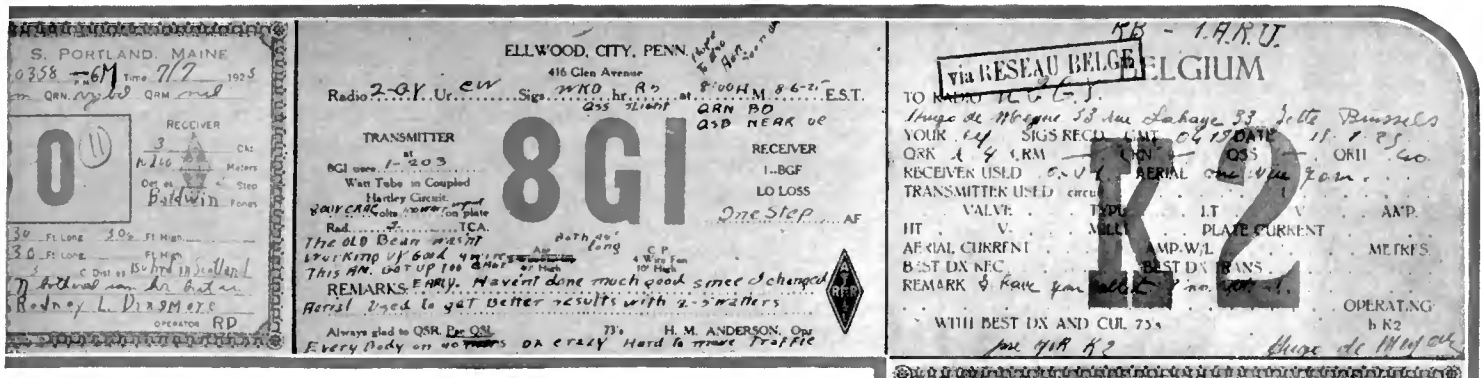
It is needless to describe in detail a suitable receiver, because extensive experiments are under way, leading to the development of short wave receivers for the needs of new recruits to this new field. Simple receivers and small battery powered transmitters will soon be described in RADIO BROADCAST, and these can be built at costs ranging from $20 to $50, including vacuum tubes. These experiments are being conducted at the RADIO BROADCAST

I WAS talking to a chap in Australia last night" is not an uncommon report from a well equipped amateur radio operator in these days of short wave, low power transmitting. The Navy, in 1902 were gleeful over a record of established communication from Annapolis, Maryland to a ship off the coast, 50 miles away. But to-day, even the lowliest amateur would consider a 50-mile transmission as nothing. Of course all this short wave communication is accomplished by radio telegraph and one has to have a working knowledge of the Continental code in order to share the thrills of this long distance work. But learning the code is not



HOW SHORT WAVE HIGH POWER—

A section of tape, part of a message received at the Broad Street offices of the Radio Corporation of America from station SAQ at Gothenburg, Sweden. The message reads: "Favor creditbank Oslo 2." The effects of static can be seen in several places appearing as a sharp pointed mark much narrower



Paradise for the DX Fan

on Forty Meters the Thrill of Distance cast Listener—The Apparatus Is Com- Code Is Necessary But Not Difficult

H. FELIX

laboratories with the coöperation of the National Carbon Company.

Amateur transmission is carried on largely on a frequency of 7496 kc. (40 meters). Some stations work on about 60,000 kc. (5 meters) and a great many others on 3750 kc. (80 meters). Another group, employing radio telephony and continuous wave telegraphy, work on 1666 kc. (180 meters). A 7496 kc. (40 meter) receiver, however, gives ample opportunity for DX work because amateurs in all countries of the world where the contagion has spread are permitted entrance to the ether on or about this frequency.

WHO'S WHO ON SHORT WAVES

THERE are also other ethereal attractions available to the possessor of the short wave receiver. Considerable commercial transoceanic communication is carried on by new experimental short wave transmitters, which may some day supplant the immense high power, long wave equipments erected prior to the debut of the short wave. Among these stations are Nauen, Germany, POZ, operating on 15,000 kc. (20 meters); 2YT, Poldhu, England, 12,000 kc. (25 meters); LPZ, Buenos Ayres, 8333 kc. (36 meters); 1 XAO, Belfast, Ireland, 4997 kc., (60 meters); SFR, Paris, France, 4614 kc. (65 meters); WQM, Rocky Point, Long Island, 4000 kc. (75 meters) and RDW, Moscow, Russia, 3614 kc., (83 meters.)

Another service, which lends enchantment to the short wave territory, are special rebroadcasting links used to interconnect chains of stations or to furnish programs to permanent stations. The programs of WGY are broadcast on 8570 kc. (35 meters); KFKX, Hastings, Nebraska, 5357 kc. (56 meters) and KDKA, Pittsburgh, 4838 kc. (62 meters.) Oftentimes these programs can be heard with great volume on the short wavelengths while the broadcast receiver is incapable of picking them up on their regular broadcasting channel.

The MacMillan expedition also used short wave transmission for code and radio telephone communication, during its recent exploration voyage. Short wave enthusiasts were privileged to hear the transmitters installed on the two principal ships of the expedition.

The Navy Department has taken cognizance of the possibilities of the short wave in its recent Pacific cruise by the installation of short wave station NRRL aboard the U. S. S. *Seattle*, flagship of the fleet. It selected Mr. F. H. Schnell, Traffic Manager of the American Radio Relay League, to take charge of the transmitter. The extraordinary success of his work is one of the most interesting chapters of amateur short wave history, producing as it did convincing evidence to naval officials of the practicability of extremely long range transmission on low power. The experimental station of this magazine, 2GY, communicated with NRRL while she was leaving Tahiti in the South Pacific Ocean. Forty meters and five watts of power were used at the Garden City end.

Two difficulties of broadcast DX are not encountered to a great degree in short wave reception. First, interference is minimized because of the very much sharper tuning on the high frequencies (low wavelengths.) Second, the difficulty of identifying stations is greatly reduced because amateurs sign their call letters frequently and freely.

THE CODE: OPEN SESAME

ON THE other hand, the broadcast listener must spend some patient evenings in learning the code, for amateur communication is carried out by the dot and dash method. Not that this is a tremendous undertaking, although the first few hours of code education are usually quite bewildering. It is something like learning to operate a typewriter. If you do not know the location of a single letter on the keyboard, your progress is very slow. But as soon as you are familiar with the position of a few letters, progress is quite rapid.

Amateur communication is carried on at a much slower rate of sending than that used in commercial traffic. By the use of abbreviations, representing an efficiency comparable only to that of short wave transmission itself, the amateur compresses

such a chore as it is commonly reported to be, and more than one broadcast listener, to whom DX reception is almost essential, is buckling down with key and buzzer to learn the code and take part in the fascinating short wave communication. We shall publish articles in later numbers, describing the construction of simple transmitters and receivers which will operate on these bands. We believe with many of our readers who have written us since articles about short wave communication have appeared in this magazine, that this is a fascinating new field to which many broadcast listeners will glady come.—THE EDITOR.

—RADIO MESSAGES ARE RECEIVED

than the characters of the code. The Radio Corporation maintains several short wave stations, some operating on frequencies as high as 15,000 kc. (20 meters), mainly as an adjunct to their long wavelength stations. German and Argentine stations are also using short waves for telegraphic traffic

into a few letters messages of considerable import and significance. A few samples of this esoteric language will serve to indicate the principles upon which it is founded.

First amateur:

CQ CQ CQ CQ CQ CQ U1AQR U1AQR U1AQR U1AQR . . . . CQ CQ CQ CQ U1AQR U1AQR U1AQR

Second amateur:

U1AQR U1AQR U1AQR G2BAO G2BAO G2BAO G2BAO QRA?

First amateur:

G2BAO G2BAO G2BAO U1AQR U1AQR U1AQR QRA WALTHAM MASS GE OM U VY QSA HR BUT QRM FM U6CIX WL WK U LATER HV 2 MSGS 4 CUL 73 OM

Second amateur:

R R UR SIGS GD BUT QSS CUL

This seemingly cryptic communication is pregnant with information and good manners. CQ is a general invitation to communicate. CQD, the predecessor of the now universally adopted SOS distress call, is derived from CQ, the D being added to signify "danger."

U1AQR is the first amateur's official call. The letter prefix designates him as a resident of the United States. The figure 1 indicates his location in the New England district. The United States is divided into nine districts, each headed by a radio inspector. AQR are the letters assigned to this particular amateur by the Department of Commerce.

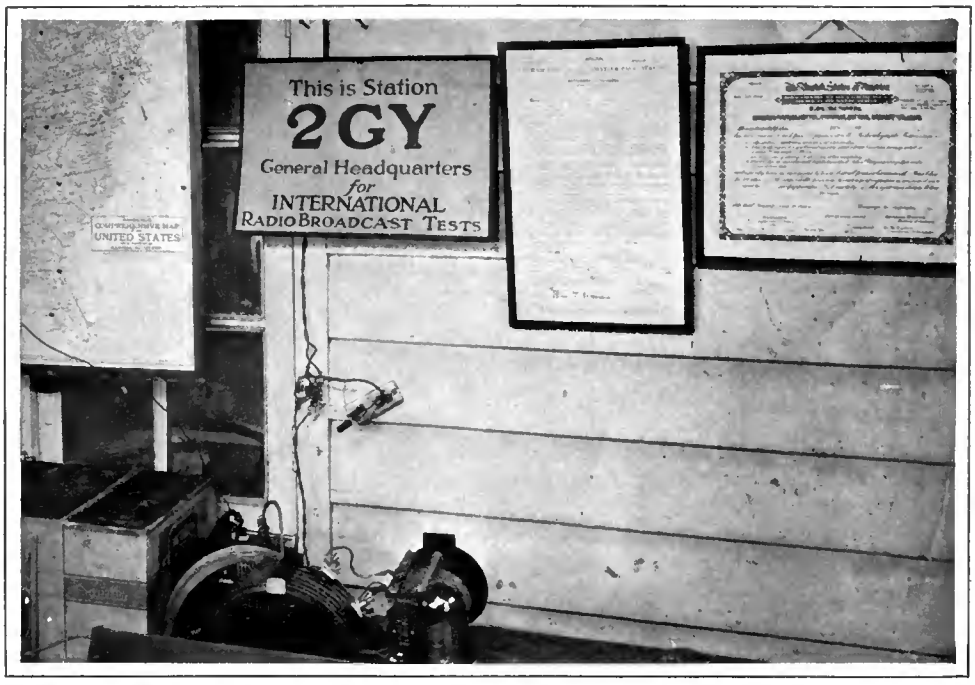
The acknowledgement of the second amateur consists of the first amateur's call, followed by that of the second amateur's. The letter G—called in amateur parlance, the intermediate—indicates him to be a resident of the British Isles. The prefix A indicates an Australian amateur; B, Belgian; BZ, Brazilian; C, Canadian; CH, Chilian; D, Danish; I, Italian; J, Japanese; M, Mexican; O, South African; PI, Philippine Islander; R, Argentinian; Y, Uruguayan; and Z, New Zealander. The QRA? means, "Where are you located?"

The answer of the first amateur consists of the usual acknowledgement followed by, "My location is (QRA without question mark) New Britain, Connecticut. Good evening, old man (GE OM). You are very loud here (U VY QSA HR) but I am having interference from U6CIX an American amateur on the Pacific Coast (BUT QRM FM U6CIX) I will work with you later (WL WK U LATER). I have two messages for you (HV 2 MSGS 4 U). I'll see you later (CUL) Best wishes, old man (73 OM)."

The reply means: "I received your message satisfactorilay. (RR) Your signals are good (UR SIGS GD) but they fade in and out (QSS). I'll see you later (CUL)."

Eavesdropping on short wavelengths has its fascination but almost invariably, it serves only as an introduction to the creation of a "dyed-in-the-wool ham." The term "ham" is used to describe the owner of an amateur transmitting outfit. Possessed of a transmitter, amateur radio becomes a personal and living thing. It is no longer an external world which you visit as an onlooker. You too can press the key and become a part of the international dot-and-dash whirl.

Those of you who have seen giant transoceanic radio stations, with their immense and stately towers, overshadowing power houses, and buildings filled with transmitting and receiving apparatus, may hesitate to believe that tiny miniatures of these imposing equipments have sent their message half way 'round the world. But the remarkable feature of short wave transmission is the fact that only very minute power is required to set up ether waves which radiate for thousands of miles. Recently an amateur in British Columbia maintained a regular schedule of transmission and reception for fourteen successive nights with a radio-found friend in Australia, using only a five-volt receiving tube, powered by heavy duty B batteries, designed for use with receiving sets! Think of it, you owners of five-tube sets—one receiving tube, efficiently used, is capable of transmitting half way round the world.



TWO ESSENTIALS FOR AMATEUR TRANSMITTING

The regulations of the Department of Commerce, the Bureau in charge of radio in this country, are that for a transmitting station capable of sending signals outside of the state in which the set is located, a license is necessary. The operator of the station must have a license also. The amateur station license is the long one in the center and the operator's license is shown at the right of that. There is no fee for either license and the examination is not difficult. Licenses are granted to those who can send and receive ten words per minute in the Continental code and who can pass a simple theoretical examination, dealing with the theory and operation of amateur apparatus

SIMPLE APPARATUS IS USED

THE circuits used in these diminutive transmitters are very simple. The all-important thing is the correct arrangement and placement of high grade components. In a characteristic way, RADIO BROADCAST is leading the way to the new field, by collecting data and designing transmitters and receivers for the special benefit of broadcast listeners. As rapidly as the engineers conducting the RADIO BROADCAST-Eveready short wave experiments progress with their work, descriptive articles will be printed in the magazine, giving full details of construction and operation.

Although primarily a sport and hobby, there are serious aspects to amateur transmission. Feelings of sectionalism and nationalism vanish when personal friendships are built up between amateurs in the four corners of the globe. As the boundaries of friendship have been extended through the ages by means of easy communication and transportation, from tribe to community, community to state, and state to nation, we have gradually acquired a unified national consciousness. Tribes no longer fight tribes; rivalries between cities, as that of Carthage and Rome of old, no longer result in bloody warfare, as the telegraph, telephone, railroad and steamship have cemented friendships and demonstrated powerful common interests.

Now we have short wave, low power radio, producing the citizen of the world, with friends whom he calls by name through the radio night, in Melbourne, Paris, Tokio, and Rome! If short wave radio spreads as rapidly as has broadcasting during its first five years, international peace will have a recruit and ally of significant influence. Predictions seem visionary, but we need contemplate only the influence of the telegraph and telephone, which has lifted us out of community interest to a true national consciousness, to lend the color of realism to the hope that the seeds are firmly planted for a new recognition of international bond, established through the agency of short wave radio!

Plans for the Third of the International Radio Broadcast Tests

The First Announcement of the Tests Which This Year Will Take Place in January—Coöperation in All Branches of the Radio Industry Will Make the Third Yearly Test More Successful Than Ever

By ARTHUR H. LYNCH

Director, International Radio Broadcast Tests

FOR two years, now, we have, during the early part of the winter, had an opportunity to listen to foreign stations with American broadcasters off the air. Listeners in the far West have heard programs directly from France, England, Spain, and other countries. Our European neighbors have listened to our concerts, and many reports have reached us from South America, Australia and, in fact, almost every nook and corner of the globe.

But every effort which has been made in the past is to be outdone this year. Preparations are now being undertaken to assure some very worth while features on the programs themselves, as well as for the immediate check-up of the origin of certain numbers broadcast, which will make it a simple matter to recognize a station, even when the call letters cannot be understood.

The great difference between this year's tests and those we have formerly conducted, however, lies essentially in the period we have selected. The matter was put to a vote at the Associated Manufacturers of Electrical Supplies Convention at Hot Springs several months ago; at the Radio Manufacturers Association Convention at Atlantic City; the National Radio Trade Association Convention at New York in September; and a referendum was recently taken by mail. In every instance the majority was in favor of the latter part of January, when receiving conditions would be better than at any other time during the year.

Many of the trade associations have already signified their intention of coöperating, and during the annual meeting of the National Radio Trade Association, a fund of several thousand dollars was raised to assist in letting the public know about International Radio Week. Powel Crosley was re-elected Chairman of International Radio Week and L. A. Nixon was put in charge of the publicity and other matters of a kindred nature.

Among those whose aid has been secured are Mr. F. N. Doubleday, President of Doubleday, Page & Co., who is now in England, where with the assistance of his friend, Rudyard Kipling, he hopes to arrange for the King to address a few words to President Coolidge while millions of us radio-eavesdrop.

Our Canadian friends, under the direction of Jacques Cartier, who is in charge of the week for Canada, are also attempting an exchange of greetings between the King and his Western Dominion representatives.

Radio organizations which for the last two years have been tolerant spectators, are now enthusiastic supporters of the International Test idea and many such groups are taking it upon themselves to see that the entertainment provided for our foreign friends will be of a superior nature.

Nor are we forgetting about the folks at home. Even though the programs are being specially designed for our foreign listeners, they will be of such high quality as to meet the demands of the most sophisticated dial twisters.

The success of the tests this year is made doubly secure, because in Europe and America there are more high-power broadcasters than heretofore, and there will be, by the time the tests are under way, a direct short wave tie-up between our headquarters at Garden City and most of the countries taking part.

From our experience during the last two years, we have learned much and hope to eliminate some of the difficulties by applying what we have learned. One of our greatest troubles was caused by lack of accurate knowledge of what was being broadcast by the foreigners. This year we hope to overcome this bothersome obstacle by having the foreign programs well in advance so as to be able to send them to the press. We are going to arrange to have to-night's program appear in to-morrow morning's paper and in this way make it possible for the listeners in any part of the country to make a check-up for themselves, instead of writing to us, or telephoning us from San Francisco or Houston, to verify a program, as has been the case heretofore.

In the past, many imaginative listeners heard all sorts of things, some of them based on fact. This year we are going to arrange to mislead the misleaders by inserting one or two false numbers in the programs. These numbers will appear in the newspapers, but will not actually be played. Thus, when we get a report from some listener who claims to have heard a number which we know was not broadcast, we will see that his membership in the Ananias Club be entered at once.

For the serious listener, however, who wants to enjoy the thrill of personal contact with many foreign nations within a single short hour, or the scientist who, by properly co-relating data from various sections of the world, taken during the tests, a golden opportunity will be provided.

Months of preparation will result, this year, we feel certain, in European and other foreign stations being heard in every corner of our country and vice versa. Every listener in America is invited to take part in these tests and assist in making them the greatest we have had thus far.

THE COMMITTEE IN CHARGE OF THE TESTS

Powel Crosley Jr., is at the head of the table; at his left is Arthur H. Lynch; others in the group include L. A. Nixon, second from Mr. Crosley's right, R. W. Demott of *Radio News*, third from Mr. Crosley's left; H. S. Fraine, of RADIO BROADCAST next to Mr. Demott on his left. Mr. George Furness of the National Carbon Company is in the right foreground

An Improved Plate Current Supply Unit

How to Build a Universal B Battery Substitute Which Is Highly Satisfactory in Operation and Low in Cost—The Parts Are Readily Obtainable—A Description of the New Raytheon Rectifier Tube Which is the Essential Feature of This Device

By ROLAND F. BEERS

SO MUCH has been published in the last six months with regard to B-battery substitutes that the average broadcast listener is in doubt as to what type will give him the most satisfaction. It is natural that certain prevailing types of eliminators will be suited for particular types of receivers, while they are entirely unsuitable for use on others. In order to make an intelligent choice between these various designs, the broadcast listener has had to try out one after another until he has obtained satisfaction. Even after a comparatively thorough test, he may find that the short life of the rectifier elements will cause an expense equal to that of maintaining B batteries.

It is the purpose of this article to describe the theory and construction of a universal B-battery substitute having excellent operating characteristics on all types of receivers, and an unusually long life. The cost of construction will not exceed twenty-

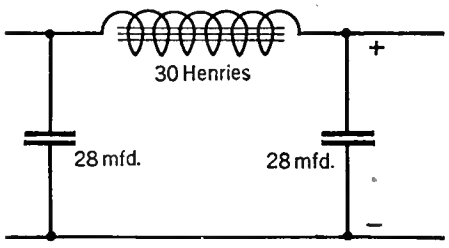


FIG. 1

Two types of filter circuits. That shown in Fig. 1A is the "smoothing" filter popular in 1924 while the circuit, shown directly above, is the "brute force" or reservoir type so highly efficient

five dollars, and, as all parts are readily available, the entire unit may be constructed at home. Several advanced features are present in the design described below.

Battery eliminators generally consist of three major elements: A *Transformer* to convert the 110 volt a.c. supply to the required voltages; a *rectifier* which converts the a.c. into pulsating d.c. and a *filter circuit* which smooths out the irregularities of the rectified voltage into a uniform d.c. Most of our readers are already familiar with these elements from previous articles in this magazine. However, the study and development underlying the design of eliminators that are appearing this fall have brought forth new facts which are extremely important for the attainment of high quality performance. Many weaknesses were present in the designs of last year's models: but the research of the last twelve months has succeeded in building up units of recognized quality and dependability.

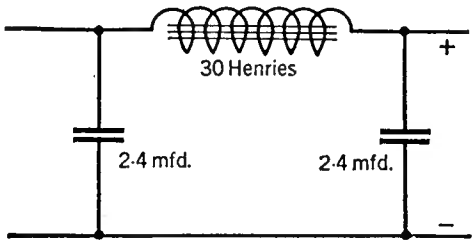


FIG. 1A

In the discussion given below, the reader will find complete instructions and drawings for making a B battery substitute. The general design is similar to that developed by several manufacturers of new B battery substitutes that will be marketed this fall. Complete dimensions, list of materials, size and turns of wire, etc., are given for those who want to make up a complete unit at home. This construction can be very easily accomplished, but for the convenience of those who prefer to use factory-made transformers and choke coils, units are described wherein use is made of these parts manufactured by the Acme Apparatus Company, General Radio Company, Dongan Electric Manufacturing Company, and Jefferson Electric Manufacturing Company. On 60-cycle supply, any of these manufactured parts may be employed with excellent results, and the appearance of the unit using them will certainly surpass that of the home-made model. The photographs, Figs. 4 and 6, show the construction of models employing factory parts.

THE RAYTHEON TUBE

THE very heart of this device is the new Raytheon rectifier tube, which has been developed for this specific purpose. The characteristics of this tube are quite revolutionary in their nature.

In the construction of this tube, two anodes are provided, so that the tube rectifies both halves of the alternating current wave. This feature is of first importance because it greatly simplifies the problem of filtering to obtain a pure d.c. supply. An additional feature made possible by the small anode area is that it permits but a minute fraction of the current to flow during the reversed voltage period of the current-flow cycle. Many rectifiers operating on the gaseous conduction principle give forth an extraordinarily high "back current", as it is called, which

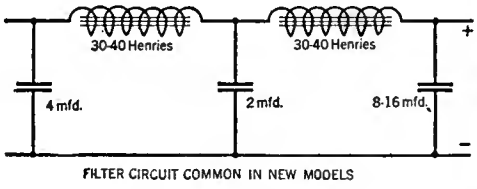


FIG. 2

A filter circuit common in new models. The intelligent use of chokes and filter condensers here insures smooth output

frequently rises to such a value as to become of great danger to the life of the tube and unnecessarily complicates the filter circuit problem. In the Raytheon tube it is extremely difficult to detect the back current by even the most sensitive measuring instruments.

The Raytheon rectifier has been designed to meet the requirements of most of the standard B-battery substitutes. Its starting voltage is very low—approximately 155–160 volts—and its current carrying capacity is high. The Raytheon tube type B is rated at 60 milliamperes at 150 volts d.c. output. As there is no filament to burn out, the life of the rectifier is extremely long. Standard Raytheon tubes

SINCE our September, 1924, number RADIO BROADCAST *has printed the best and almost without exception the only material on chemical and tube-rectified plate supply units. The present article involves nothing startlingly new, but it does describe a new rectifier tube which should have a very wide application and popularity for this type of service. The Raytheon tube, whose use is described here, has no filament. This simplifies the step-up transformer winding, since no extra tap-off from that winding is necessary to supply current for a filament. This unit is also a full-wave rectifier which produces a much smoother potential supply than the other types and simplifies the problem of filtering the output. One of the features of construction of the transformer in this unit is a shield around the primary of the transformer which effectively prevents any stray noises present in the power line from reaching the secondary and being communicated to the rest of the radio circuit. Such a device has never been described before. The problems of construction and assembly are unusually few.*

—THE EDITOR.

have been on test at maximum output for more than 4000 hours, and have not yet shown signs of deterioration. It is doubtful if the maximum life of these tubes can be determined at intermittent operating periods such as they would receive in the ordinary operation of a current tap. If they were not abused by overload or continued short-circuit, they should last for years.

The operation of the Raytheon tube in a B-substitute is unusually quiet. The reason for this is that the gaseous discharge is entirely enclosed. There cannot be any sputtering of the discharge which might occur if the elements were exposed to the glass tube or insulators. This act conserves the helium gas with which the tube is filled, and greatly prolongs the tube life.

The operation of a properly designed current tap employing the Raytheon rectifier tube has unusually good characteristics. Some of these will be pointed out in connection with points previously explained. First of all, we have exceptionally good "regulation." The impedance of the Raytheon tube increases with load, causing an upward curve in the load characteristic, in distinction to the usual straight line falling curve that gives low voltage at full load current. The fact that the output voltage does not fall off as rapidly as usual obviates the necessity of providing an excessively high transformer secondary voltage. The lowered a.c. voltage is an important contribution to the safety of operation of the device.

The current and power capacity of the Raytheon tube are sufficient to supply the greater majority of radio receivers. The current output is rated at 60 milliamperes at 150 volts and it has been found from measurements of the plate current consumption of large numbers of receivers that this value is more than sufficient for the demands of most receivers.

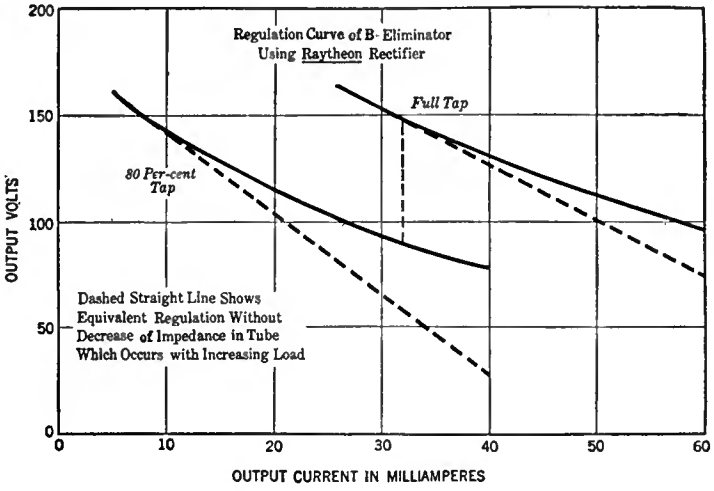


FIG. 3

The filtering problem in plate current supply units is usually one of high cost and considerable difficulty. When the Raytheon tube is employed, as it gives rectification of both halves of the a.c. wave, the filtering requirements are much simpler. Here one tube does the work of two at a great saving in cost, and at a higher efficiency. As indicated previously, there is no back-current perceptible. Back-current is a bad feature from a filtering standpoint, as it complicates the filtering problem, and heats up the choke coil windings often to an injurious degree.

Another important feature presented by the Raytheon rectifier is that it requires no power for lighting a filament. This power very often demands a large transformer supply, the cost of which is an item of great importance. With the use of the Raytheon tube, a complete B-substitute can be made up in a space no larger than a heavy duty B-battery.

After a consideration of the foregoing remarks, we may write a set of specifications for the ideal B battery eliminator of to-day:

HOW TO BUILD THE APPARATUS

WE WILL now proceed with the building of the eliminator. Figs. 4 and 6 show the arrangements of the parts when the unit is assembled from factory models. The basis of these models lies in the circuit diagram, a schematic drawing of which is shown in Fig. 7. The values of capacity, inductance, and resistance shown in this diagram have been determined after considerable investigation, and the builder will do well to adhere to these quantities as strictly as possible. These instructions also apply to the construction of the home-made transformer and chokes described below.

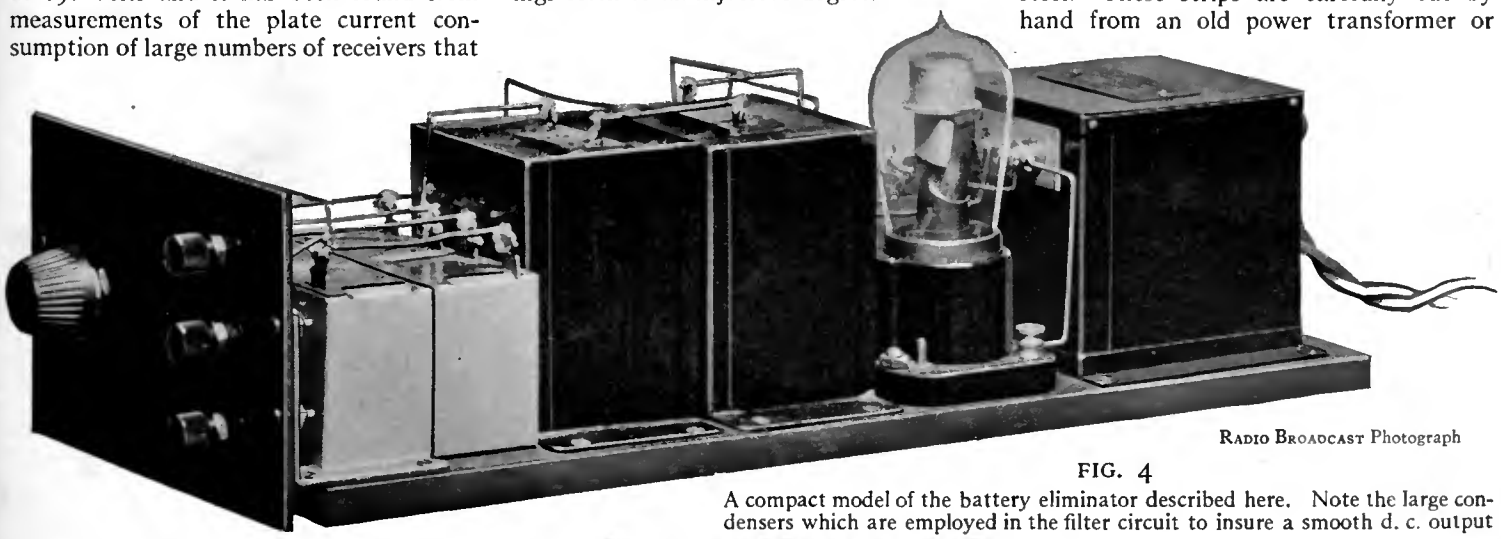
Dimensions for the transformer used in this eliminator are shown in Fig. 8. The reader will do well to refer to pages 640–650 of the September RADIO BROADCAST for a general discussion on the proper method of winding and assembling transformers. For the benefit of those who cannot secure copies of this number, a brief discussion of the general procedure will be helpful.

The transformer is made up of three coils of insulated copper wire wound over a core composed of a large number of strips of No. 29 gauge Apollo special electrical steel. These strips are carefully cut by hand from an old power transformer or

LIST OF RAW MATERIALS REQUIRED

6 lbs. Silicon Steel	$ 1.20
28 ozs. No. 31 d.c.c. wire	2.19
12 ozs. No. 32 d.c.c. wire	.94
7–2-Mfd. Condensers	12.25
1–0.5 Mfd. Condensers	.90
2–0.1 Mfd. Condensers	1.40
1 Bradleyohm No. 10	2.00
1 Raytheon tube	6.00
1 Standard socket	.25
1-10,000-ohm resistance	1.00
	$28.13

The prices quoted above are maximum retail prices. In some cases substantial reductions can be obtained from the costs given.



RADIO BROADCAST Photograph

FIG. 4

A compact model of the battery eliminator described here. Note the large condensers which are employed in the filter circuit to insure a smooth d. c. output

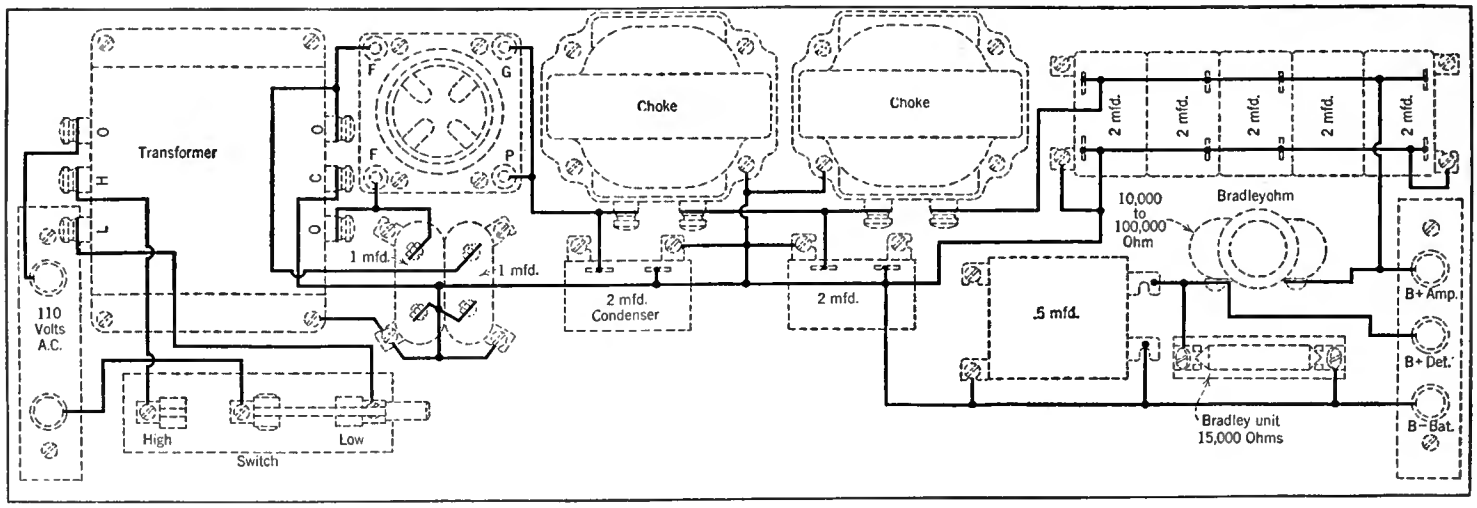


FIG. 5

A picture diagram and wiring layout of the eliminator whose circuit is embodied in the diagram Fig. 7

from sheets of the proper material, and shaped into the forms shown in Fig. 8. Enough pieces are cut out to make up a complete core of the dimensions given in Fig. 8, when they are assembled and clamped together in a vise to determine if the required amount of steel has been prepared. All rough edges must be removed, and the dimensions shown must be uniformly attained.

There are three windings on the transformer which are wound in place on the winding form illustrated in Fig. 9. The winding spool may be assembled on a long stove bolt with nut and clamped in a hand drill, carpenter's brace, or in the chuck of a lathe for convenience in winding the coils. Some means should be provided for counting the turns exactly as they are applied. If the ratio of turns of the hand drill is known for one turn of the handle, it is a very simple matter to use this factor in counting the turns as they are applied. Care should be used to obtain within one per cent. of the specified number of turns on each winding. The primary winding is applied first over the entire length of the winding form, and consists of 1250 turns of No. 31 enameled copper wire, with a tap taken out and insulated at the 1000th turn. Two layers of Empire cloth are placed over the primary winding, then the two separate secondary windings are wound, each of which consists of 2900 turns of No. 32 enameled copper wire, These two secondary windings are insulated from each other at the middle of the winding form by means of a rectangular separator of .010-inch fiber. This separator is cut out after the primary insulation has been applied, and is put in place by means of a slot cut in one face of the separator. See Fig. 9.

While the first secondary is being wound, the remaining winding space is tightly filled up with a number of strips of cotton muslin or cotton tape, in order to prevent the wire from crowding the winding separator out of place. In all cases, insulated leads 8 inches long, of flexible stranded wire (six No. 30 d.c.c. wires twisted together are satisfactory) are soldered to the ends of the windings for terminals, before the ends are brought out from the winding. Each terminal is tied in place in order to prevent its being ripped from the coil by accident. If it is necessary, thin strips of paper may be laid over each layer of wire as it is completed, in order to insure smooth layers in the winding. When the coils are completed, the outside is wrapped with two layers of Empire cloth or heavy manila paper as a protection and an insulator.

The steel laminations are now inserted one by one in the completed winding, as shown in Fig. 8 and the transformer is bolted together. If it is not convenient to drill holes in the laminations for the clamping bolts, the builder may cut out clamping plates from hard wood or angle iron. In such case, the bolts will pass through the ends of the clamping plates at the ends of the core, instead of through the holes therein. Fig. 12 shows the method of clamping adopted by the author in preference to drilling holes in the core. If the builder desires, he may put mounting

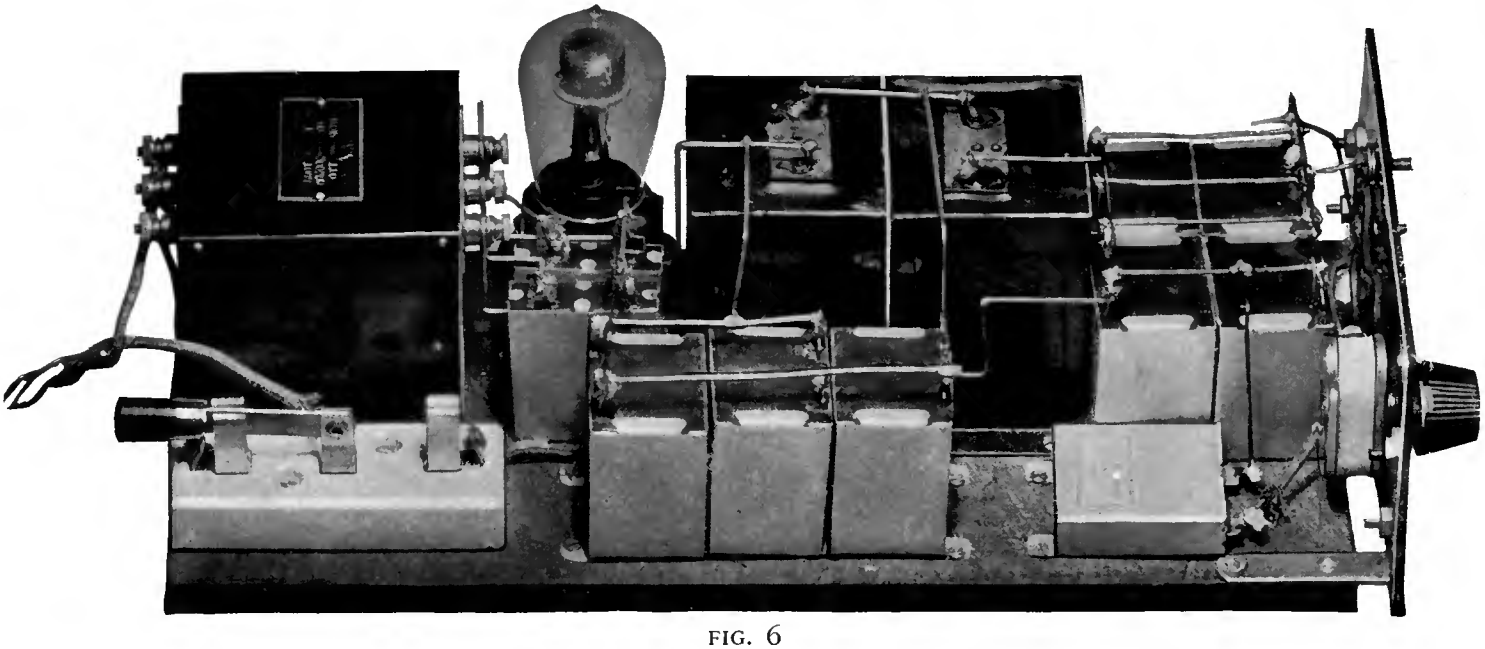


FIG. 6

A different view of the eliminator employing manufactured parts

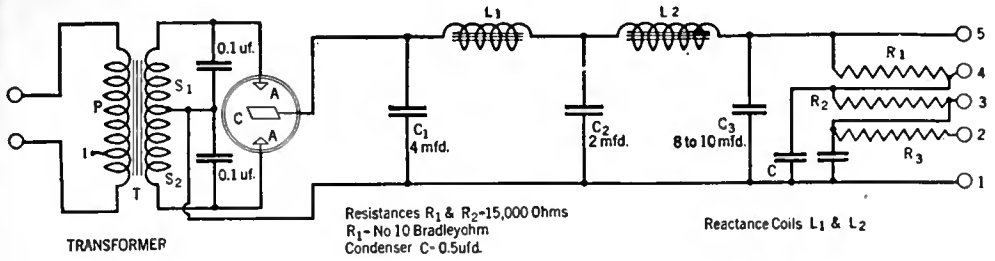


FIG. 7

The circuit diagram of the entire eliminator unit. The transformer at the left steps up the line voltage, passes it to the double-wave tube which rectifies both halves of the cycle. Thence it is passes to the filter where it is smoothed out into pure d. c. The resistances permit the tap-off of the desired voltages necessary to the operation of the receiver

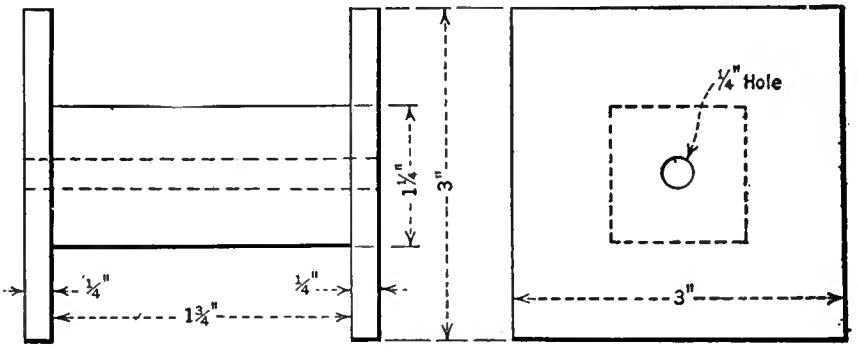
brackets on the base of the transformer to aid in securing the instrument to the base board.

NEXT, THE CHOKE COILS

THE choke coils, shown at L_1 and L_2, Fig. 7 are constructed in a manner similar to that employed in the making of the transformer. Each of these coils will have an inductance of approximately 20 henries if care is taken in constructing and assembling the cores. All rough edges should be removed and the cores should be assembled in an orderly manner.

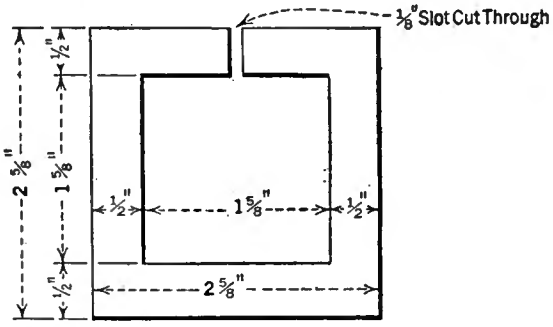
The winding on each choke coil consists of 5000 turns of No. 31 enameled copper wire, wound in smooth layers with the necessary interleaving papers. The outside of the completed coil is wrapped with one layer of heavy manila paper as a protection. The laminations shown in Fig. 10 are inserted in the completed windings, and the entire coil is assembled in accordance with the description of the power transformer above. A piece of .005-inch paper is inserted in the air gaps of the choke coil cores, to insure the magnetic stability necessary under the operating conditions. When this has been accomplished, the clamping plates are secured as described above.

The filter condensers, shown in Figs. 4 and 6 were procured from Tobe Deutschmann, Cornhill, Boston, Massachusetts, and have passed the most severe operating conditions. They were subjected to repeated charging and discharging at 700 volts d.c., and

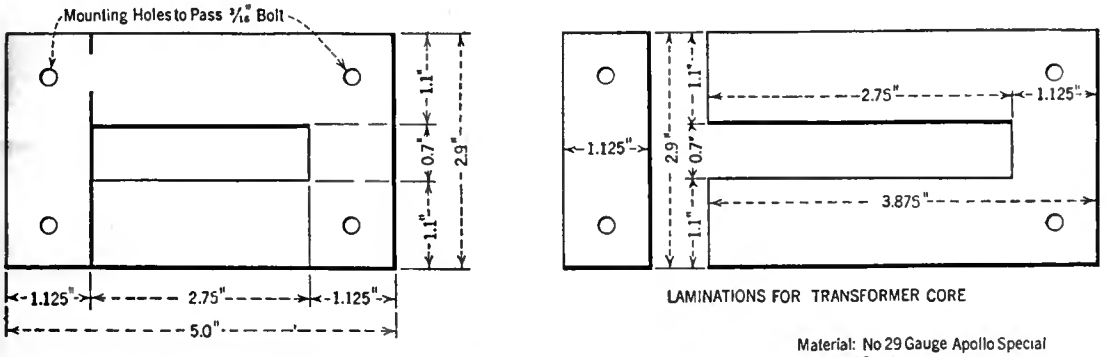


WINDING FORM FOR TRANSFORMER COILS

FIG. 9

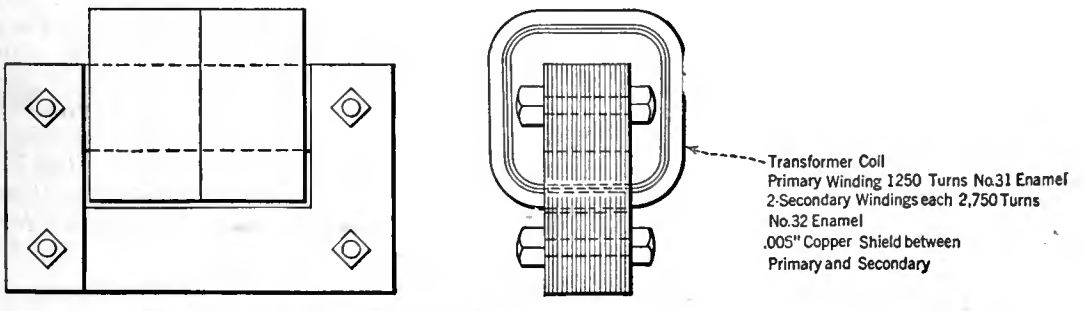


WINDING SEPARATOR FOR SECONDARY WINDINGS-⅜" FIBRE



LAMINATIONS FOR TRANSFORMER CORE

ASSEMBLED TRANSFORMER CORE



ASSEMBLED TRANSFORMER WITH WINDINGS IN PLACE

FIG. 8

Transformer core details

withstood the strain upon the dielectric successfully. None of the samples examined in this way were found to break down. The equivalent series resistance was found to be low enough to give excellent results in connection with the B battery filter circuit. The particular arrangement of the filter circuit shown in Fig. 7 requires a total capacity of 14 mfd. and the distribution of this quantity is more important than the absolute value. If this circuit does not meet with the requirements of the attached receiver and loud speaker, a slight improvement will be effected by increasing the value of C_3 to 12 or 16 mfd. Increasing this capacity beyond 20 mfd. does not add greatly to the standard of quality already established and, for average conditions, this capacity need not exceed 8 mfd.

The arrangement of the detector voltage control shown in Fig. 7 is unique in some respects, and is an improvement over the usual series resistance method. A 0.5 mfd. condenser is used to by-pass any disturbance that might reach the detector through other paths. The amplifier volt-

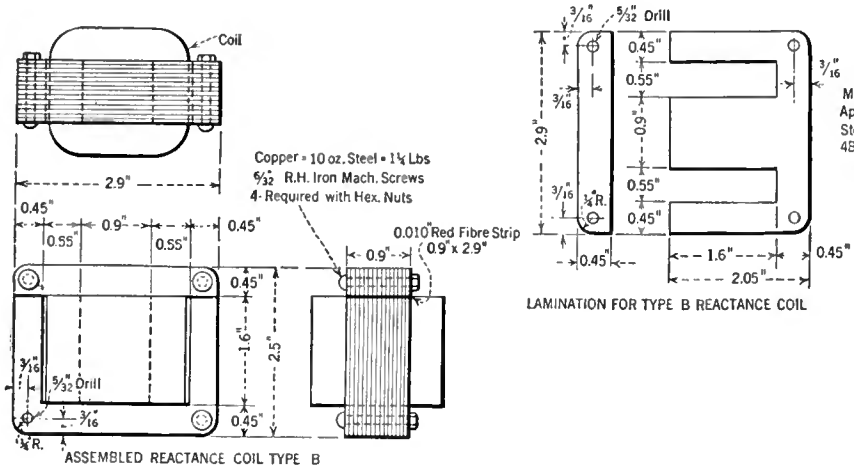
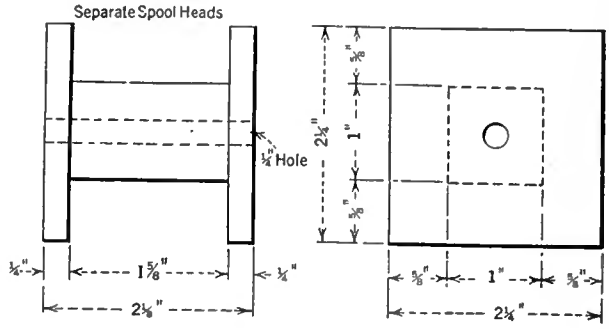


FIG. 10
Here are given all the specifications necessary for the construction and assembly of the choke coil cores



WINDING FORM FOR CHOKE COILS

Material: Wood Winding: 5,000 Turns No.31 Enamel Copper Wire

FIG. 11

age is controlled by means of the switch shown at S, Fig. 7. The blade of this single pole, double throw switch is connected to one side of the 110 volt a.c. line; one lug goes to the 1000th turn tap on the primary, the other lug goes to the full secondary terminal at 1250 turns. When the switch is thrown to the 1000-turn tap, the output voltage will be from 30 to 50 volts higher than on the 1250 tap, depending upon the connected load.

The Raytheon rectifier tube will ordinarily run at a temperature in the neighborhood of 200 degrees F. In case the cup should become red hot, there is evidence that the circuit is being overloaded. Although no permanent damage will be done, it is not advisable to continue this load for more than a few minutes. Continued overloading will soon saturate the cores of the choke coils and render them useless as filter chokes.

In order to prevent the transmission of power line noises through the eliminator circuit, a copper shield has been placed between the primary and secondary windings, and thoroughly insulated therefrom. This consists of a strip of .005-inch copper carefully wrapped over the Empire cloth insulation, and extending within $\frac{1}{4}$ inch of the entire periphery of the primary winding. A flexible lead is soldered to the shield, brought out from the winding, and later connected to the ground terminal of the eliminator. All cores of the instrument should be connected together and to the ground terminal. The homemade unit should be placed in an iron or steel case which completely encloses the unit. In the case of the factory units, each part has been placed in an iron magnetic shield, and this is connected to ground to prevent induction of hum in the receiver. Another means for preventing the transmission of line noises through the eliminator is the use of the buffer condensers, shown shunted across the mid-tap and outer leads of the secondary of the transformer, Fig. 7. These each have a capacity of 0.1 mfd. and serve the purpose of balancing the admittance of each secondary to the neutral or ground side of the line. There is in this way an easy path to ground provided for any disturbing unbalance that might arise in any part of the circuit. The inclusion of these condensers is an important feature, and one that will more than repay their cost.

Specifications for the Design of Ideal B Battery Substitute

I. TRANSFORMER

1. Power loss should not exceed 10 watts.
2. Should operate on 25 to 75 cycles a.c.
3. Secondary voltage should not exceed 300 volts for safety.
4. Should be shielded in magnetic shield.
5. Should have electrostatic shield between primary and secondary windings to prevent transmission of line noises to radio receiver. Secondary winding should be balanced for inductance and capacity.

II. RECTIFIER

1. Should have life of at least 5000 hours.
2. " deliver sufficient current at all times.
3. " have low impedance, preferably rising characteristic. (See Fig. 3).
4. Should rectify completely with no reverse current, and with quiet performance at all times.
5. Should rectify both waves of cycle.
6. Should have low starting voltage—i.e. not greater than 160 volts.

III. FILTER CIRCUIT

1. Should filter perfectly, leaving no hum in headphones.
2. D.c. resistance should not exceed 750 ohms.
3. Should consist of two or more sections instead of one section.

IV. MISCELLANEOUS

1. Should give complete control of amplifier and detector voltages.
2. Should be small and light in weight.
3. Should be capable of being installed in receivers without producing interference.
4. Cost of construction and maintenance should be low.

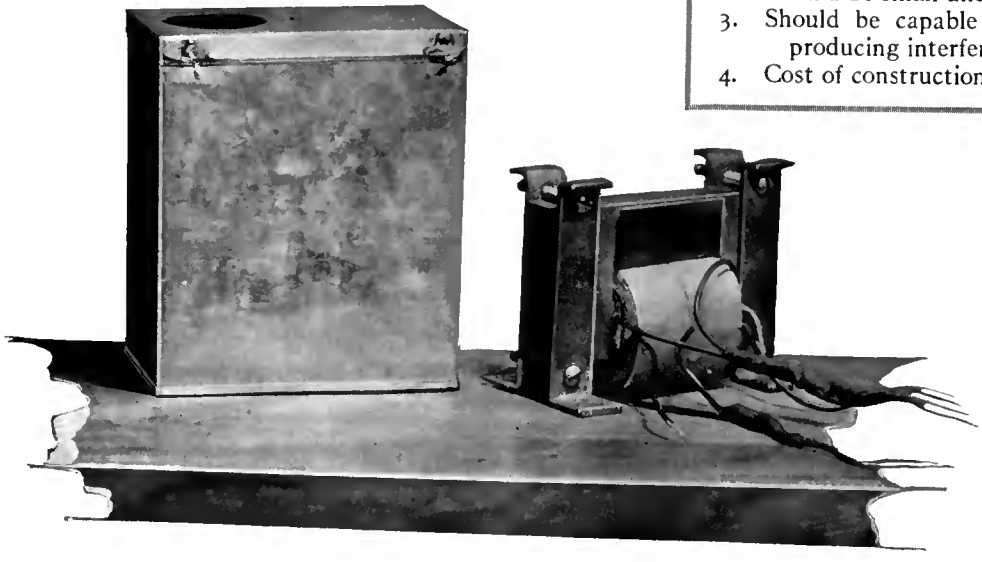
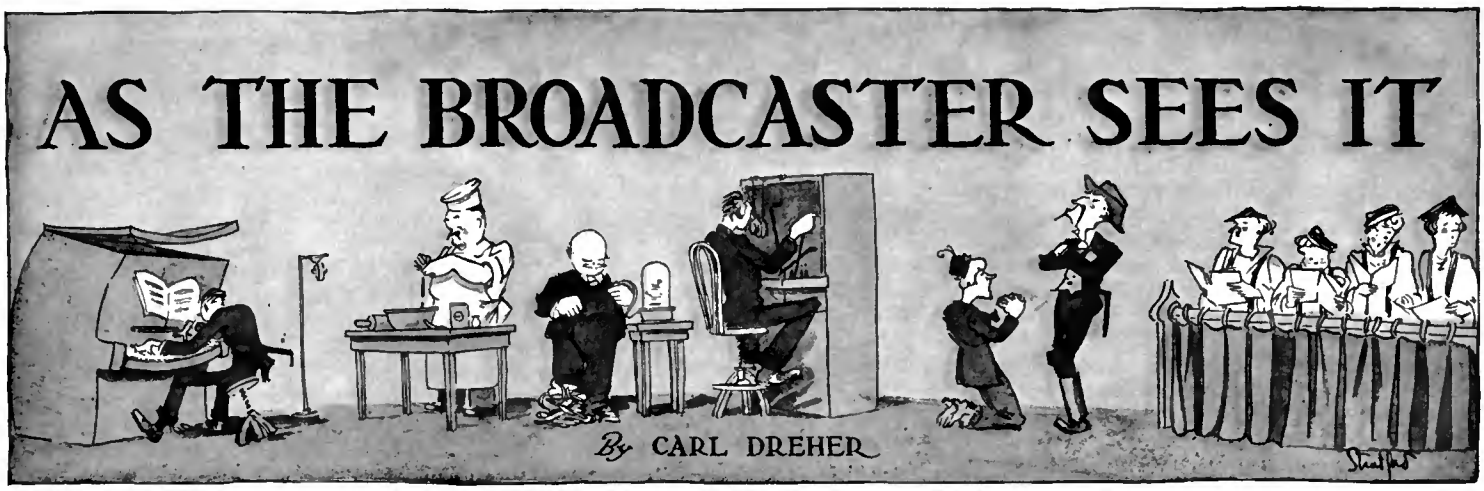


FIG. 12
A made-up transformer with its tin-can shield



Drawings by Franklyn F. Stratford

In Defense of Broadcasting

IN THE September issue of the *American Mercury*, under the rubric of his monthly department, "The Theatre," Mr. George Jean Nathan pays his respects to broadcasting in terms which will descend harshly on the ears of radio impresarios who were beginning to believe what their own publicity representatives write about them.

Supporting the cheap magazines and moving pictures in their campaign to moronize the country, *writes Mr. Nathan*, we now have the radio. The roofs of houses from the Atlantic to the Pacific presently take on the aspect of so many sailless schooners. And nightly the front parlors of the proletariat resound to the strains of alley jazz pounded out by bad hotel orchestras, to lectures on Swedenborgianism by ex-veterinary surgeons, to songs about red hot mammas and Beale Street melancholias by hard-up vaudeville performers and to the names of the notables who have just come into Reuben's delicatessen restaurant. Where a few years ago, a family living in the hinterland occasionally after dinner read a book or at least looked through an album of "Famous Masterpieces of Painting," it presently glues receivers to its ears and is thrown into wild aesthetic transports by some Harlem coon's *recitativo* on his *Heimweh* for Alabamy or some two-a-day De Pachmann's interpretation of Mozart on a saw. There are two radio broadcasting stations, one in New York and one in Philadelphia, that have made an effort periodically to give their customers something better in the way of music than that which, for its finest effect, must be played on kitchen utensils and cowbells and something better in the way of educational talks than lectures on hygiene by press agents for new mouth-washes, but I understand that they have found the going rough and, in self-preservation, have been forced to fall back more and more on the gibberish and caterwauling that the aërial connoisseurs admire.

Readers who have never before encountered Mr. Nathan's mode of expression will observe that he does not deal in weasel words. He makes it plain that no high-pressure salesman is going to sell him a $575. radio set. Not that Mr. Nathan has anything against broadcasting in particular. In the article from which I have quoted he rends and tramples on the twenty cent magazines, the movies, tabloid newspapers, and other such agencies of popular enlightenment. If you were the editor of a tabloid newspaper, how would you like this projectile: "A tabloid newspaper, you need not be told, is a newspaper reduced in size, sense, taste, and decency." Mr. Nathan lets radio off easy, comparatively speaking.

Many broadcasters, unused to criticism along old fashioned football lines, will roar indignantly and let it go at that. That attitude possesses neither maturity nor good sense. If the critic has no case, what he says will in time dissipate itself, like gasolene vapor on a boulevard, and there is no need to get het up about it. If what he says is true, wholly or partially, we might as well let him rub our noses in it and then see what we can do about it. And then, criticism is advertising, and no one can tell me that broadcasters don't like advertising. In this they are like George Moore, who used to say, according to Frank Harris: "Attack me as you please; slang me, but write about me. I'd rather have a libelous article than silence; indeed, I think slander more effective than eulogy. If you hate my books, say so, please, at length; that will get me readers."

WHEN IN DOUBT, THEY WIELD THE BLUE PENCIL

As for me, I can discuss this subject in a serene and unprejudiced spirit. While I am a professional broadcaster and derive most of my income from radio, my responsibilities are purely technical. I am an engineer and I put out on the air what is given to me, just as a telephone installation man wires up equipment indiscriminately for crooks, philanthropists, theatrical ladies who drive Minerva cars on an apparent income of $35. per week, and gentlemen of the cloth. The gentle rain falls alike on the just and the unjust, and I don't care what I broadcast. It's no skin off my back if the programs are rotten. As long as the transmission is good, I get my check and the V.P. & G. M. smiles on me. So much for the benefit of those spectators who might imagine that I am moved in my defense of broadcasting—to the extent that I feel called on to defend it—by my need for Hungarian goulash and French pastry.

Mr. Nathan's indictment is true enough, alas, but it should be added that he has selected the holes in the cheese for his discussion. There is considerable nourishment in the solid portions. Among some 600 broadcasting stations in operation in the United States, at any given time, some will be radiating respectable stuff, others will be carrying a load of aspiring sopranos and so-so material, still others will be engaged in purveying aërial garbage for the listeners who like that sort of thing. A cross-sectional view of the burden of the ether waves would show as great a variety in quality as the same process applied to periodical publishing, say. If one walked blindfolded up to the newsstand at the corner of Sixth Avenue and Forty-Second Street in New York, picked out a magazine, opened it at random, and analyzed the pages exposed for ideas, the percentage revealed would probably run even with the birth rate among mules. And that newsstand, be it noted, carries all the respectable magazines

as well as the cash girl trade; at most magazine stores the chances of lighting on something in the cultural Class A would be even less. If you are after intellect and good taste, you must pick it out from amid the rubbish. Likewise in radio. If you want jazz issuing from your loud speaker, there are certain wavelengths in every radio locality where you can get it at any time. If you want something better, you may be able to get it if you have learned to discriminate between stations. You may not be able to get it just when you want it. But there is just as wide a range between the best and the worst broadcasters as that between the most estimable and the most trashy books or magazines. And, owing to the vast and, perhaps, excessive amount of broadcasting, there is also a great variation with respect to time in the case of any given station. In order to arrive at a fair judgment, one would have to assess a lot of broadcast material and to do far more listening than Mr. Nathan has either the time or the inclination for, in all probability. As one of his customers in his present vocation, I should lament his engaging in any such Augean task. But I, perforce, have done something of the sort. In the last two and one half years, equipped, gratis, with a very fine receiving set, I have put in some 3000 hours listening to my own stations and others. Some of the stuff was not fit to inflict on an ursine howler. Most of it, culturally, was neither here nor there, like the columns of a newspaper or the counters of a five-and-ten-cent store, it had nothing to do with learning the arts, or civilized taste. It neither assisted nor came into conflict with these things. Some of it, the cream, required no apologies to any one. For three summers, now, any one who cared to tune to 600 kc. (455 meters) could hear the New York Philharmonic on the air two or three nights a week, absolutely "without concessions", as the management puts it, to the popular taste for operatic selections, easy overtures, and the like. Having thus thoroughly sampled the etherial waves, and emerged sound and articulate, I depose and say that the average metropolitan broadcasting performance is no more offensive to good taste than the average printed book or magazine, not half as disturbing to the same as the average city newspaper, and not one quarter as flagrant as the average big time vaudeville show or moving picture. As for the tabloid newspapers and other such dunghill enterprises, broadcasting, with all its glaring faults, is positively a civilizing influence; by contrast, its entrepreneurs and managers become so many Schopenhauers, and Sidney Laniers.

It is true that a great many silly and obvious talks get a hearing *via* radio, and that not a few of the lectures have an unpleasantly sanctimonious and oily tone. The second fault is caused partly by the influx of people quite without qualifications for radio lecturing, who try to compensate for their deficiencies by slobbering over the listeners. On the other hand, one hears more than a few people on the air whose natural frankness and sincerity manages to get through to the orifices of the loudspeakers. Dr. John H. Finley is one such engaging speaker; even if one does not agree with what he says it is pleasant to listen to him. As for the content of the talks, it varies all over the map. I have heard everything from an inspirational speaker (he broadcast in a frock coat, incidentally) declaring, "All the evils of the world are due to incorrect thinking," to a lecture on Whitman by such a recognized authority as Prof. Emory Holloway, the reading of a story by Sherwood Anderson, and performances of one act Provincetown plays.

The trouble with radio talks is mainly that the owners and program managers of the stations feel it incumbent on them not to offend *anyone*. They are in a constant stew about "adverse publicity." A few letters from irate listeners give them the horrors. They run their stations for advertising or good will, and as soon as any one looks at them cross-eyed their knees shake. When in doubt, they wield the blue pencil, and any one who tries to please the whole world is in doubt most of the time. In such large audiences as those they figure they are catering to, there are thousands of inferiority complexes ready to be triggered off. Eddie Cantor once delivered a first-rate humorous talk over the radio, and at one point he remarked extemporaneously, "For all I know a lot of Polacks are listening to me." The comedian, of course, had no offensive intention, but during the next few days he received twenty protests from Polish listeners, including a formal denunciation from a society. If I wrote a story containing some reference to an elderly Jew in a green sport suit, and there was nothing else the matter with it, there would be no difficulty in getting it published and receiving payment for it. But broadcasting that phrase, at the present stage, would be out of the question. No program manager would touch it. In his audience of several hundred thousand there must be several elderly Jewish gentlemen who wear green sport suits, and he wouldn't make them sore for the world. No one must be offended, no one's morals must be impaired, a thousand dignities must be tenderly preserved, the lecture must be fit for everyone between the ages of eight and eighty. If, under these conditions, the content of the talk is also to be mature and significant, you have a large order.

Even controversy is often frowned upon. Admiral William Ledyard Rodgers and General Tasker Howard Bliss recently broadcast a debate on "Shall America Arm for War?" under the auspices of the *Forum*. The debators did not come to blows, no riots were reported, and the more thoughtful among the listeners spent a profitable half-hour. The magazine next wanted to put on the air a debate between Professor Osborn and Mr. Bryan on the subject of Evolution. But this was declared to be "too controversial" by all the station managers interviewed. So it was not broadcast.

Mr. Nathan's conclusion that jazz is the staple radio musical diet does not jibe with my observations. There is a great deal of jazz on the air, and a few stations emit almost nothing else, but they are decidedly atypical. The average musical radio offering is rather something on the order of the Silvestri-Toselli "Rimpianto" serenade—pretty and obvious. In short, the sort of thing all dining room orchestras in big hotels turn out. Some of the hotel "ensembles" are very good, incidentally. They broadcast popular classics. If I have heard "Mon coeur s'ouvre a ta voix" once, I have heard it a hundred times. There is a lot of Old Black Joe-ing and Silver Threads Among the Gold on the air, but, after all, these are decent folk songs, objectionable only when overdone. Down another peg are college things like "Rolling Down to Rio," and the bombastic "Invictus." Not over a third of the total is jazz, and on top you have beautiful *Lieder*, the best symphonies, including all the Brahms, the tone poems (I have heard *Don Juan* on the air in its entirety seven times) and the Strauss waltzes. At one station in New York, for example, absolutely no dance music is allowed on the air until after 10.30 in the evening. All in all, not so bad.

Such inventions as the motion picture and the radio telephone have cultural and artistic possibilities, which are rarely realized because, with a large initial investment and heavy operating expenses, the only way to get a return on the money is to produce something attractive to the masses. The result is what we know. Only two copies of Thomas Hardy were sold in Boston in the six months from January 1 to July 1, Mr. Nathan points out. Still, the movies could do something even for Hardy's art. Needless to say, I don't mean any such shameful burlesque as the movie version of *Tess of the d'Urbervilles* which appeared a while ago. But if I had a few million dollars, I'd make a moving picture of Hardy's *The Dynasts* and perform it, serial fashion, a competent actor, to be

RADIO IS TRYING TO PLEASE ALL BETWEEN EIGHT AND EIGHTY

selected by Mr. Nathan, intoning the lines, to the accompaniment of a first class symphony orchestra. I should do this, not to improve the movies, which can go straight into the sewer for all I care, but purely for the benefit of the few who care for that sort of thing. The Napoleonic wars forming the background of Hardy's great epic, the transparent tentacles of the Immanent Will, moving irresistibly those great columns of soldiers wearing the expression of men in a dream, could only be portrayed in the medium of the cinema.

Similarly, some day, somewhere, a millionaire with *American Mercury* tastes may endow a radio broadcasting station to disseminate material which is agreeable to him. If so, I shall be pleased to oil the generators for same, and to be counted among its listeners. Mr. Nathan might buy an eight-tube "super" on that remote to-morrow. In the meantime, radio is neither as good as the publicity artists would have us believe, nor as bad as Mr. Nathan has painted it.

Technical Routine in Broadcasting Stations

1. *Wire Lines*

LAST month, in our discussion of "Personnel and Organization in Broadcasting," we took up in some detail the responsibilities and functions of the various employees, program and technical. However, the bulk of the discussion was on the problem of securing programs, rather than broadcasting them. In this issue we shall get down to the actual business of putting the program material out on the air. with all the technical preliminaries involved.

The technical staff, as we have seen, is divided into transmitter, control, and field divisions, all reporting to an engineer-in-charge or chief technician of some sort. These men work with the announcers and the studio manager during the actual broadcasting. First, however, we shall take up the technical routine which precedes it.

This technical routine, in many respects, is not radio at all. For example, the testing of wire lines is no more characteristic of broadcasting than of wire telephony, but it is equally important in both. Practically every large broadcasting station finds it necessary to go after its programs by means of telephone lines. These lines are in a few cases owned outright by the broadcasting company, but as a rule they are leased from some pre-existing telephone or telegraph company. Lines are costly and one does not generally buy them outright, any more than one buys a railroad in order to commute. When the lines are leased from some public service corporation, they are usually maintained by the owners. Such a system will consist of certain trunks running through the principal part of the town, possibly in the form of a ten-pair cable devoted exclusively to radio, for it is important that these wires should not be subject to inductive disturbances and that they should not interfere, in turn, with other public services.

A week or more before the time scheduled for broadcasting, the program department sends a list of projected field events to the line company. On a certain day, for example, a musical comedy is to be broadcast from a theatre. The wire company then runs a twisted pair from a convenient terminal box on the nearest trunk, over housetops and streets, to the theatre in question. This lead is called a "lateral." If the broadcasting company is leasing an adequate wire system these laterals are normally only a few blocks long. The expense of work and material is charged to the broadcasting company, so it is wise for the latter to balance trunk costs against additional construction in order to get a minimum total for the two. When the wire is placed in the theatre, with a long lead left in a coil so that the broadcasting operators can set up at a convenient point in the house, the telephone or wire company's lineman calls up the station, using an ordinary portable telephone, and tests through. He rings the station with a magneto, causing a telephone relay to release a drop on the station switch board, and says to the control operator who answers. "This is——at the Criterion Theatre. Will you test this loop?" The operator then puts 110 volts on each side of the line through a voltmeter to ground. If the loop is properly insulated the meter will read only a few volts, the resistance in series with it being of the order of many megohms. The ends of the pair are then short-circuited at the theatre and a continuity test is made to locate high resistance joints and the like. If the line is in good shape, the meter will read practically full voltage, the line resistance being negligible compared to the resistance of the voltmeter. So far we have merely the standard procedure which thousands of wire chiefs go through every day on telephone and telegraph lines. However, a further test is now made in which radio standards are rather more critical than those of the older services. The men on the line listen for noise. If they can hear any noise at all with an ordinary pair of telephones bridged across the line, they are apt to run into trouble during quiet intervals in the broadcasting.

Noise comes in from various sources, such as stock-tickers, parallel Morse circuits, elevator motors, etc. Each of these machines has a characteristic sound, and men who work on lines become familiar with the various types. Usually noise interference is due to some unbalance of the line. It is necessary to have the circuit accurately symmetrical, electrically, about an imaginary reference line in the middle. Fig. 1 shows this condition, the line terminating at either end in repeating coils, or 1:1 transformers, with grounded midpoints. Each side is assumed to measure 60 megohms to ground. If, now, one side of the line should be opened or grounded, a roar of noise would probably come in, although in the balanced condition the circuit might be perfectly quiet. But it is not sufficient to have the two sides of the line equal in insulation resistance. It is also necessary to transpose or interchange the two wires frequently, so that induction picked up in one stretch is neutralized in the next stretch of equal length. On an open wire line running on crossarms fastened to poles, each pair of wires will be transposed at, say, every tenth pole. Likewise, in a cable, the various wires must be "paired." "Twisted pair" is used, never simply a pair of wires lying side by side. In a properly paired cable several miles long, a few hundred feet of "straight-laid" conductor will ruin the entire circuit for broadcasting purposes, because of the excessive noise picked up. The telephone engineers put it this way: "A telephone circuit balanced in all respects, including balance to other circuits, is immune to inductive interference."

When trouble is encountered on wire circuits, it is hunted down by the process of "localizing." On long lines it is necessary to use special tests which show the distance of the fault from the testing point, but on short local circuits the lineman simply cuts out a section and by proceeding in this way sooner or later reduces the trouble to one section. He usually knows the weak spots in each section—here the wire runs through a damp cellar, and there it rubs against a roof coping, and so on; and sooner or later he finds the particular spot which is causing the trouble.

Of course no circuit of any length is ever exactly balanced, in practice, and in the presence of very powerful inductive fields noise will inevitably be picked up. For example, nearby lightning will register on the best lines; high tension leaks, power plant troubles, certain types of automatic and multiplex telegraph circuits, will interfere on almost any loop near them. Even if a man has armor on, you can probably kill him with a sledge-hammer or an elephant rifle. The only answer is to keep away from trouble-making types of service as much as possible. However, various devices, such as shielded, paired cables; anti-noise sets, which slow down electrical impulses to a point where they no longer interfere, have been used with considerable success. Again, some types of interference clear themselves through the cessation of business activity in the early evening. Ticker noise encountered on a morning test of a certain circuit, which is to be used in the evening for broadcasting, may be ignored if it

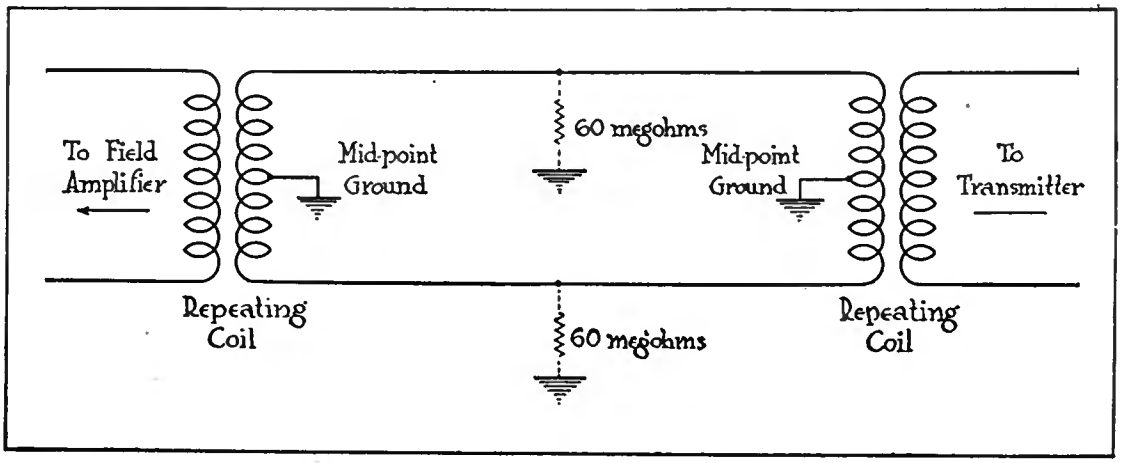


FIG. 1

Electrically symmetrical lines are necessary in outside "pick-ups." The diagram shows the circuit used. The field amplifier is controlled by an operator at the actual point of broadcasting

is known to come from certain financial houses which close down at 4 p. m. In case of emergency, it is sometimes possible to shut down parallel, interfering circuits during the period of broadcasting.

Broadcast operators and the lineman who work with them know all these kinks and utilize them in their work. The organization chart shown last month did not include a lineman among the technical employees, but as a matter of fact, although this man is usually not on the broadcasting station's payroll, he works in the closest coöperation with the station staff and is to all intents and purposes a member of it, and, if he knows his business, no mean asset.

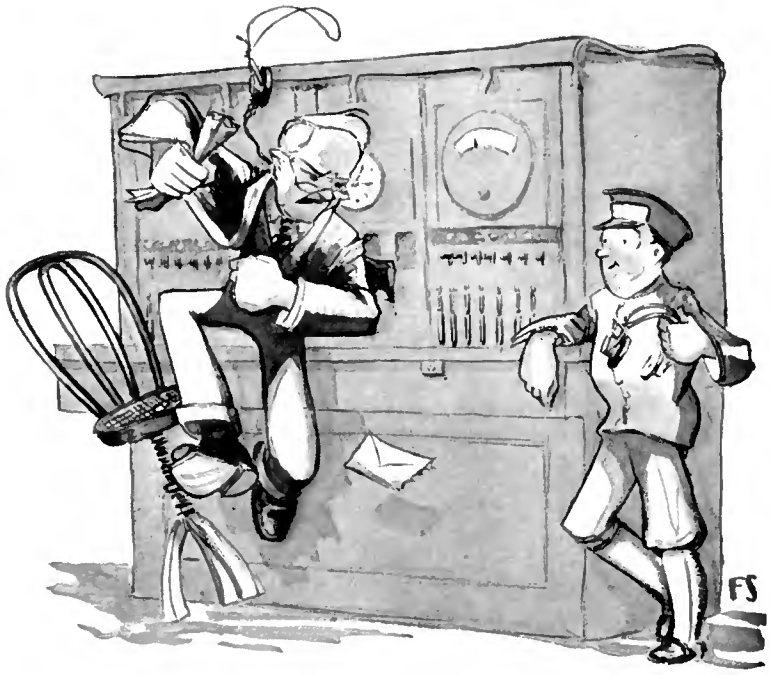
Regardless of previous tests, it is important that every wire circuit which is to be used on a certain day for broadcasting, should be tested on that day some hours before the event is scheduled. Accidents often happen at the last minute. If the event is a very important one, such as a presidential broadcast, or a major prizefight, if may even pay to have the lineman around till the job is done on the air. For these occasions, also, it is quite necessary to have two or three pairs, one for broadcasting, one as a breakdown pair, and one for an "order wire." For ordinary jobs a single pair is generally sufficient. The operators talk over it until it is time to take the air, and use it for post-mortems afterward. Sometimes the wire is simplexed or used for telegraph conversation during the broadcasting without interference between the two functions. This is not very common in local work, but it is the usual thing on long out-of-town circuits, where the cost of the line is so great that all its potentialities must be utilized.

Wire tests must not be left to any one's memory, but a log book, as shown in Fig. 2, is kept, showing the condition of the circuit at the time tested, and who is responsible for the observations.

It is possible to have one control operator in the station who is exclusively detailed for wire line work, but the usual procedure is to have the men rotate, so that everyone takes a turn at it. Often the station is on the air in the morning and the operator who runs the control room at that time also takes care of the wire line tests for the day, since as a rule the observations are quickly made, and there are long intervals between tests while the lineman goes from one remote point to another. In a large station one operator may be "on the channel," as the saying is—watching what goes out on the air and making necessary adjustments—while another man handles the wire tests and does maintenance work in the intervals.

One point that should not be neglected is the removal of all laterals not in use on any given trunk. Otherwise the laterals pile up, increasing the capacity of the line to the point where the higher frequencies are lost and quality of transmission is adversely affected. These sections hanging on uselessly may also bring in noise. In a properly maintained wire system the trunks are stripped of laterals at frequent intervals—and that does not mean every few weeks.

If the lines pass through telephone exchanges or telegraph offices the utmost care must be taken to avoid interference by employees who don't know what is going on. The broadcasting lines should be red-tagged and a special notice sent around cautioning all unauthorized people to keep away. Most telegraph and telephone men have little notion of what broadcasting quality is and they will sometimes innocently break up a circuit in order to get a little amusement during idle periods. At one station it was noticed that music coming over a long line (some five miles) was curiously tinny—lacking in the lower frequencies. This was just the opposite of what one would expect—the suppression of the higher frequencies by the line capacity. The engineers were somewhat puzzled until one day one of them happened to be at the main telegraph office in the city in question and saw an idle operator plug a 60-ohm telephone into the jack panel of the broadcasting station, in order to listen to the music. The circuit was one terminating in 500-ohm impedances, so this low inductance was effectively by-passing all the lower frequencies. The engineer sent a 2000-ohm headset down to the telegraph office with a polite note to the wire chief suggesting that if the operators wanted to listen in they could use the high impedance telephones without ruining quality on the air. But the wire chief, receiving this epistle, flew high up in the air, returned the 2000-ohm phones with thanks and apologies, and posted a notice informing his staff that any one who plugged anything into those circuits without authority would be summarily fired. Then there was peace.



"THE WIRE CHIEF WENT UP IN THE AIR"

Radio Lingo, Past and Present

SOMEWHERE in his writings or conversations Anatole France compares a synthetic language to a doll, while a natural language, with its centuries of use, growth, and development, he likens to a living woman. On a more modest scale, the technical terminology of an art or science, as it reflects the achievements and changes of years of effort on the part of many men, takes on an almost organic meaning and color. We usually think of objects like antennas and microphones as purely inanimate and lifeless, forgetting that they are the tools of human aspirations and carry with them an emanation of human emotions. The names of these tools, and of the scientific ideas which they embody, and the way in which people talk about them, all change with time. Not only do they change, but they show a tendency toward poetic figures of speech, and many terms which we use daily in the most matter of fact way, if we stop to examine them, show an interesting technical and literary history. This is particularly the case with radio terms, and I purpose to classify and discuss some of these now popular expressions in the light of their origin and history.

Radio, contrary to the notion of many of its devotees, did not start in 1920. It had its period of development in the minds of men like Maxwell, Henry, Heaviside, and Hertz, it was born three decades ago, and it is now past its infancy. It has borrowed from all the older engineering arts both words and ideas. If, as someone has asserted, one can understand a thing only by understanding how it became what it is, an examination of the technical jargon of radio should be as instructive as an article on hook-ups and super-circuits—and a little more out of the ordinary.

Physical Characteristics

As in every field, the obvious physical characteristics of objects suggest suitable names. We speak of cat-whisker detectors, bulbs, tubes, condenser plates, plugs, knobs, etc. Position in space acts in the same way; *aerial* is the most prominent instance. The types of aerials are all named in the same way: umbrella, harp, fan, V, inverted-V, flat-top, inverted-L, and T. In these cases the name, or the figure of speech, was suggested by the physical appearance. Somewhat the same process occurs with inductance coils. We refer to inductance spirals and helices, and to honeycomb, latticework, basket-wound or cellular coils where the criss-

FIG. 2

A typical test report made by broadcast operators on the condition of an outside wire used for picking up programs

LOOP NUMBER	TO	LEAKS TO GROUND		CONTINUITY	DATE	OPERATOR
		Tip	*Sleeve*			
465	Criterion Theatre	8	8	118	9/15/25	GN
...	....	.	.	...	....	....
...	....	.	.	...	....	....

crossing of the turns results in a cellular structure. This is the simplest and least imaginative portion of radio philology.

Figurative Expressions

If to call an aerial by that name is an obvious procedure—as well as a trifle out of date in those instances where the aerial has been taken in out of the wet to share the rarified atmosphere with the vases and porcelain dogs on the Dutch shelf of the living room—the term *antenna* is a step higher in the literary if not in the physical sense. This was originally a zoological name, applied to the organs of feeling with which lobsters, cockroaches, and other noble animals poke their way. No one who has seen an insect waving his antennae around when in an uncertain situation, confronted, for example, by an angry housewife with a mop, could have overlooked the analogy with a crystal set owner striving to receive Los Angeles from the Eastern coast. A radio antenna is, in fact, an artificial feeler or organ of sensation.

We speak of a "phantom" or "dummy" antenna, as used for testing purposes where radiation must be suppressed. Another figurative expression in connection with antennas is "counterpoise"—literally a counterweight—applied to a network of wires beneath an antenna, the purpose being to keep the electric field away from poor conducting materials, such as dry earth, and thereby to reduce the losses of the transmitting system. It might really be called a "counter-capacity."

The Memoirs of a Radio Engineer
VII

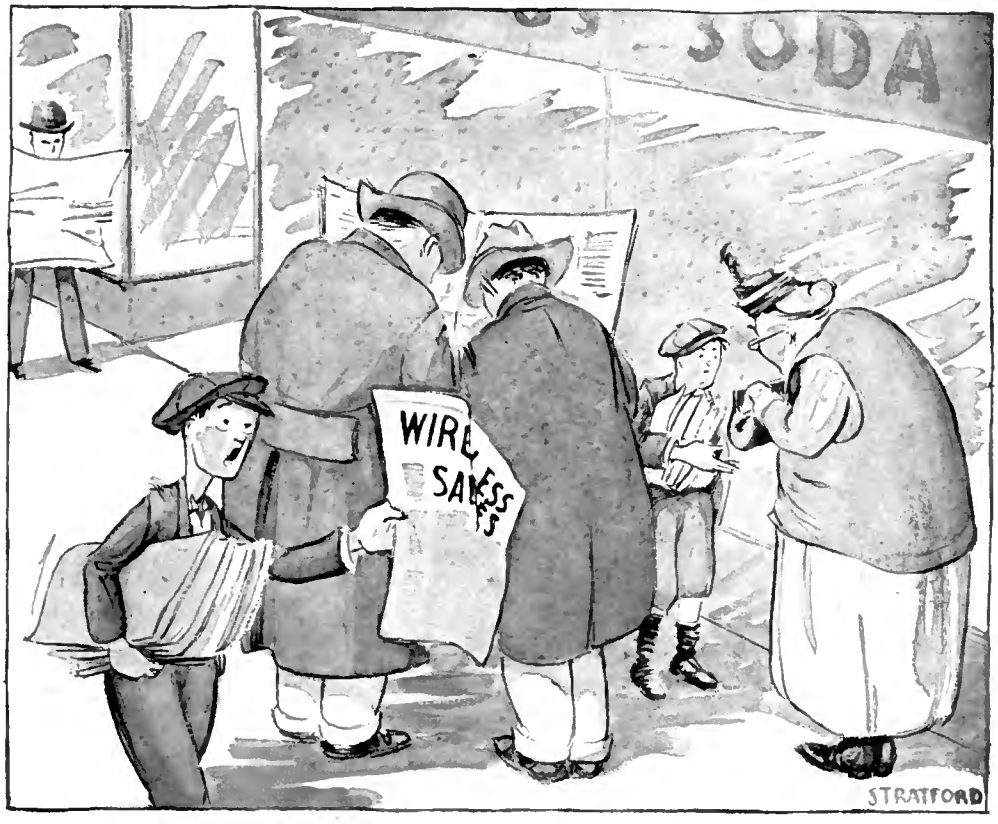
NOWADAYS radio gets the bulk of its publicity through broadcasting. Some famous opera singer performs for the radio, or the President delivers a speech, and the headline writers get busy. In the pre-broadcasting era, maritime disasters in which radio played a part were the principal source of publicity for the art. Of course, at that time there was a novelty about the whole business which has largely disappeared since, so that incidents like two stations exchanging messages over a distance of a few thousand miles, would get into the newspapers, while now no one pays any attention to them. But anything that saves human lives interests everybody, and it was in connection with accidents at sea that many people first heard of radio or had it called strikingly, often unforgettably, to their attention. It must be remembered that at this time, around 1910, communication with a vessel at sea was still a novelty. The act requiring passenger-carrying vessels making sea voyages more than 100 miles in length to be equipped with "wireless" was passed by the United States Congress in that year. It was not much more than ten years before that the first radio set had been installed on a ship. Along in the early part of the first decade of the Twentieth Century, it was still the usual thing for vessels carrying hundreds of passengers to leave land and not be heard from again till they reached their destination, or, in some instances, not to be heard from again at all. The sea swallowed them up, and that was all. After radio was introduced, such episodes became rare. Radio cannot prevent shipwrecks altogether, but a great percentage of them may be avoided by its use, and practically always help can be summoned when needed. That help may be only partially effective, or it may arrive too late, for, unfortunately, men and ships cannot be transported with the speed of the ether waves, and there are storms and situations in which every ship has all it can do to take care of itself, but at least one has the consolation of knowing that what man can do was done. Before radio got into the picture, a vessel could burn up or founder with hundreds of people on board, and another ship near by might go on its way oblivious of what was happening. There is no tragedy like an avoidable tragedy.

It was in 1909 that through the intervention of radio such a tragedy was averted. The White Star passenger steamship *Republic* collided near Nantucket Light with the freighter *Florida* and sank some hours later. But before she went down she called for help on her wireless set, operated by Jack Binns. That call, picked up at Siasconsett, Massachusetts and by various other coast and ship stations, resulted in all the passengers and crew being taken off the *Republic* before she sank, and what would probably have amounted to a loss of hundreds of lives was limited to the six casualties which had occurred during the actual collision. The world sat up and took notice. Many people who had thought of the wireless telegraph as merely an interesting scientific toy, changed their minds overnight. Some of them bought stock in radio companies, not all of it good.

Three years passed, with the number of wireless stations and activities in general increasing rapidly. Then, once more, the aerial telegraph played its part, effectively enough, and yet it was not sufficient to obviate a great loss of life when the S. S. *Titanic*, then the largest ship in the world, sank 800 miles off the Grand Banks of Newfoundland, at 2 a.m., April 15, 1912, after striking an iceberg. The *Titanic* was driving through the night on her maiden trip, trying to make a record for the crossing (Those were the days of rivalry between British and German shipping interests) when her nose crashed into a "growler" of moderate size, but large enough to open the liner's compartments, so that she sank only a few hours later. Although the accident occurred in midocean, many vessels were near, and if the *Titanic* could have managed to stay afloat six or eight hours almost everyone might have been saved. The nearest ship was the *Carpathia* and it was she who sped 58 miles, under forced draught, in three and one half hours, arriving at the scene of the disaster at 4.10 in the morning, to find lifeboats filled with survivors dotting the icy sea. The dead numbered 1635, among them Jack Phillips, the senior wireless operator, to whom the surviving 700 owed their lives, for it was his CQD and SOS calls that summoned the *Carpathia* to the rescue. Other vessels, the *Olympic*, the *Birma*, the *Virginian*, and the *Baltic*, were on their way, but turned around on hearing that the *Carpathia* had already done all that human sailors in iron ships could do.

Great as the service of radio proved on this occasion, luck and uncertainty played too great a part in what followed the collision of the ship and the iceberg. The *Titanic* carried an adequate transmitting set, with a day range of more than 400 miles and a night range which carried her cry of distress far over the sea, and yet she might easily have missed altogether the *Carpathia*, the one ship near enough to give quick assistance. It was also rumored at the time that one freighter, unequipped with radio, was even closer and might have taken off passengers who could not find a place in the lifeboats and whose lives ended shortly in the cold water. The fact was that the *Carpathia's* one operator, H. T. Cottam, was going to bed before the *Titanic* smashed her nose on the iceberg, and it was only by chance, or, if you please, the intervention of Providence, that he stayed up a little longer to get off some messages, and heard the *Titanic's* CQD buzzing into his headphones, at 12:35 in the morning. Cottam already had his coat off. Had he taken off the phones and grounded his antenna a few minutes earlier, the *Carpathia* would have continued tranquilly on her course while 2000 people were perishing 60 miles away. The necessity of a *continuous* watch by two or more operators was impressed on everyone

(To be continued)



MARINE RADIO GAVE THE ART ITS FIRST PUBLICITY

The "ARISTOCRAT"

A Gallery of Interesting Models of the RADIO BROADCAST "Aristocrat" Receiver, Especially Adapted for the Phonograph Cabinet —the High Quality Audio Channel is Assured by Resistance-Coupled Amplification

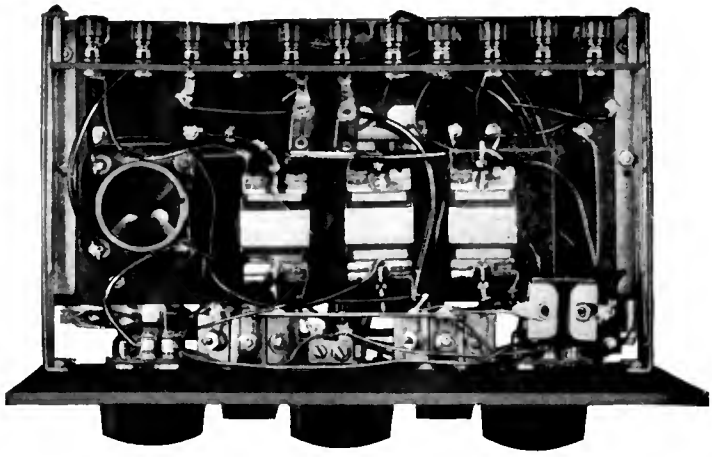


FIG. 1

One of the Phonograph Receivers described in RADIO BROADCAST for June, July, and August, converted into a RADIO BROADCAST "Aristocrat" by the addition of one tube and by replacing the transformers with Dubilier condenser and resistance units for making a resistance-coupled amplifier

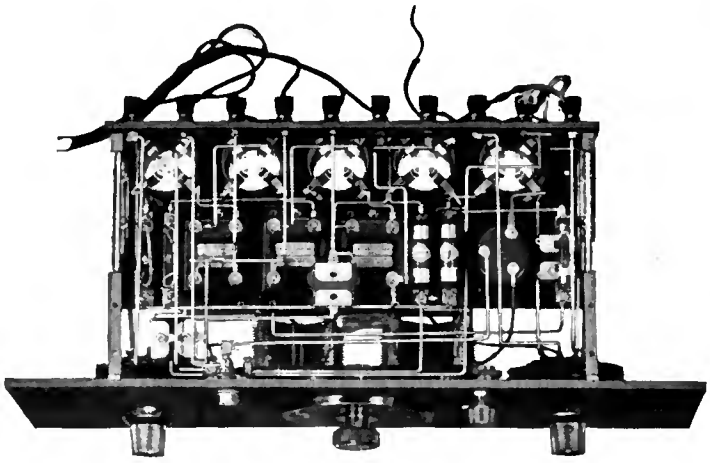


FIG. 2

This is a bottom view of the receiver shown in Figs. 5 and 8. The filament circuit in this receiver has been somewhat altered in that ½-ampere ballasts, one each, have been used in the detector and radio-frequency amplifier filament circuits. A half-ampere ballast is used in the first two audio tube circuits and another is used in the output tube circuit. Where six-volt tubes are used instead of the five-volt type, short pieces of bus wire may be employed in place of the ballast resistors as indicated at the left hand side of the illustration, where two such base connections have been made. It will be noted that in this receiver Brach resistance coupling units and Brach ballast resistors have been used

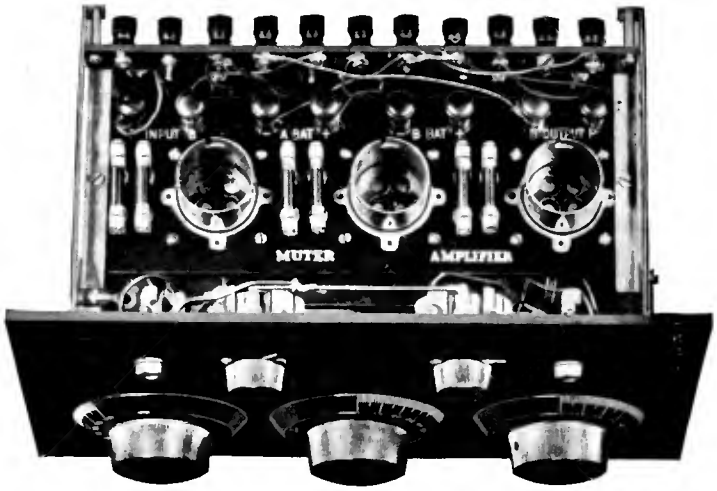


FIG. 3

Another RADIO BROADCAST Phonograph Receiver converted into an "Aristocrat" by the use of a three-stage Muter resistance-coupled amplifier

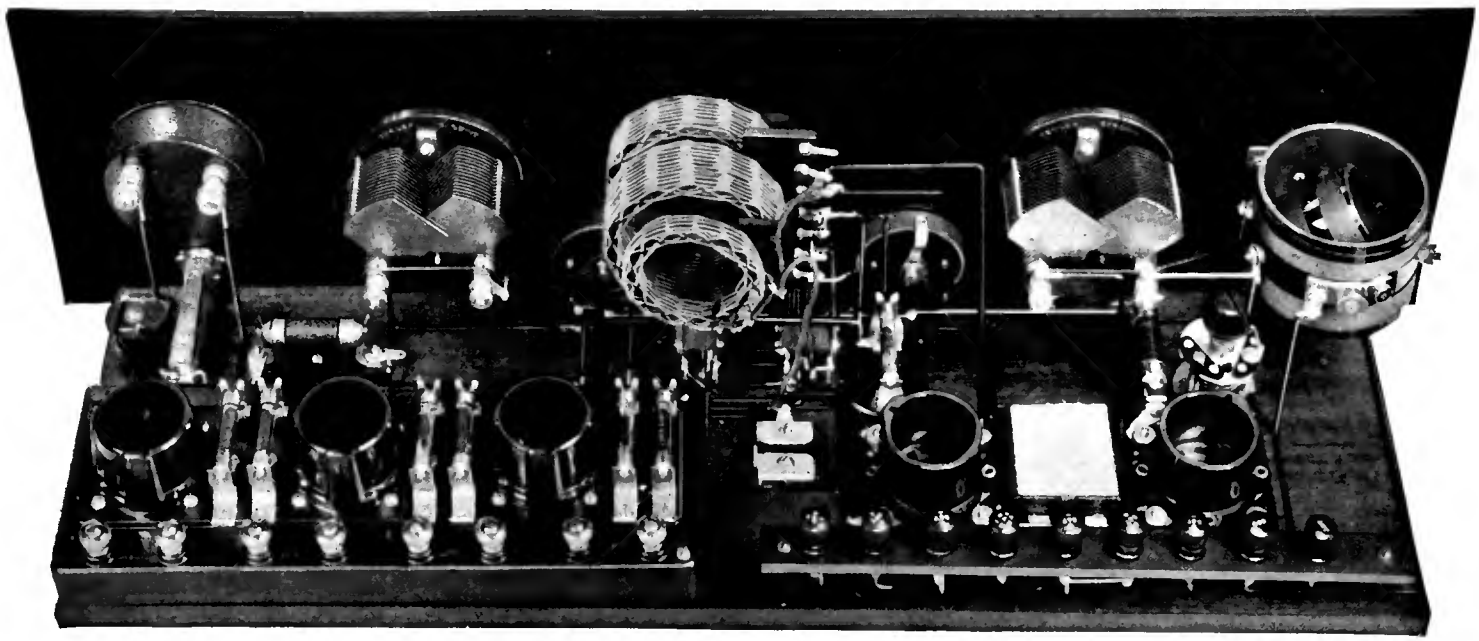


FIG. 4

This RADIO BROADCAST "Aristocrat" was made by Radio Research Laboratories, New York, and they have incorporated some slight modifications of their own, which are to be commended. For instance, the General Radio variocoupler used in the antenna circuit makes it possible to compensate for various antennas without tap switch. The voltmeter has a multiplier in series as it is one of the double scale type. Victor coils have been used in the radio frequency unit, and they have been found very satisfactory. Two Pacent 10-ohm rheostats are employed, one in the detector circuit and one in the radio-frequency amplifier circuit. The latter makes a particularly good volume control. The entire assembly is an example of the kind of workmanship that any home constructor may accomplish if he will devote himself sincerely to the job

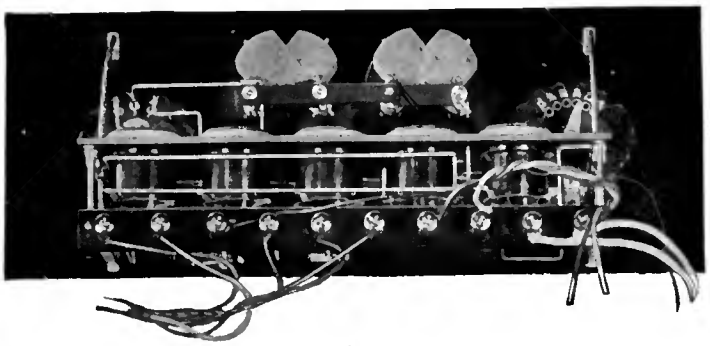


FIG. 5

This is a rear view of the receiver shown in Fig. 8. The simplicity of the layout is brought out thoroughly from this viewpoint. It will be noted that the sockets extend far enough beneath the sub-base to allow wiring to be made at approximately the level of the socket prongs. The manner of fastening the sub-base and binding post strip to the Bruno bracket is very satisfactory and very substantial

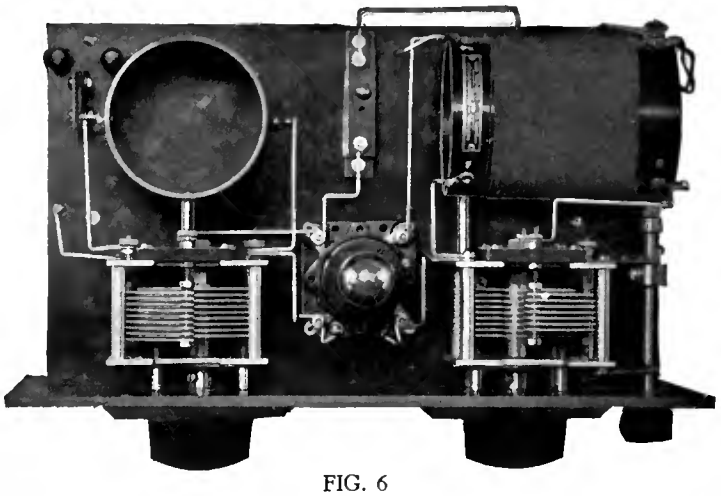


FIG. 6

A Phonograph Receiver using the National Regenoformer Kit and the Browning-Drake circuit with a Heath resistance coupled amplifier unit. A 199 tube used in the radio frequency part of the circuit to save current and facilitate neutralization

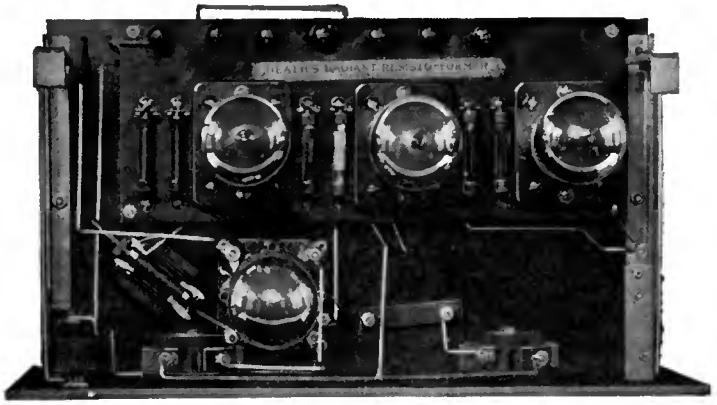


FIG. 7

This is the under side of Fig. 6. The small resistance in series with the right hand rheostat is used to reduce the current from the storage battery to a point where operation of the 199 tube is possible without overloading. The use of a three-stage resistance-coupled unit in receivers of this kind makes the entire wiring job a simple one. The arrangement illustrated in Figs. 6 and 7 is very neat and the performance of the receiver is such that we do not hesitate to recommend it for those who desire a really good receiver for installation in their phonographs

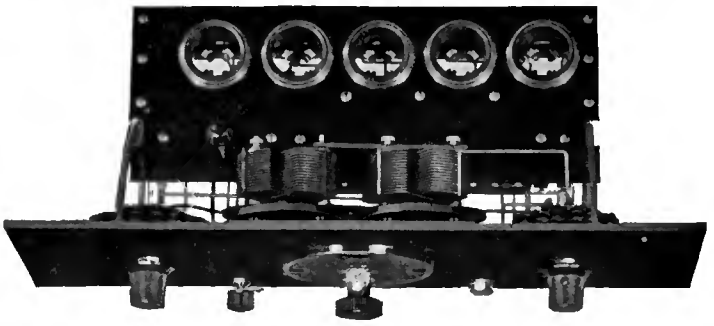


FIG. 8

Another RADIO BROADCAST "Aristocrat" receiver. The panel itself is but 18 inches in length and there is plenty of room left at either end. Specially designed coils for the "Aristocrat" receiver, made by the American Mechanical Laboratories, have been incorporated in this model and the movable tickler is replaced by a variable resistance. This unit with the primary and secondary radio frequency coils is called a Clarotuner. Bruno brackets have been used and the sub-base has been made to our design by the Osborne Company of Boston, Massachusetts.

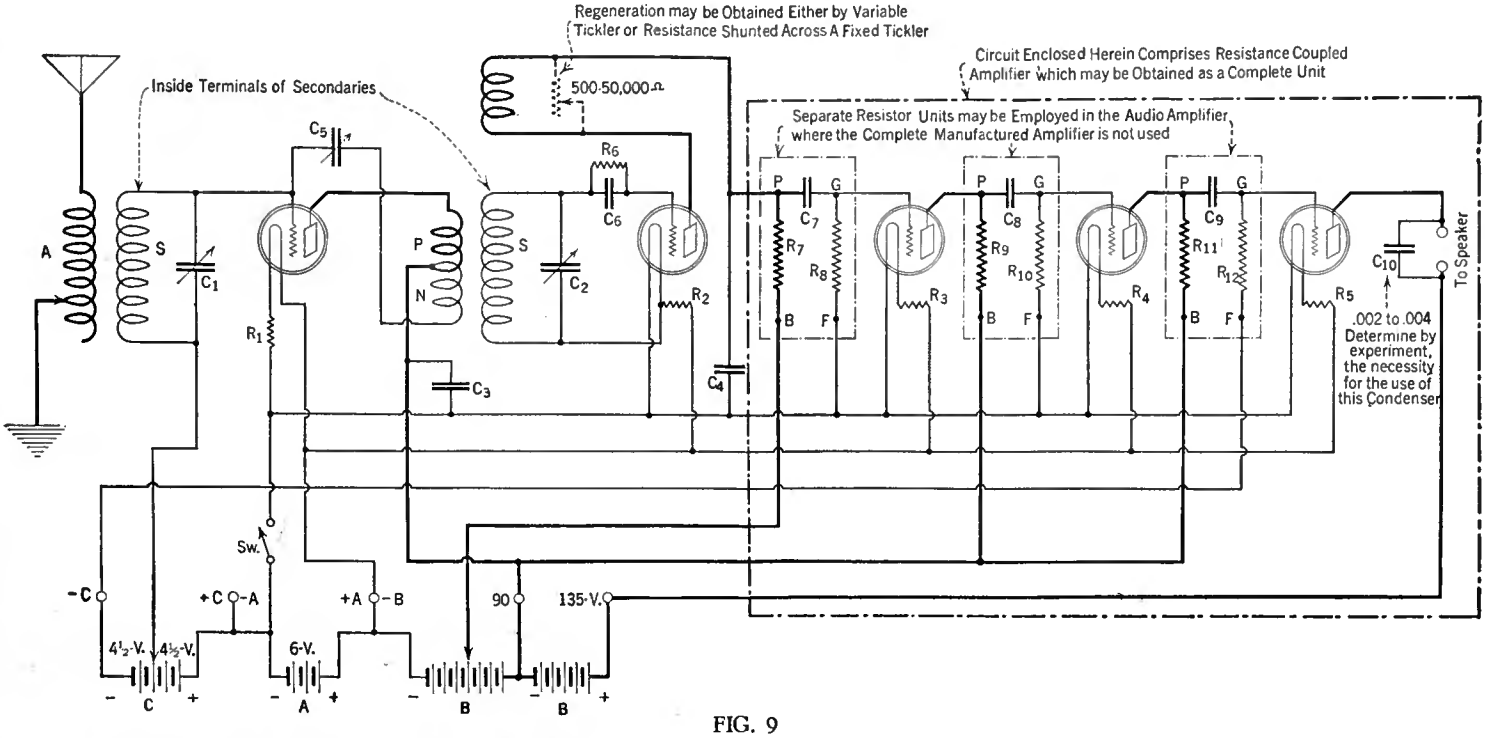


FIG. 9

This is the circuit diagram of the RADIO BROADCAST "Aristocrat". Note that the connections of C3 have been altered. They were incorrectly shown in the diagram accompanying the constructional article on this circuit on page 30 of RADIO BROADCAST for November. A .5 mfd. condenser should be tried across the B battery, which may improve the tone. Amperite ballasts may be used for filament control in each of the tubes

How to Use Meters in Your Receiver

The Meter is a Comparatively Inexpensive and Valuable Refinement—How Meters Work and How to Use Them for Best Results

By JAMES MILLEN

THIS article might have an alternative title, "How to Get More Out of Your Receiver," for that is exactly what will happen if Mr. Millen's suggestions are followed. It is easy enough for anyone to tell how a radio receiver is operating acoustically, but electrically, meters are required to tell the operator how the circuits are functioning. The addition of the proper meters to any set is neither an inordinately expensive matter nor a very difficult one. The mere assurance that one is using his tubes at the proper filament voltage is enough reason for installing the meters. In addition, the use of a plate current milliameter will register instantly the slightest distortion occuring in the audio circuit, after the fashion described by Mr. Crom in his article in RADIO BROADCAST *for October. Mr. Millen's excellent suggestions can aid every home constructor and not a few of those who have manufactured sets which they would like to improve.*

—THE EDITOR.

NOT a few broadcast listeners have the idea that meters in a radio receiver, if they are built in at all, are there for appearance and not for any good they may do in enabling the operator of the set to use his receiver more effectively. Of course, everybody knows that a set will work without a meter, but few know how much the proper meters will help in obtaining economy and quality performance.

A small voltmeter, connected in the filament circuit enables one quickly to turn the control rheostats to the proper point so that enough current is flowing

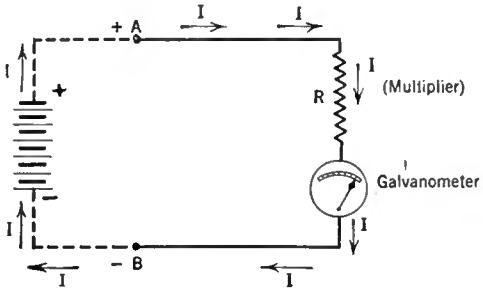


FIG. 1

This diagram shows how a resistance and a current measuring device are employed to determine voltage

through the circuit to heat the filament wire to insure emission of electrons in the proper quantity. This is one of the conditions for the production of good quality. At the same time, the filament is not operated above its rated voltage. This prolongs the life of the tube. When a tube is used with a very slight increase over its rated voltage, its life is greatly reduced.

Depleted B batteries are frequently a source of noise and distortion in radio receivers. And when, as is frequently the case, the B batteries are located in the cellar or some out-of-the-way place, it is inconvenient to test them frequently with a pocket voltmeter. So they are often neglected and as a result the quality of reception becomes poorer, all unnoticed by the owner, because the process is gradual. But some evening, when the receiver is put into operation it refuses to work. Had the set been provided with a conveniently arranged panel voltmeter, the operator could have made a frequent and easy check on the condition of the batteries.

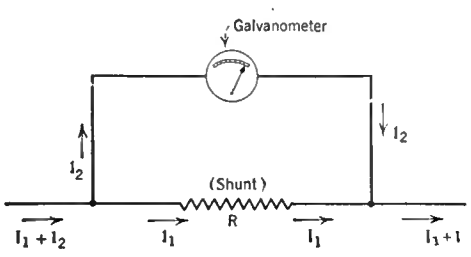


FIG. 2

A shunt resistance is employed in order that only a small percentage of the total current in the circuit passes through the meter

The third meter which helps toward good quality and economical operation is a plate-current milliammeter. A plate milliammeter primarily indicates the rate at which energy is being drawn from the B batteries. If this plate current is excessive, the life of the batteries and the tubes will be seriously impaired. By means of proper C voltages it is possible to vary the plate current and thus secure the value specified by the manufacturers of the tube for any given plate voltage.

A second, but not a lesser important function of the plate milliammeter, is to indicate how an amplifier tube is "modulating." For quality reception it is absolutely essential that the d. c. component of the space current of a tube, as indicated by a d. c. milliammeter does not vary. If the needle on the milliammeter drops down on a strong signal, the tube is said to be "modulating down" and the C voltage must be increased. If, on the other hand, the needle advances on a strong signal, the amplifier is said to be "modulating up," which indicates that the C voltage is too high for the plate voltage being used. Should the needle fluctuate violently in both directions, the tube is very much overloaded and both B and C voltages must be materially increased.

MANY USES FOR METERS

THERE are also a number of other uses for meters in connection with radio receiving sets, but with the equipment as available at present, their use is of value mainly in the laboratory. Such a meter is an ammeter for indicating the rate at which a storage battery is being charged. As the charging rate on the majority of home battery chargers is not variable, there is little to be gained by the use of a meter in such cases.

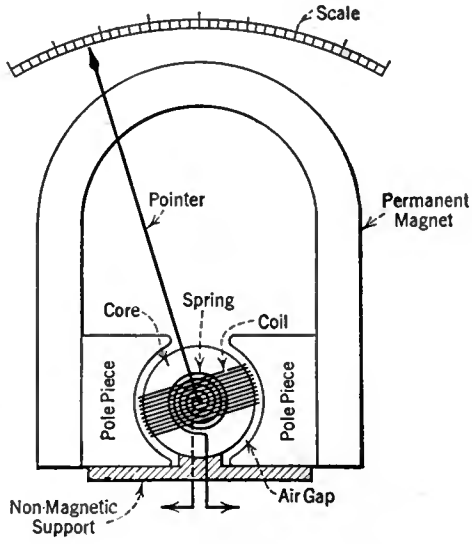
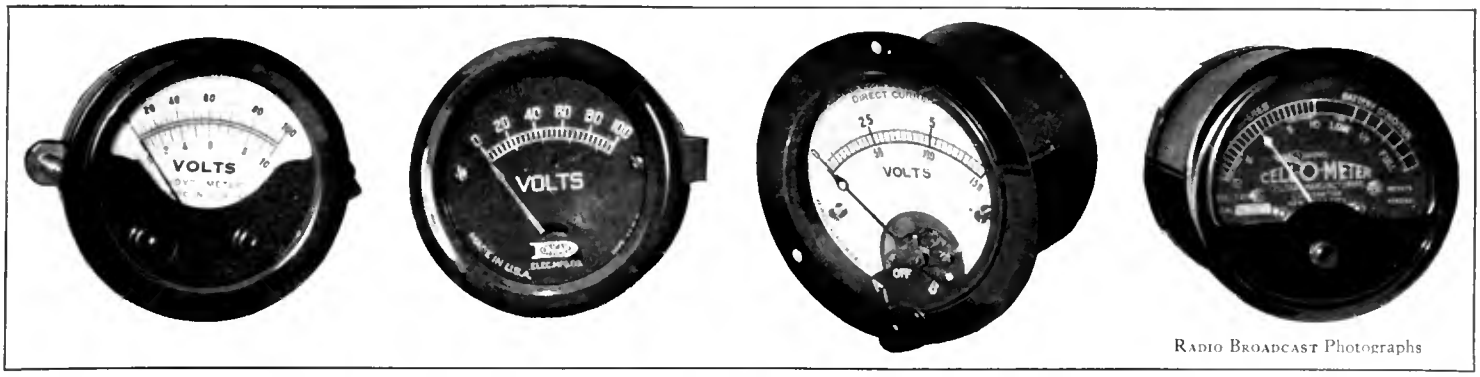


FIG. 3

The most accurate meters are of the moving-coil type, such as shown in this diagram. The photograph below shows a meter of the moving coil type, apart. The D-shaped piece on the base of the meter, center, is the permanent magnet

RADIO BROADCAST Photograph

FIG. 3A



Radio Broadcast Photographs

FIG. 4

There are a number of different concerns making meters for radio use. The products of Hoyt (Burton and Rogers), Dongan, Jewell, and Cellokay are shown

Another such meter is a wavelength or frequency meter, but this too may be dispensed with in the modern radio broadcast receiver by the simple expedient of calibrating the dials on the receiving set.

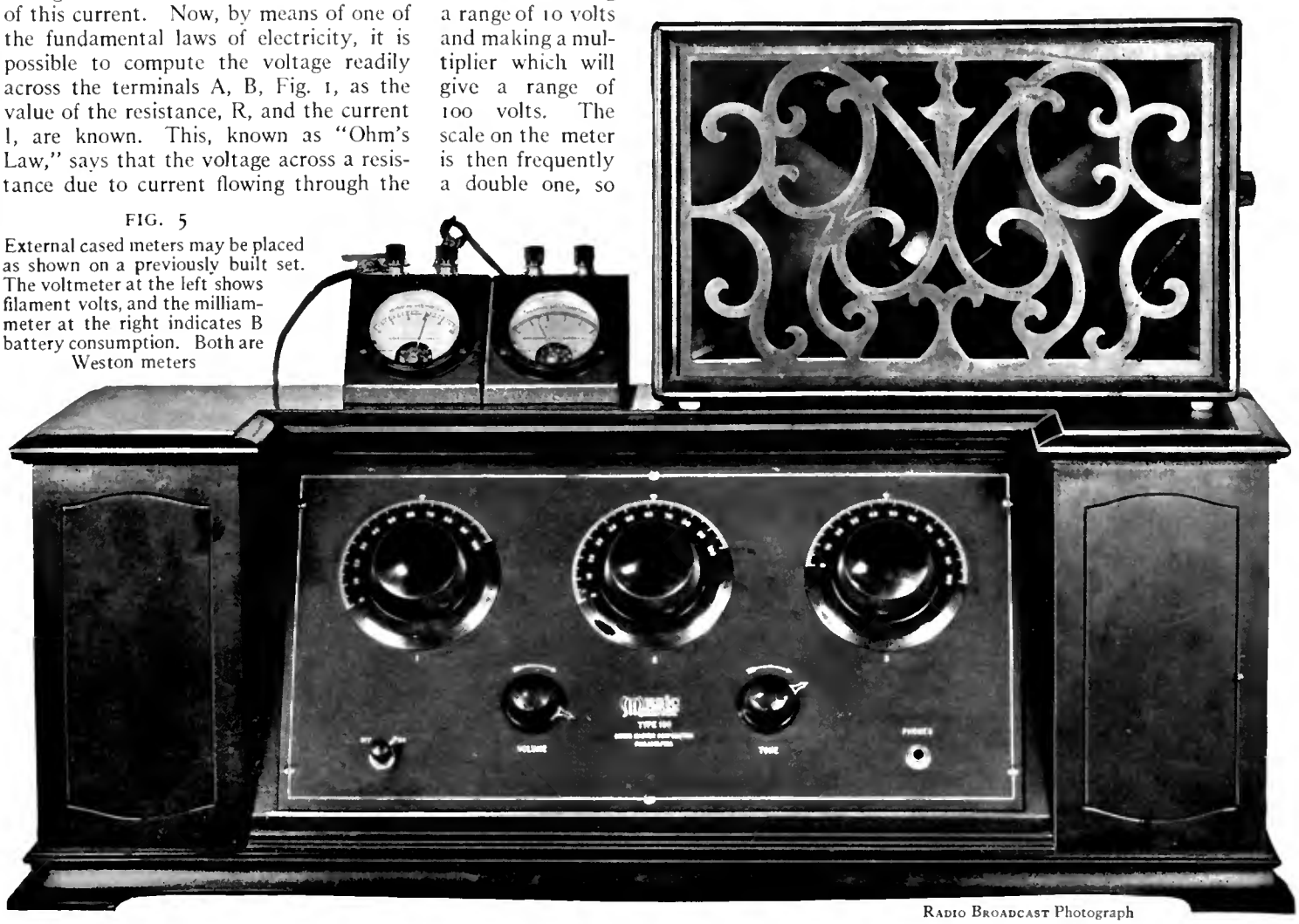
All of the meters referred to above with the exception of the wavemeter are fundamentally the same—that is, they are essentially galvanometers, or devices for indicating current flow. If a voltage is to be measured, then a high resistance unit, called a multiplier, is connected in series with a galvanometer and the combination connected to the source whose voltage is to be measured. This arrangement is shown in Fig. 1. A small current will flow through the resistance and galvanometer. The galvanometer will indicate the value of this current. Now, by means of one of the fundamental laws of electricity, it is possible to compute the voltage readily across the terminals A, B, Fig. 1, as the value of the resistance, R, and the current I, are known. This, known as "Ohm's Law," says that the voltage across a resistance due to current flowing through the resistance is equal to the product of resistance in ohms and the current in amperes, which, in symbols is $E = IR$.

Of course, it is not convenient to make even this simple calculation every time one wants to know the voltage of his batteries, so the manufacturers put a special scale on the galvanometer which reads directly in volts. Then they go still another step farther and build meters having an inherent resistance of such a magnitude that, for voltages under say 50 volts, the use of an external resistance or multiplier is dispensed with. For higher voltages, such as B battery voltages, it is generally customary for the meter manufacturers to take a lower voltage meter, such as one having a range of 10 volts and making a multiplier which will give a range of 100 volts. The scale on the meter is then frequently a double one, so that either the 0–10, or 0–100-volt scale may be referred to depending upon whether or not the multiplier is being used.

Ammeters are also fundamentally galvanometers, which would be burned out if a heavy current were to be passed through them. In order that they may be used to measure heavy currents, resistances are connected across them so as to "by-pass" most of the current and thus let only a small fraction of the total current pass through the meter. This "by-pass" resistance is known as a shunt and in the case of the small panel mounting type of milliammeters used for radio work, the shunt generally consists of a small piece of resistance wire contained within the meter case.

FIG. 5

External cased meters may be placed as shown on a previously built set. The voltmeter at the left shows filament volts, and the milliammeter at the right indicates B battery consumption. Both are Weston meters



Radio Broadcast Photograph

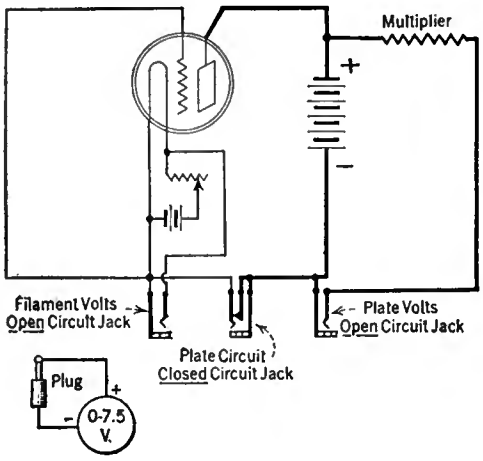


FIG. 7

By connecting three jacks in each tube circuit, it is possible to use one meter for many different purposes. In order that several different multipliers will not be required, one multiplier may be arranged with a short-circuiting switch in the plug circuit

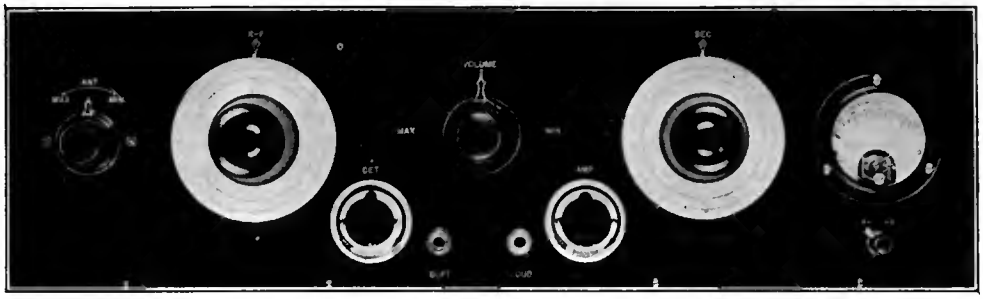


FIG. 9

This is the panel view of the "Aristocrat" receiver shown in Fig. 4 on page 196 of this issue. The switch below the meter at the right side of the panel allows the meter to read either filament or plate voltages

HOW THE METER WORKS

THE galvanometer units generally, in the higher grade instruments, consists of a movable coil, to which is affixed a pointer, pivoted in a strong magnetic field set up by a permanent magnet of the "horseshoe" type. This arrangement is illustrated in Fig. 3. When a current passes through the coil, an electro-magnetic field is set up which reacts with that set up by the permanent magnet and the coil tends to rotate. It is held back by a small hair spring. The force (or as it is technically called, torque) tending to rotate the coil is directly proportional to the current flowing through the coil. Furthermore, the deflection of the coil is governed by the spring, whose deflection with certain limits, is directly proportional to the torque. Thus the deflection of the galvanometer is directly proportional to current.

Instruments, such as the Weston and the Jewel employ the movable coil type of movement illustrated in Fig. 3. The less expensive meters, especially the small pocket volt and ammeter used for testing dry cells are of what are known as either the plugger, and iron vane type. The iron vane type consists of a small electro-magnet with a soft iron core. When a current is passed through the winding of the electro-magnet a small iron "vane," which is mounted on a shaft, is attracted. The vane is held back by the permanent magnet, and a pointer is affixed to the shaft so as to indicate the deflection.

The electro-magnet in an ammeter of this type consists of a half dozen turns of very heavy wire, whereas the voltmeter electro-magnet is wound with many turns of very fine wire.

In the past, instruments of the iron vane type have not been considered very accurate for high grade work. Furthermore, they consumed considerable power, and thus could not be left in a circuit for any length of time, as they would run the batteries down. This is especially true of voltmeters since they are shunted across the supply and if left in circuit would deplete the batteries very rapidly.

At present, however, there are at least two well-known concerns manufacturing improved instruments of this type which are well suited for radio use, particularly for measuring B battery voltages. Such a meter mounted on the panel of a tuned radio frequency receiver is shown in Fig. 8. Two push buttons are provided so that either the detector or the amplifier B voltages may be instantly read with the same meter. When push-buttons are used for this purpose there is no danger of the meter remaining connected to the B batteries for long periods and thus unnecessarily running them down.

Fig. 4 shows a group of different meters for mounting on the panel of a radio receiving set. The meters may be mounted in small cases, and connected to the set with flexible lamp cord. Such an arrangement is shown in Fig. 5.

Fig. 6 shows how these meters are connected in a RADIO BROADCAST Four-Tube Knockout receiver. By carefully examining the way in which the meters are connected in this circuit, the manner in which they should be connected in any circuit will be evident.

If a meter is equipped with an ordinary phone plug and flexible cord, jacks may be arranged on the panel of the receiver so that it may be plugged into any part of the circuit. Fig. 7 indicates how to connect the jacks in a circuit.

Instead of having three separate meters —A voltage, B voltage, and plate current— for use with the set in Fig. 7, one meter may be made to serve the purpose most excellently. If a 0 to 7.5 voltmeter is available it may be used directly to read filament volts, with a resistance in series (8825 ohms for Weston 0–7.5-volt No. 301) to read up to 150 volts (multiply scale readings by 20) and without any attachments, as a milliammeter. For the model 301 Weston meters, a full scale deflection requires 16.1 milliamperes or for the 0 to 7.5 volt Weston meter, each division is equal to 2.146 milliamperes or approximately 2 milliamperes.

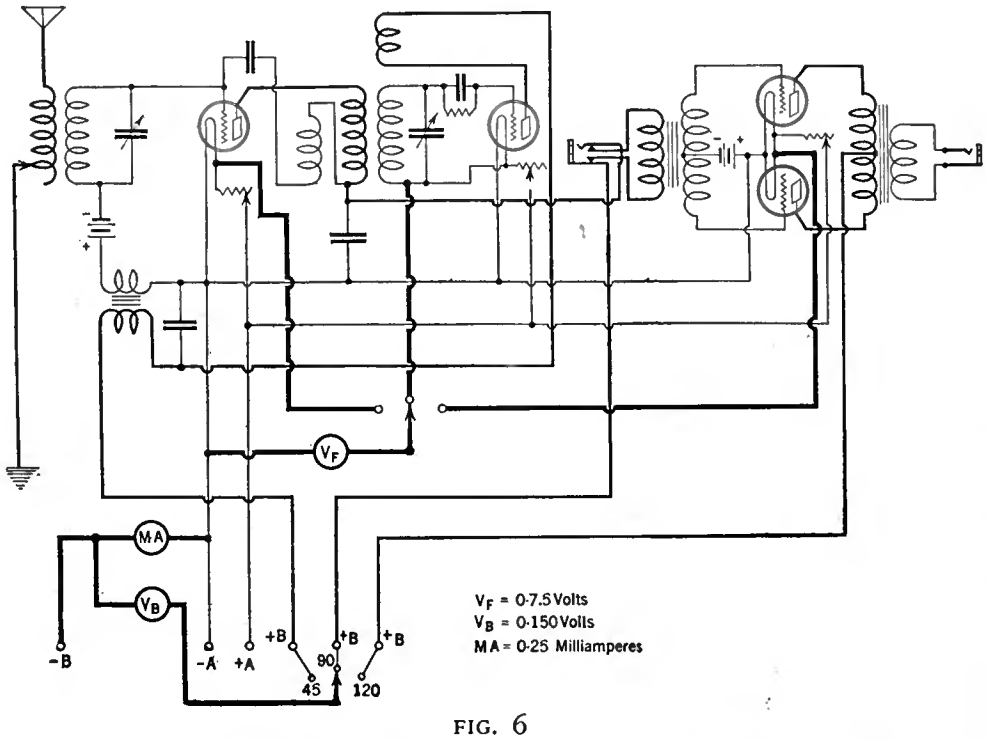


FIG. 6

This circuit diagram shows how to connect a filament voltmeter, a plate voltmeter, and a plate milliammeter in a RADIO BROADCAST Four-tube Knockout receiver

New Fields for the Home Constructor

The Second of a Series of Articles—Each Complete in Itself—Showing the Jaded Home Builder How He Can Use His Present Equipment to Make Valuable and Useful Measurements and Experiments in His Own Home

By KEITH HENNEY

Director, "Radio Broadcast" Laboratory

THERE can be little doubt that radio is one of the most attractive fields for home experiment that has ever offered itself to the average layman. The ramifications of this specialized part of electrical engineering are so many and so varied that "that tired feeling" of having solved all is always far in the distance, and the home experimenter, with inexpensive and not too complicated apparatus, can approach so closely to actual scientific research that he cannot help attaining a distinct feeling of having accomplished something of value at the end of each day's experiment.

For a long time the Editors have been sure that there were many who felt they had built enough receivers, but who still had a craving to construct something with their own hands that would work in some useful way. Tools accumulated through days of receiver building cannot lay idle; radio junk collected during those same days, is always too good to throw away; experience in radio matters causes a yearning for more experience—and yet, to build one more receiver might be the breaking of the proverbial camel's back. What is the home constructor to do?

This series of articles, of which this is the second, has been planned with but one object in view, to lead these jaded souls into a field where there is endless variety, and where each thing accomplished leads to something else. And for those who really want to know more about radio, who want to find out for themselves what is going on behind laboratory doors, these articles will be written so that they will be in some degree helpful. The home constructor naturally fits into the field of radio experiment since he has already tasted the joys of building successful apparatus, and in this way he has learned the "feeling" of electrical equipment

The first article, in the September number, described a simple piece of laboratory equipment that is efficient enough to grace the best laboratory, useful enough to make it worth while for any one to build, and at the same time inexpensive and not complicated. It is a two-tube oscillator, one of the tubes working at broadcasting radio frequencies, and the other at a fixed audio frequency. Either tube may be used alone, or the two may be operated together as a source of modulated high frequency energy.

USES OF AN AUDIO OSCILLATOR

FOR example, the audio part of the oscillator referred to above is used in the Laboratory of RADIO BROADCAST for the following purposes:

1. Source of tone for testing open circuits.
2. Tone for measuring capacity, inductance, or resistance.
3. Measuring the characteristics of audio instruments, such as audio-frequency transformers, loud speakers, etc.

It is common practice among radio workers to use a battery and a pair of head phones to test open circuits, and at times a dry-cell operated buzzer is used. For example in a receiver which is inoperative due to a broken connection, the wiring may be traced until the break is found.

In testing audio frequency circuits in which transformers are used, it is extremely bad practice to use direct current for testing. After such a test it may be found that the iron cores are magnetized with the result that distortion occurs when the amplifier is again placed in operation. In the laboratories of the telephone companies, where hundreds of telephone transformers are used, it is strictly against the rules for laboratory assistants to "buzz" out circuits either with the phones and dry cell or with a buzzer.

The 1000-cycle tone emitted by the audio oscillator described in the September article, is an alternating current of small amplitude which cannot magnetize the cores of any transformers. Fig. 1 shows the usual method of testing open circuits with battery and headphones, as well as the correct method of using the audio oscillator as a tone tester. The jack in the oscillator provides an outlet for the 1000-cycle tone and a plug in this jack will have the alternating voltage across its terminals. One terminal should go to the receivers, and the remaining wires, one from the oscillator and the other from the phones, should go across the suspected broken connection.

Capacity and inductance, as well as alternating current resistance, are measured by what is known as an "impedance bridge" which operates from a source of alternating current. The audio part of this oscillator is again useful here, and Fig. 2 shows how it is used in the Laboratory. It is not necessary to have much power for work of this kind, and if extraneous noises make it difficult to get proper balance on the bridge, a one- or two-stage audio amplifier is connected to the bridge and thence to the receivers. For example, in the Laboratory, the noise and vibration from presses, in action several floors below, makes it difficult to obtain correct measurements, without the aid of the amplifier shown in Fig. 2.

A simplified form of bridge will be described soon in this series and, with the aid of the audio oscillator, will enable the experimenter to measure his own inductances and capacities just as is done in any large and well equipped laboratory. This will eliminate much of the cut-and-try method that is now in order when the radio builder decides to make new coils, or to try different sizes of condensers to tune to certain frequencies. The bridge shown in Fig. 2 is made by the General Radio Company.

By varying the tuning condenser across the secondary of the oscillator, notes may be secured varying from about 200 cycles to the natural frequency of the transformer itself, which is usually around 5000 cycles. These tones may be amplified if necessary,

TO SHOW how the home constructor can go on in radio after he has built the radio sets that to him are satisfactory, is the purpose of these articles. The first "What Is to Become of the Home Constructor?" appeared in this magazine for September and has created a phenomenal amount of interest. Each of these articles really gives a complete set of experiments and useful tests which may be made by any experimenter who is properly equipped. The apparatus, most of it at least, in the form of parts, is in the radio "junk pile" of almost every constructor. Each article is complete in itself, the experiments are related and they have a very definite use in any one of a number of ways. Using the audio oscillator to test receivers and the radio oscillator to calibrate them, is, for example, of great use to radio dealers who take pride in their repair and service departments. The uses of the radio oscillator suggested here are novel and ingenious and bound to be helpful. Those who are interested in laying out a modest little "lab." of their own will be interested in the suggestions given at the end of this article.—THE EDITOR.

and used to determine the characteristics of audio-frequency transformers as well as the resonance peaks which exist in many loud speakers. Methods of testing these low frequency instruments will be described later. Calibrating the oscillator is not difficult provided access is had to a musical instrument that is accurately tuned.

Middle C on a properly tuned piano corresponds to a frequency of 256 cycles per second, and is a good starting point for the calibration of an audio oscillator. The tuning condenser should be varied until the sounds emitted by the piano string and the oscillator are the same. Other frequencies may be obtained in the same manner. The relation between frequency and the piano scale will be shown graphically in the January RADIO BROADCAST.

Tuning forks may be purchased from musical supply houses and a small set, say, those of 256, 512, 1024, and 4196 cycles, will enable any one to calibrate an oscillator.

USING THE RADIO OSCILLATOR

In the Laboratory, the radio part of this simple device is used for the following purposes:

1. Calibrate receiving sets.
2. Set receiver for a given frequency.
3. Measure the frequency of incoming signals.
4. As a separate oscillator for superheterodynes.
5. Source of radio frequency energy for measuring losses in coils, etc.
6. Wavemeter.
7. Energy for neutralizing receivers.

As an example, let us suppose that a new receiver is constructed and we are desirous of finding out what frequency band it will cover. We crank up the oscillator and tune the receiver to it. Noting the dial numbers of the receiver, we change the frequency of the oscillator and again tune the receiver. In this manner we

FIG. 1
A source of pure alternating current is useful in testing audio-frequency transformers. There is no danger of magnetizing the cores when such a tone source is used. The battery "click" method is dangerous. An Erla cruciform audio transformer is being tested in this view

RADIO BROADCAST Photograph

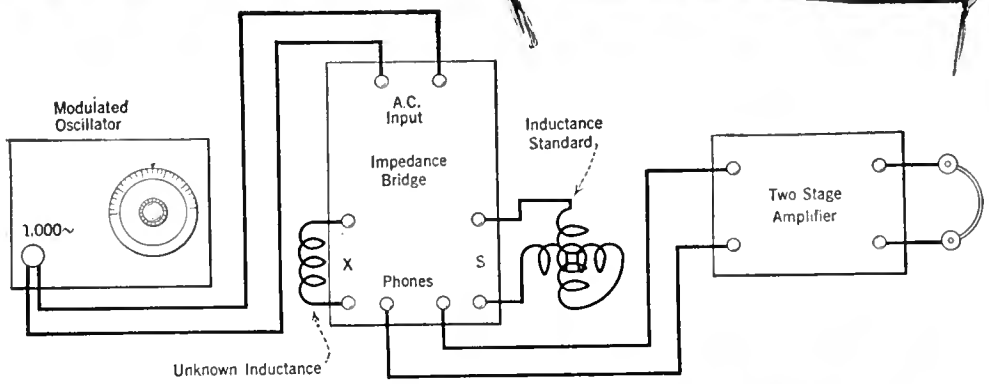
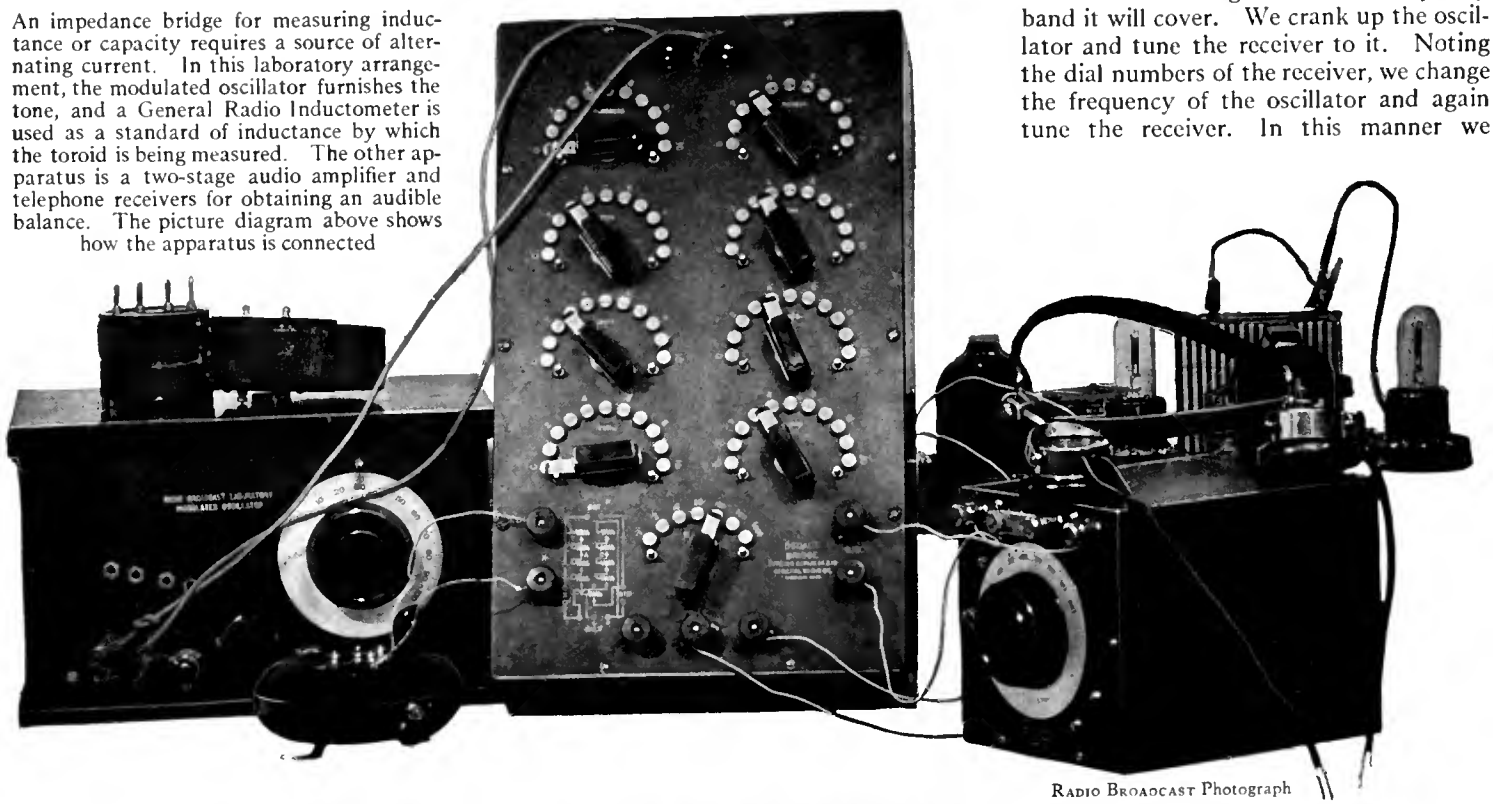


FIG. 2
An impedance bridge for measuring inductance or capacity requires a source of alternating current. In this laboratory arrangement, the modulated oscillator furnishes the tone, and a General Radio Inductometer is used as a standard of inductance by which the toroid is being measured. The other apparatus is a two-stage audio amplifier and telephone receivers for obtaining an audible balance. The picture diagram above shows how the apparatus is connected



RADIO BROADCAST Photograph

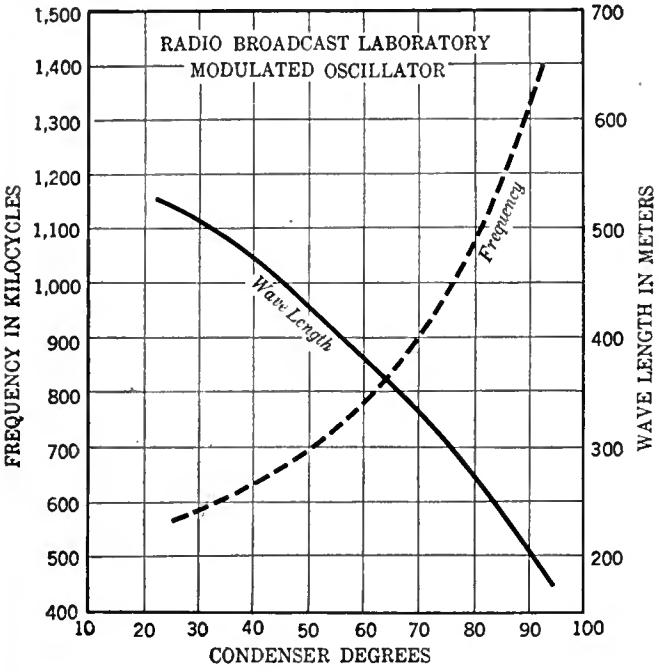


FIG. 3

A calibration of the Laboratory's oscillator. Both frequencies and wavelengths are plotted against condenser settings. This calibration will be true only of the coil and condenser used in this particular case. All other combinations must be calibrated against standard frequency signals either from a known broadcast station or from the standard frequency signals sent out by the Bureau of Standards

may have an exact tuning curve of the receiver before a single station is heard. Fig. 3 shows a calibration of the radio part of the Laboratory's oscillator. This of course will differ for each coil and condenser used and the effect of connections will not be negligible.

This means that each constructor will have to calibrate his own oscillator, but at night this is not a difficult task. With both tubes functioning it is only necessary to tune a receiver to a known station. Then the oscillator is varied until the tone is heard in the receiver. Now that radio stations stay closely to their required frequencies, it is possible to own a very accurate wavemeter using this simple means of calibrating it.

Incoming signals on any receiver may be measured for their frequency by tuning the oscillator until it is heard together with the stations signals. A glance at the calibration will show what station is being received.

The receiver may be set at a required frequency by setting the oscillator for this frequency by means of its calibration curve, and then tuning the receiver until the sound is heard. In other words, the modulated oscillator will make a good wavemeter, and due to the fact that both audio and radio waves are tube-generated they will be very sharp. The old time buzzer with sparking contacts is notoriously broad in the frequency spectrum it turns out.

USE IN NEUTRALIZING RECEIVERS

THERE is another use of the radio part of the apparatus that is very important, and in the Laboratory it has been used many times for this purpose and may easily find the same use in many home laboratories. This is the neutralization of radio-frequency amplifiers. Tuning-in a signal and then, with the radio frequency tubes turned out, to adjust the neutralizing condenser until no sound is heard is one method, and the modulated oscillator, with both tubes burning, provides a good source of energy for this purpose.

There is another method that may be used, especially where a regenerative detector is in the circuit, and it is somewhat more accurate. This is particularly true if high gain amplifiers are used, characterized by many plate turns in the amplifier coils, and correspondingly large fields.

The detector is made to oscillate, and with the radio frequency tube of the oscillator set at some frequency in the middle of the broadcast band, the detector tuning condenser is varied until a beat note between the detector current and that emitted by the oscillator is heard. Then the radio-frequency amplifier condenser is varied. If the amplifier is not properly neutralized, the beat note will change pitch rapidly as the amplifier is tuned. If far from the neutralizing point, the amplifier may oscillate, or reaction between the amplifier and detector may be so great that the detector will refuse to oscillate.

The neutralizing condenser is then varied until changing the amplifier tuning has little or no effect upon the detector circuit. This balanced condition will be noted when the beat note between detector and oscillator does not change appreciably when the radio-frequency amplifier is tuned.

Since it is not always possible to pick up broadcasting stations, especially where constructors are out of the daytime range, the oscillator provides an excellent source of both pure radio and modulated radio frequency energy for neutralizing purposes.

TO GET GREATER ENERGY FROM THE OSCILLATOR

FOR some purposes it is necessary to have greater power than is turned out by the WD-12 tubes used in the Laboratory oscillator. In this case it is only necessary to use standard 5-volt tubes, or better yet, the new one-half ampere, 5-volt tubes, such as the UX-112, the Daven MU-6, Cleartron 112, etc., and to push up the B battery voltage until the required power is obtained. It will be necessary to recalibrate the set owing to the changed grid-filament capacity, but the differences will be small and unless very accurate work is to be done, recalibration will not really be necessary.

The audio output may be sent through an audio-frequency amplifier such as is illustrated in Fig. 2 if greater tone volume is needed.

Another method of getting greater voltages out of the radio part of the device is shown in Fig. 4, which gives the entire circuit. Currents in tuned resonant circuits are usually high, and this is particularly true when those circuits are of low resistance. Thus the output of the oscillator may be coupled to a tuned circuit and part of the voltage of that circuit used for whatever purpose is necessary, such as for measuring the resistance of coils and other radio frequency apparatus.

The oscillator is first tuned to the required frequency. Then the output circuit is tuned, and finally the circuit to be driven. Unless considerable power is required, it is not necessary to tune the output circuit which is then acting as an untuned "transmission line," and serves simply to transfer energy from one circuit to another.

Little current will flow through the transmission line, if it is untuned, but in the tuned circuit at the end there will be heavy currents.

Fig. 5 shows the apparatus required for measuring the high frequency resistance of coils. With the addition of a vacuum tube voltmeter, such as was described in RADIO

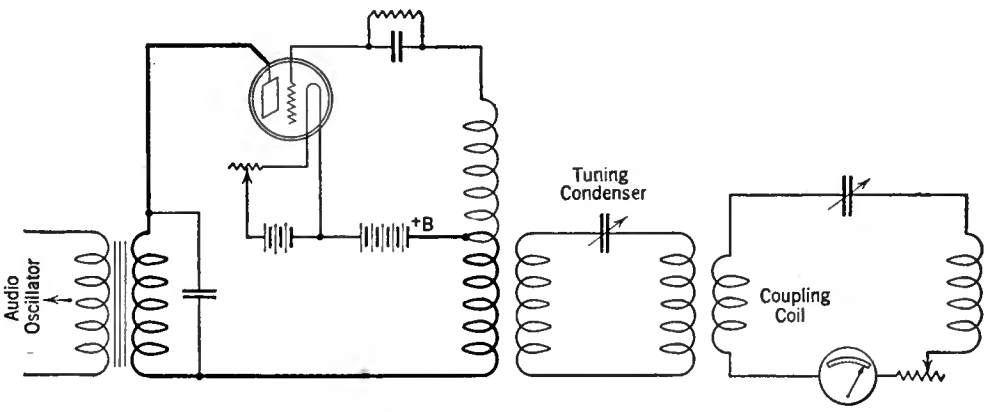


FIG. 4

A use for the radio frequency part of the oscillator. By use of a coupling coil, energy may be transferred from the oscillator to some other circuit. If this intermediate circuit is tuned by means of the condenser, much more current will flow in it and correspondingly greater voltages may be transferred to the circuit under test

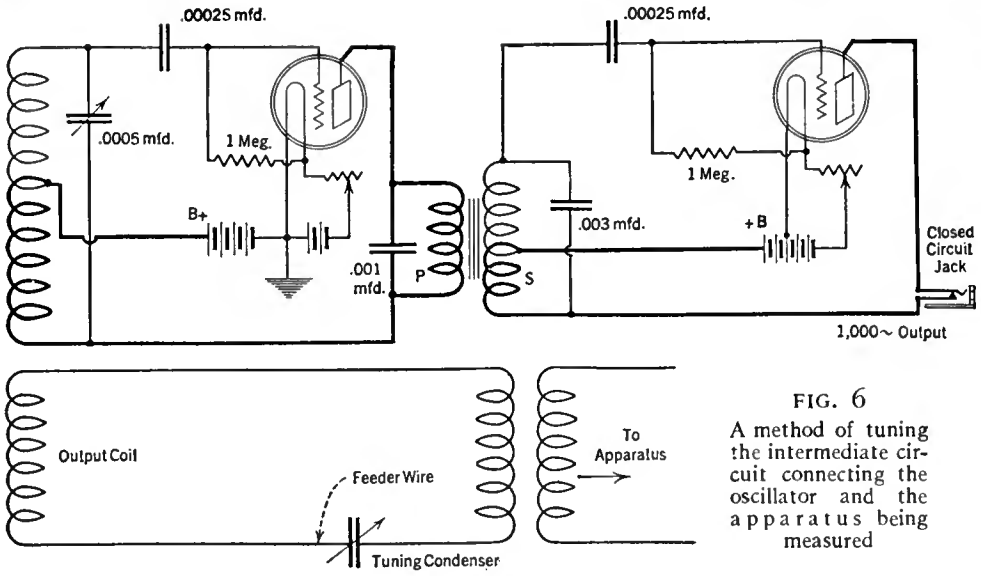


FIG. 6

A method of tuning the intermediate circuit connecting the oscillator and the apparatus being measured

Broadcast for February, 1925, page 1101, the gain of radio-frequency amplifiers may be measured.

Many experiments are now being simplified in Radio Broadcast Laboratory for inclusion in this series. A simple and fairly accurate impedance bridge will be described, methods of measuring the amplification of both audio- and radio-frequency transformers and the losses in coils will be explained, and among other apparatus described there will be a vacuum tube voltmeter with which many important experiments can be performed. Wherever possible references to current literature will be cited as well as to standard texts. Readers are invited to write of their experiences or difficulties or to state what particular problems they would like to see treated in this series.

WHAT SHOULD THE HOME "LAB" BE?

IT SEEMS to the writer that there are two methods by which the experimenter may carry out his work. He may have a regular place for his apparatus and for his work, or he may not. Naturally, the laboratory should be a fixed place, where apparatus may be set up and not disturbed until the experiments in progress are finished.

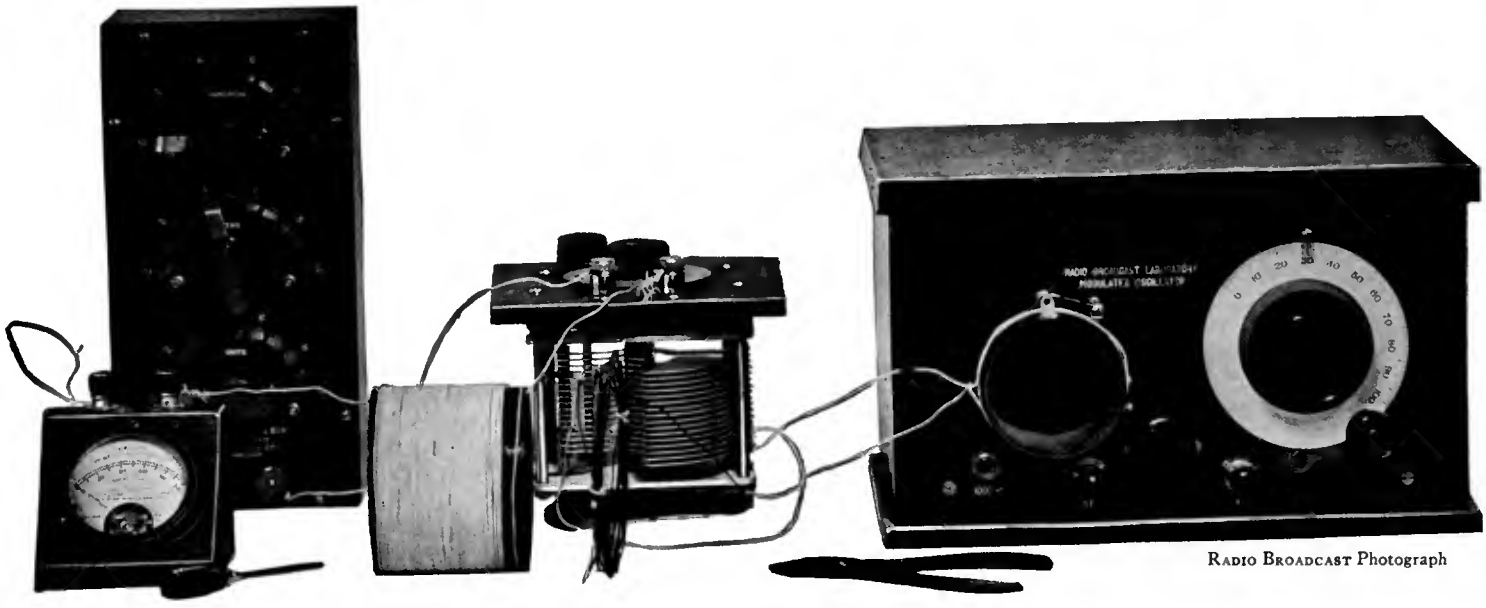
In this place there should be a work bench and a laboratory bench, and the latter should be kept free for the actual work at hand. It often happens that a certain set-up of apparatus will be used for some time, for instance where one is measuring the gain of radio-frequency amplifiers, and it is a waste of time and energy to tear down and set up the equipment each time an experiment is completed. Added to the nuisance of such movement there is the likelihood that readings taken on successive days will not check—for radio frequency circuits are tricky affairs.

The tools that are needed are no more than are required for constructing receivers, but, like the electrical equipment, they should be of the best make possible. A good drill, a pair of long nose pliers, a pair of cutters, and a long, narrow screw driver are vitally necessary. Added to these may be the usual wood working tools, such as a hammer, a saw, and a plane.

Electrically speaking, the home experimenter should begin his collection of apparatus by purchasing a good voltmeter and a good milliammeter. The meters may be of the Weston 301 type installed in student bases, or corresponding meters made by Jewell, Roller-Smith, General Radio, etc. The voltmeter should have a range of 0 to 10 volts and an ammeter which will be found to have many convenient uses should read from 0 to 10 milliamperes. This will read the plate currents of 5-volt tubes under ordinary conditions, and with some simple accessory apparatus will enable the experimenter to measure the constants of tubes as well as to check up on the other experiments that go on.

Such meters can be purchased for about $10 each with base, and are the first equipment that the experimenter should possess. Additional equipment will be cited in future articles.

Radio Broadcast Laboratory wishes success to prospective home laboratory owners, and will be glad to hear from readers who are interested in the experiments described here.



Radio Broadcast Photograph

FIG. 5

A photograph of apparatus actually being used to measure the high frequency resistance of coils. The oscillator supplies the energy, a Weston galvanometer, Model 425, measures the current flowing, and a General Radio Laboratory condenser and resistance box aid in the actual measurement. In this case the intermediate coupling circuit is not tuned, consisting merely of two very small coils, one coupled to the oscillator, one to the coil under test. Later articles will contain descriptions of simple apparatus which is capable of performing similar experiments to those described in this article

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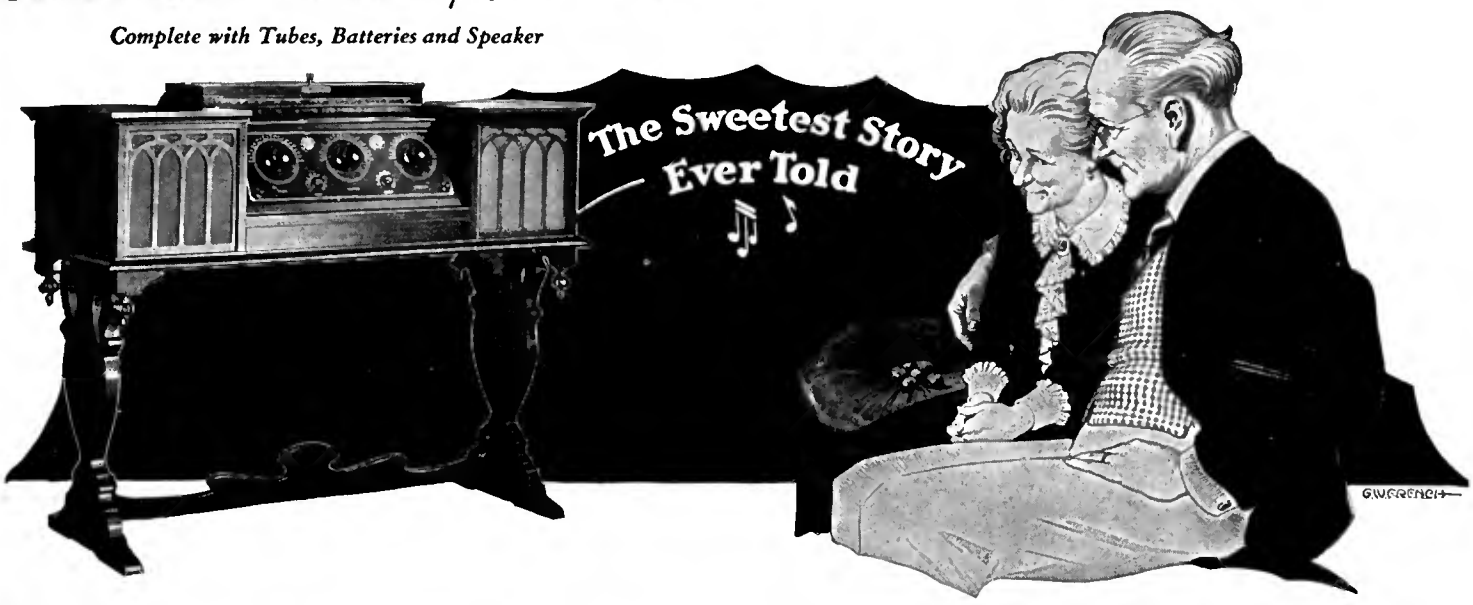
Complete with Tubes, Batteries and Speaker



If Your Radio is Bought Right It will be a Life-Long Pal

A LITTLE more time, a little more care in making the selection in the first place generally tends to more lasting satisfaction.

Out of every 100 Ozarka's sold in 1922 only eight are not today in the hands of the original owners—this does not include 17 out of each 100 who have purchased later Ozarka models in newer type cabinets. If there is a single Ozarka that is not in active service today, we have never heard of it.

Without the Ozarka Service in charge of direct factory trained representatives, such a record would not be possible. Ozarka service can be had today in almost every country. Purchasers in South Africa, Alaska, Sweden, Newfoundland, New Zealand, and Japan all receive the same practical service as those in Canada, United States, Mexico and Cuba. Whenever you find the sign of the Ozarka long distance goose, you'll find a man who knows Ozarka instruments perfectly.

If such service added more to your cost price it might be a matter to consider, but it doesn't. Quality for quality you'll find Ozarka prices lower—four tube Ozarka's with built-in loud speakers retail for $58.00—five tube with built-in speaker $64.00, up to solid walnut console design, $160.50.

Our nearest representative will gladly set up an Ozarka in your home, without any obligation whatever. He won't tell you what it will do—he will let you do all the tuning. With the Ozarka you must satisfy yourself, as to distance, tone, volume, ease of tuning and selectivity.

More than this you will be very agreeably surprised at Ozarka prices—selling as we do, thru our own direct factory representatives, our selling expense is very low—we give Ozarka purchasers the benefit of it.

Where is there a value to compare with the one shown above — solid walnut cabinet (no walnut finish or veneer), imported English loud speaker of a marvelous tone, five tube instrument with 75 ampere Exide storage battery, 90 volts of Eveready "B" battery, 5 tubes, aerial equipment all erected and the price is only $197.50.

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In a great many counties we have the man we want. He is rapidly building up a permanent and profitable business of his own because he has an instrument that will more than meet all competition. More than this, he is trained to back up his sales with the kind of service that counts.

Many well established Ozarka representatives started by giving us only their spare time—their evenings. If your county is open you can do the same.

The investment in cash is very small. The investment in time necessary for study is considerable. It requires patience, but the results have enabled many men to get out of the salary and time clock class.

Any previous sales experience is helpful but not necessary. We can and will teach you how to sell.

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This book is entirely too expensive to be sent out on postal card requests. It will be sent FREE to any man who mails the coupon below and who is really anxious to improve his condition. Tell us about yourself — ask for Ozarka Plan No. 100 and don't fail to give the name of your county.

OZARKA
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Chicago Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

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Address..... City.....

County..... State.....

Ask the Man Who Wears this Button

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Chicago, Illinois

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan No. 100," whereby I can sell your radio instruments.

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County..... State.....

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"NOW, I HAVE FOUND . . ."

A Department for the Exchange of Ideas and Suggestions of Value to the Radio Constructor and Operator

CONTRIBUTIONS to this department are welcome and those used will be paid for at the usual rates, that is from two to ten dollars each. A prize of twenty-five dollars is given for the best idea used during each three-month period. The prizewinner for the last period was announced in the November RADIO BROADCAST. *All manuscripts intended for this department should not exceed about three hundred words and should be typewritten. Little consideration can be given to manuscripts not typewritten. Envelopes should be addressed to this department,* RADIO BROADCAST, *Garden City, New York.*

TRACING RADIO NOISES

MANY radio listeners have been led to believe that certain objectionable noises accompanying reception were caused by power-line interference, or other neighborhood operated devices, from the advice, "if the noise ceases when the antenna is disconnected, it is an indication of outdoor interference," and as such, was largely beyond the individual efforts of the set owner to control. This is not always true.

A particularly bad case of interference, which had the characteristics of outdoor interference, was discovered to be coming from the residence main switch and branch terminal cabinet, which was located fourteen feet from the receiver, in the same room.

The switch cabinet and receiver were installed on opposite sides of this room, and the lead-in wire paralleled the house wiring through the adjoining rear room at a distance of five feet, for fifteen feet, and did not enter nearer to the switch than the width of the room.

The receiver, a five-tube neutrodyne, with loud speaker, was adjusted until noises were loudest. The time selected for test was 2 a. m. when no interference was encountered from street cars, regenerative sets, or neighborhood electrical devices.

Disconnecting the antenna produced silence. Replacing the antenna and operating the room switches, the noise was still present in full volume.

Next, the residence main switch was opened, and the mystery was solved. for the noises could be produced and made to disappear by closing and opening this switch.

The continuous "crackling" or "frying" noises, similar to that produced by bad tubes, were caused by loose connection screws of the main switch, branch terminal fuse blocks, and bad contact of plug fuses.

An occasionally loud "zip," or "buzz," similar to nearby code interference, or arcing of defective receiver jacks, was caused by loose rivets fastening the main switch blades to the switch block and was traced through applying test loads using heater coils, although arcing was not visible to the eye. Thus, all noises present at this time of day were eliminated. The remainder heard during usual broadcasting hours, such as code, sparking trolley wheels, and during heavy rain or snowfall were satisfactorily reduced to a minimum by various methods which have often been described and which will not be gone into here.

A. H. KLINGBEIL,
Ashtabula, Ohio

A RATCHET COIL WINDER PREVENTS UNWINDING

OFTEN in the middle of the winding of a coil, the hold will be released momentarily to straighten out the wire, and as a result the carefully arranged turns of wire may loosen, and the work has to be done over again.

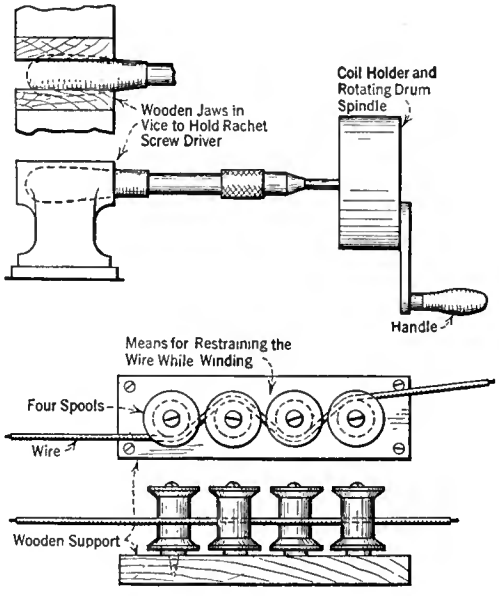


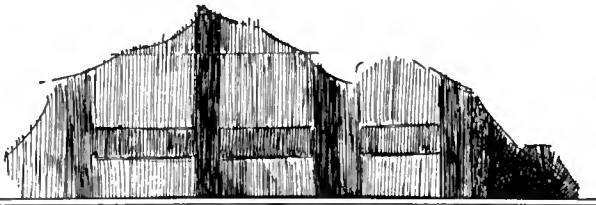
FIG. 1

A method of improving the usual winder, is shown in the sketch, Fig. 1, involving an ordinary ratchet type screw driver, which many radio experimenters have in their tool equipment. As shown, the handle of the tool is gripped in a vise, or held stationary by other means. The spindle of the winder is fixed to the barrel, and the ratchet is set so as to prevent unwinding. A ratchet type of brace bit obviously has the same advantages for this use, and the spindle is gripped in the jaws in the same manner as is the screw driver method.

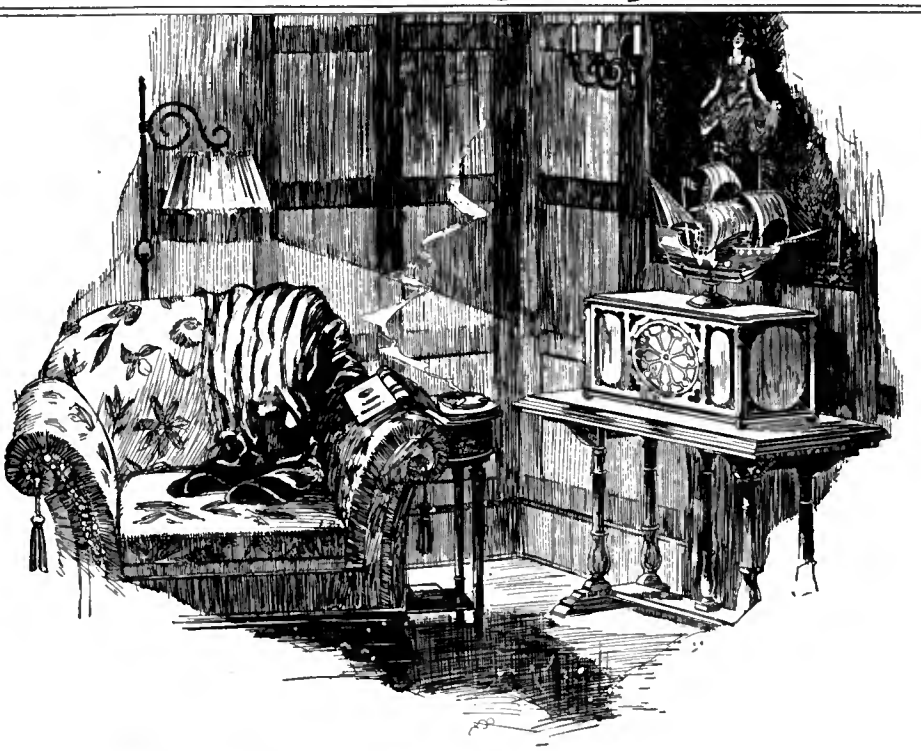
The best method of restraining the wire while winding, may not be available to radio workers, for which reason the restraining reel, shown in the lower section of the sketch, will solve their problem.

Make this up of four ordinary spools, used for thread. Mount these spools on nails or screws, so that the wire will feed through with enough tension to make it tight when wound on the coil. This reel will not only restrain the wire, but will also take out kinks and make it uniform and even throughout the length of the wound coil.

G. A. LUERS,
Washington, District of Columbia.



No Dials, No Panel, Built-in Loudspeaker



Designed by R. E. Lacault, E.E., Chief Engineer of this Company, and formerly Radio Research Engineer with the French Signal Corps, Radio Research Laboratories.

To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on the assembly lock bolts of all genuine ULTRADYNE Model L-3 Receivers. All Ultradyne Receivers are guaranteed as long as these seals remain unbroken.

$135.00

The Quiet Manner and The Eloquent Tone

UNOBTRUSIVENESS with sufficiency—the rule of good taste—is the distinguishing grace of the ULTRADYNE Model L-3 Radio Receiver. Ushers in a new era of radio reception—a new, easier command of the air's treasures.

A new artistic form of a radio receiver that blends happily with every scheme of interior decoration. Pleases the eye with its charming lines, its beautiful two-tone mahogany cabinet, its fine proportions. Has the appearance of a decorative tablepiece. Utter simplicity with superb receptive and reproductive qualities. Your local radio dealer will gladly give you a demonstration of this new modern receiver.

The Ultradyne Model L-3 is a six-tube receiver employing the fundamental principles of the best circuits greatly refined and marvelously simplified. No dials—no panel; just two inconspicuous levers, which constitute a station-selector. Volume adjustment the only other control.

Write for descriptive folder

ULTRADYNE

MODEL L-3

★

PHENIX RADIO CORPORATION, 116-C E 25th St., N. Y.

★ Tested and approved by RADIO BROADCAST ★

A COUPLING DEVICE FOR THE ROBERTS CIRCUIT

A SIMPLE device for varying the coupling between the tickler and secondary coils is presented here for the benefit of builders of receiving sets using the Roberts circuit. This device provides a 90-degree coupling, or less, with a 180-degree turn of the dial. The rotation may be in either direction to provide the same effect, and the dial may be turned more than one revolution without altering conditions.

From Fig. 2 B, it may be seen that the whole idea of the device rests in the use of a brass rod bent as shown in Fig. 3D, and a slotted fibre block as shown in Fig. 2 E. The slot takes up all the up-and-down motion of the bent rod and makes use of the side motion as the rod is rotated. Bending the rod at an angle of less than 45 degrees will produce a coupling of less than 90 degrees. The angle of coupling will be twice the angle to which the rod is bent.

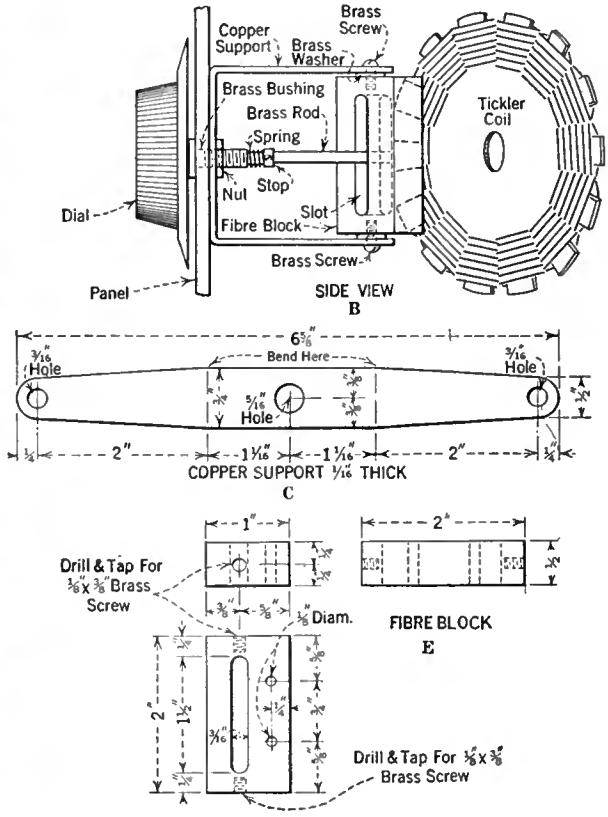


FIG. 2

The materials used are shown in the sketches, which are self-explanatory. The same materials and dimensions need not necessarily be used however. The fibre block is shown with square corners but these may be bevelled off so that other positions of the tickler may be obtained. The center lines of the rod and block must coincide to produce smooth operation.

CLARENCE J. FRENCK,
Wauwatosa, Wisconsin.

A FILE FOR IDEAS

IDEAS are elusive. They come and go.

Some means should be found for catching and using them. Memory is short-lived, not always dependable, and ideas that are worth remembering are also worthy of preservation.

By having a well-organized plan for systematically preserving and storing away the best ideas constantly appearing in the pages of magazines one does not have to depend upon memory, since an idea-file will always keep them on tap, available at a moment's notice when you want them. The necessity of having to remember where you last saw such and such an idea, and having to spend a lot of unnecessary time trying to dig it up is obviated by the use of a good file.

The idea-finder saves you this annoyance and bother. It also saves time and labor, for if you have filed away your material for safe keeping, it is always going to be on hand, right at your finger tips, ready for instant use.

Good ideas are always finding their way into print. Plans are being constantly evolved by others and heralded in the pages of magazines. There is always a wealth of various kinds of information at hand, simply awaiting collection, coördination, and preservation in organized form.

By starting such an idea-storehouse you can have within elbow reach the most useful data that can be obtained from literature of all kinds—data which might otherwise, for want of assimilation and organization, go to seed, be forgotten or neglected.

As you read a magazine you can mark articles of particular interest which suggest fruitful ideas for future application, and index them in synopsis form on a 3 x 5 inch card, which is filed in a card tray, with alphabetic guide cards. These are arranged according to subjects in which you are vitally interested.

Then again, you can clip these articles and file them away, either in filing folders, or in a desk-book file, with pocket pages, an old time bill file, or a work-organizer. Any of these simple accessories may be obtained from a local stationery store at small cost.

If you want to put your own ideas to work immediately, you scrimmage through your file and find data already in your idea-storehouse which enables you to carry out your own plans effectively, and with greater assurance of success. Or, your own ideas may start you on a scouting expedition for similar plans in the magazines to which you regularly subscribe, and so open up a new subject for further investigation and data-gathering.

F. E. KUNKEL,
Washington, D. C.

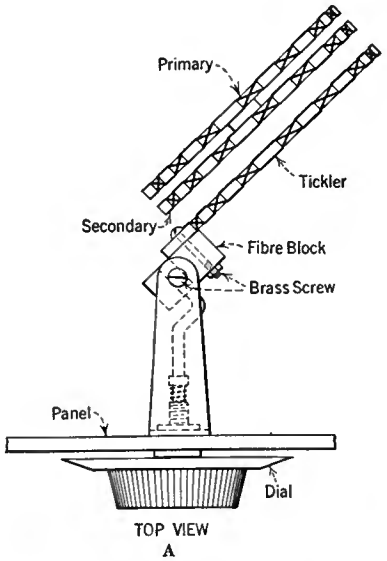
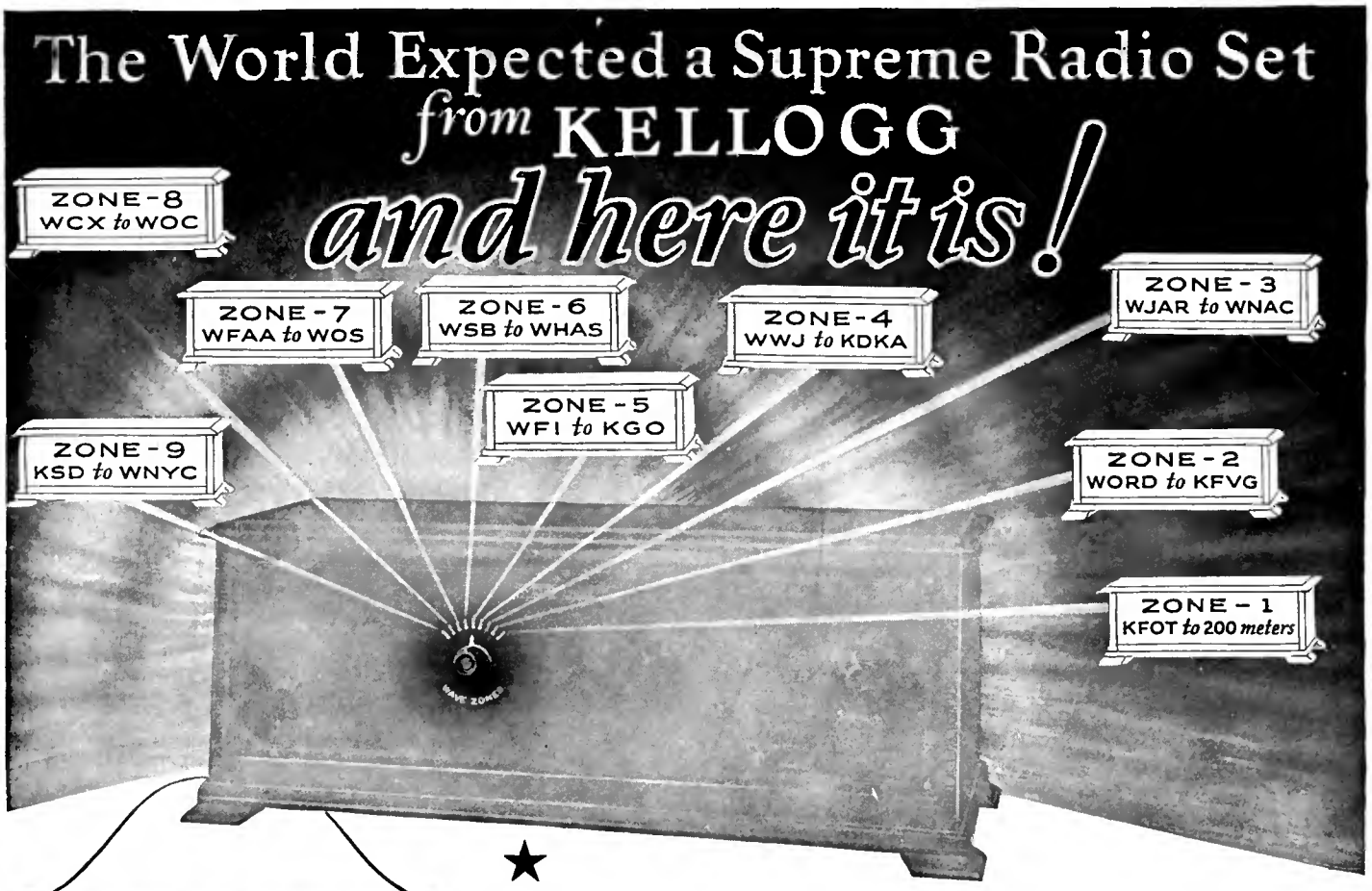


FIG. 3

The World Expected a Supreme Radio Set *from* KELLOGG *and here it is!*



WAVE-MASTER
Standard Model
$125.00

WAVE-MASTER
Brown Walnut Console with inbuilt horn
$275.00

A Separate Circuit for Each 40 Meter Wavelength Band!

Kellogg — for 28 years makers of precision telephone instruments and equipment — producers of quality parts since radio began—Kellogg has perfected a radio receiver worthy to bear the Kellogg name.

In the illustration we visualize this wonderful engineering achievement.

In the new WAVE-MASTER there are nine separate circuits—one for each 40 meter wavelength band. Each circuit gives that maximum efficiency heretofore found only in one short section of the dials of ordinary radio frequency sets. Each circuit brings within the range of the tuning dial *a different group of stations.*

How wonderfully simple tuning becomes! Merely set the pointer to the wave zone in which you are interested and bring in the desired station with the single Selector dial.

This remarkable tuning dial actually has a tuning range of 540 degrees—equal to 1½ times around a complete circle—over three times the station finding range of any other set.

All other radio frequency sets have variable capacity which must be tuned, usually with three different dials, to balance with their inductance coils.

The WAVE-MASTER'S inductance is not fixed but variable and is easily and quickly tuned, with the one Station Selector dial, to balance the fixed capacities.

Write us for the name of your nearest dealer. We will also send on request, a complete explanation of the WAVE-MASTER circuit. Ask for Folder No. 5-L.

Kellogg Switchboard & Supply Company
1042 W. Adams St., Chicago, Ill.

Radio Dealers and Jobbers

The WAVE-MASTER franchise, backed by Kellogg resources and our powerful advertising campaign, is most valuable. Open territory is being closed rapidly. Wire us, or get into Chicago, quick, and see us.

KELLOGG WAVE MASTER SWITCHBOARD & SUPPLY CO.

★ Tested and approved by Radio Broadcast ★

SUPER-HETERODYNE NOISES

I HAVE been troubled at times with a peculiar sort of throbbing, spluttering noise which was sometimes accompanied by a low whine which sounded as if it was under a strain, on my super-heterodyne.

I tried almost everything to obviate this trouble and inquired of several radio men as to the cause—without result, and was almost baffled. I finally discovered that it was due to corroded A and B battery terminals.

I used battery clips to connect to the battery and when the clips all happened to bite through the corrosion I did not get the noise. "How simple!" the reader will probably say, but I will confess that it bothered me at times for two months before I finally ran it down.

I hope that this may be of benefit to some other fan.

I. T. SUGGS,
St. Paul, Minnesota.

CHECKING UP ON B BATTERY LEAKAGE

MANY magazines are advising the use of incandescent lamps in series with the B battery to protect tube filaments, and to lengthen the life of such batteries, by lighting up to indicate shorts.

When such a lamp is used with a multi-

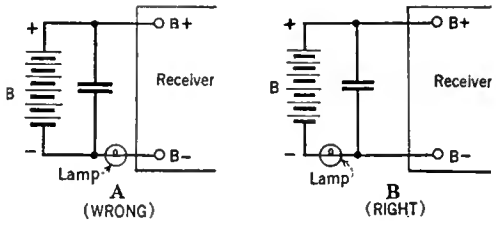


FIG. 4

tube set having no by-pass condenser, or else a very small one, oscillations and howling often result. The effect is the same as using a B battery partly run down—it adds resistance to the circuit. Therefore put a large condenser directly across the B battery as shown in Fig. 4 B.

If the lamp lights dimly when the set is turned on, of course a short circuit exists in the set and can usually be easily located. But the fact that the lamp does not light is no indication there is no B battery leakage in the set—a small leak wouldn't pass sufficient current to light the lamp. So it is advisable, before any home-made set is put in use, and after making tests for shorts and remedying any found (a short would ruin the meter in the next test), to connect a high resistance voltmeter in place of the lamp in B. Turn up the rheostats, when a small deflection on the meter should result. Then turn the rheostats completely off and the meter should read zero. If it reads even slightly past zero, there is a leak in the set which will run the B batteries down even when the set is not in use.

For example, one set checked this way showed a very small deflection, which, measured with a milliammeter, amounted to only ½ milliampere. The set required seven milliamperes in operation, but because such a leak goes on whether the set is in use or not, this one would cut the B battery life in half where average use of the set was one and a half hours per day. The trouble in this particular set was traced to a by-pass condenser of .002 mfd. size (of reliable make, probably damaged by soldering), and replacing it stopped the leakage. Another leak of this sort was located between the windings of one long-wave transformer in a super-heterodyne outfit.

The measurement by a milliammeter was not necessary to locate the leakage, it was made merely to show by calculations how serious such troubles might be. Where the B battery life is short in any set, the above test is certainly advisable.

CLAUDE SCHUDER,
Sumner, Illinois

A VARIOMETER TO TUNE ANTENNA CIRCUIT OF THE ROBERTS SET

A VARIOMETER can be used to replace the two antenna coils, variable condenser, and switch, in the Roberts circuit. It is much simpler to construct than the standard arrangement, is easier to tune, just as selective, takes up less space, and makes a neat panel appearance, and there are fewer possibilities of losses. If you are mechanically inclined, you can easily make a variometer.

The sketch, Fig. 5, shows the part of the set that is changed. From the grid of the amplifying tube and the plus terminal of the C battery, the hookup is the same as in the original circuit diagram. Connect the stator terminal to the antenna binding post. The rotor goes to the ground post. Some variometers may work better with the rotor terminal connected to the antenna post and stator to the ground. Connect the terminal of the variometer that is connected to the antenna, to the grid terminal of the amplifier tube as shown. Connect the ground terminal of variometer to the negative post on the C battery. A small fixed condenser of about .00025 mfd. will probably be needed in series with the antenna as shown, otherwise the average variometer will not reach below 999 kilocycles (300 meters) when used this way, especially if you have a long antenna. It is interesting to experiment with a variable condenser in series with the antenna.

There have been many interesting suggestions on improving the Roberts set and

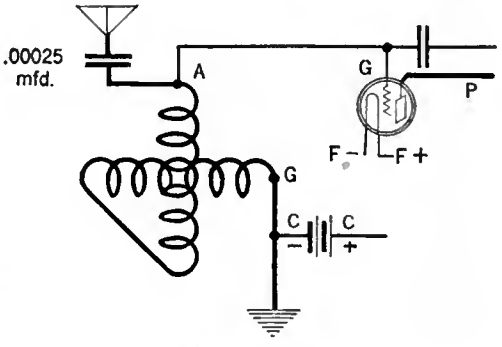


FIG. 5

the variometer will work equally well with two or four tubes. A set in Washington, District of Columbia, using four dry cell tubes, gave good loud speaker volume on KHJ. With two tubes, KHJ was easily heard on head phones. I logged seventy-five stations on a loud speaker in one month.

JOHN L. LEE,
Washington, District of Columbia.

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
Eastern Standard Time

For real radio enjoyment, tune in the "Eveready Group," broadcast through stations—

WEAF	New York	WCAE	Pittsburgh
WJAR	Providence	WSAI	Cincinnati
WEEI	Boston	WWJ	Detroit
WTAG	Worcester	WCCO	Minneapolis
WFI	Philadelphia		St. Paul
WGR	Buffalo	WOC	Davenport
KSO	St. Louis		

For radio economy

EVEREADY Radio Batteries are noted for their long service and economical operation. They are made in different sizes and types so that every radio user can enjoy the economy and convenience to be had by fitting exactly the right Eveready to his receiver. The five dry cell types of Eveready Radio Batteries are here illustrated and described to make it easy for you to decide just which will give the longest and most economical service on your set. A dealer near you sells Evereadys.

Eveready Heavy-duty "B" Battery for four or more tubes

No. 486. *Extra-large Layerbilt.* 45 volts. Vertical. Eveready's latest contribution to radio. The new Layerbilt construction which gives much greater service. Same size as No. 770. Price $5.50.

Eveready "B" Battery for one to three tube sets

No. 779. *Large.* 22½ volts. Vertical. Especially adapted for Radiola 25, DeForest D-17 and Operadio receivers. Same capacity as No. 766, and suitable wherever variable taps are not required. Price $2.00.

Eveready "B" Battery for portable sets

No. 764. *Portable.* 22½ volts. Vertical. For portable sets where medium weight and size are permissible. Price $1.75.

Eveready "A" Battery

Eveready Columbia Ignitor Dry Cell Radio "A" Battery for all dry-cell tubes. 1½ volts. The dry battery used by vacuum-tube engineers in developing the dry-cell tube.

Eveready "C" Battery

No. 771. 4½ volts. Saves "B" Batteries, improves tone. Price 60 cents.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY ★
Radio Batteries
—they last longer

No. 764 Portable 22½-volt Vertical Price $1.75

Eveready Columbia Ignitor "A" Battery, the proven dry cell for all radio dry cell tubes 1½ volts

No. 779 22½-volt Large Vertical Price $2.00

No. 771 4½-volt "C" Battery Price 60 cents

No. 486 45-volt Layerbilt Extra-large Vertical Price $5.50

★ Tested and approved by RADIO BROADCAST ★

HOW TO ELIMINATE LOCAL INTERFERENCE

Part 2

Some Practical Information Based on the Results of an Investigation on Radio Inductive Interference

LAST month's RADIO BROADCAST *presented the first of two articles to be printed herein on the above subject. The information has been taken from a very excellent little pamphlet which has been specially prepared by the Radio Branch of the Department of Marine and Fisheries of the Dominion of Canada Government, and which is entitled "Radio Inductive Interference, Bulletin Number One." The previous article was devoted chiefly to determining the source of various forms of interference while this concluding part gives much practical information for the elimination of the trouble once it has been found.*

MEANS OF SUPPRESSING RADIO INDUCTIVE INTERFERENCE

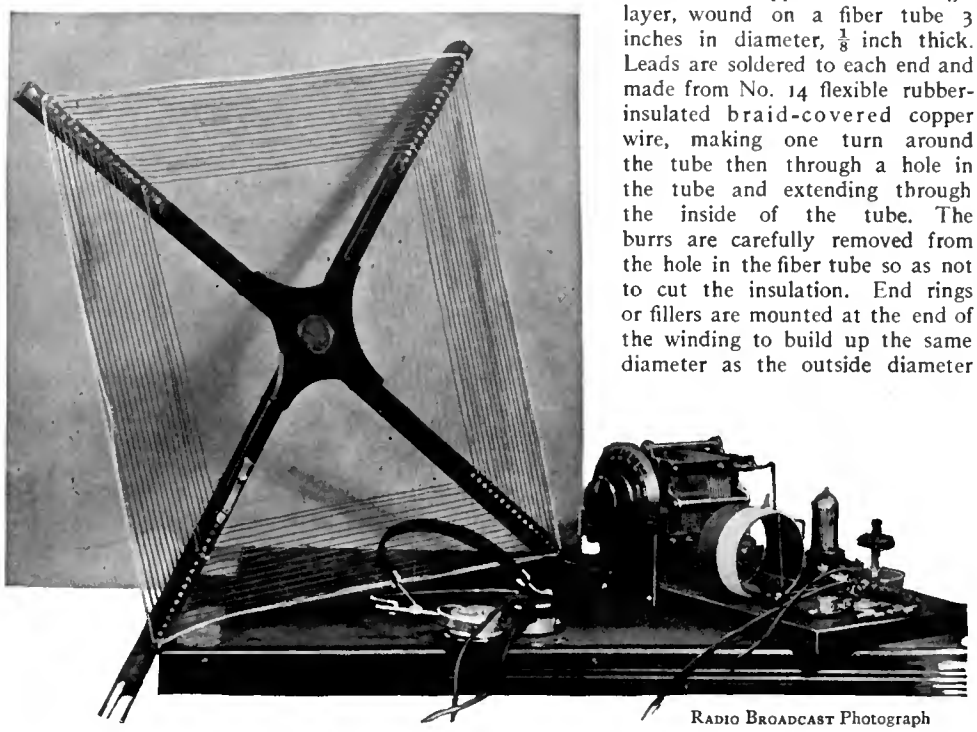
IN CASES where electrical apparatus suspected of causing interference appears to be in good mechanical and electrical condition, it is very often possible to supply some means of preventing electrical surges, originating in the apparatus, from getting out to the power line where they would radiate and cause radio interference.

These electrical surges have the property of passing through condensers more readily than through inductances. The method employed, therefore, in preventing electrical surges from traveling along the power lines and thus causing radio interference, is to provide a path to ground in the form of a condenser to filter or drain off this surge. In order to make this filter more effective, it is often advisable to introduce between the line and the source of the disturbance a trap, which will make the passage of the surge more difficult. This trap preferably takes the form of a choke coil which consists of a number of turns of wire of sufficient size to carry the required current without overheating, and sufficient insulation to withstand the voltage of the line. These installations should be approved by the local electrical inspector to ensure that there are no fire or accident hazards introduced by the installation.

It is important in the design of these choke coils that they should have low distributed capacity in order to prevent the electrical surge passing through the choke coil by means of this capacity.

CHOKE COIL

A TYPE of choke coil recommended for cases where the current is less than three amperes, is constructed according to Fig. 1. It consists of a hundred turns of No. 18 double cotton-covered copper wire in a single layer, wound on a fiber tube 3 inches in diameter, $\frac{1}{8}$ inch thick. Leads are soldered to each end and made from No. 14 flexible rubber-insulated braid-covered copper wire, making one turn around the tube then through a hole in the tube and extending through the inside of the tube. The burrs are carefully removed from the hole in the fiber tube so as not to cut the insulation. End rings or fillers are mounted at the end of the winding to build up the same diameter as the outside diameter of the winding. These may be made of tape or a suitable size of fiber tube. The whole coil is then covered with five layers of Empire cloth and then taped with black friction tape and painted with insulating varnish. Mounting lugs made of fiber are then attached to each end of the coil.



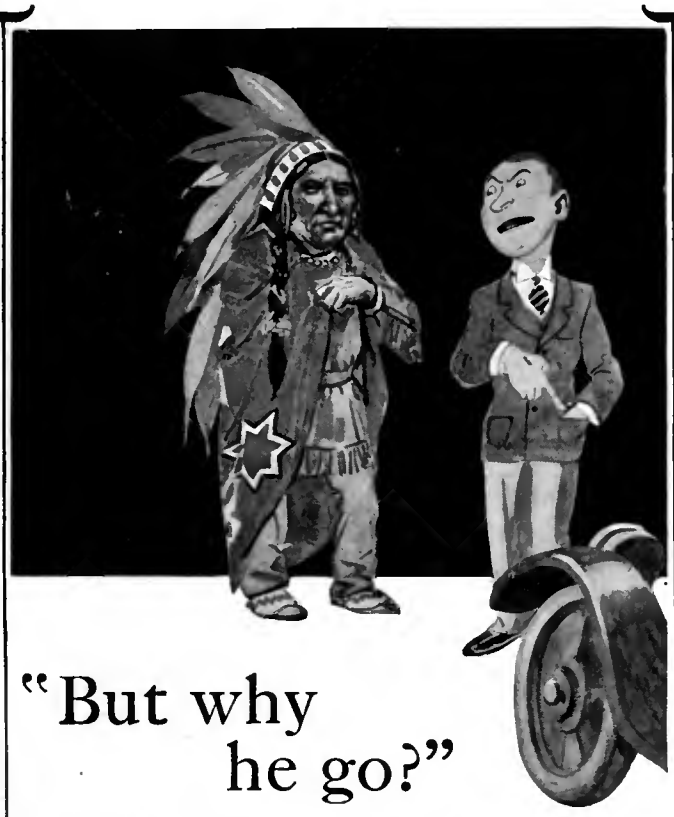
RADIO BROADCAST Photograph

AN INTERFERENCE FINDER

Of typical form. This was made in the RADIO BROADCAST Laboratory. One Duplex variable condenser tunes both loop and the R. F. secondary, which feeds into a crystal detector

This coil should be mounted on a board covered with asbestos $\frac{1}{8}$ inch thick and the leads

ATWATER KENT RADIO



"But why he go?"

WHEN they struck oil on the Indian lands in Oklahoma many of the Indians became suddenly rich. One of them, anxious to begin his life of luxury, went to buy an automobile.

The salesman launched into a description of the car in detail. Technical term followed technical term in a bewildering stream. Finally the salesman thought his work was done. He produced an order blank and paused.

"Now," he asked, "is there anything else I can tell you?" The Indian scratched his head.

"Um," he said. "You tell me: He no have horse. Why he go?"

We could give you a description of the Atwater Kent Radio Receiving Sets and Speakers that would fill hundreds of pages.

But what would be the use? You would still judge an Atwater Kent, as you should, by its performance. We want you to judge it that way, to compare it with any other radio you are considering.

By looking at it and listening to it, you will get some of its technical perfection. When you have owned it and lived with it, you will *know* how good it is.

Hear the Atwater Kent Radio Artists every Sunday evening at 9.15 o'clock (Eastern Standard Time) through stations:

WEAF	*New York*	WEEI	*Boston*	WCAE	*Pittsburgh*
WFI, WOO	*Philadelphia, alternating*	WGR	*Buffalo*	WOC	*Davenport*
		WWJ	*Detroit*	WSAI	*Cincinnati*
WJAR	*Providence*	KSD	*St. Louis*	WTAG	*Worcester*
WCAP	*Washington*	WCCO	*Minneapolis-St. Paul*		

★

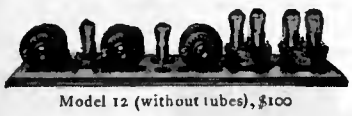
Write for illustrated booklet of Atwater Kent Radio

ATWATER KENT MANUFACTURING COMPANY
A. Atwater Kent, President
4726 WISSAHICKON AVENUE . PHILADELPHIA, PA.

★ Tested and approved by RADIO BROADCAST ★

Model R, $12

Model H, $22



Model 12 (without tubes), $100

Model 19, $60

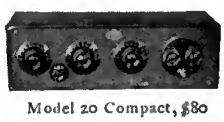
Model 20, $80

Prices slightly higher from the Rockies west, and in Canada

Model L, $17

Model M, $28

Model 10 (without tubes), $80



Model 20 Compact, $80

Model 24, $100

Prices slightly higher from the Rockies west, and in Canada

soldered and thoroughly taped according to standard wiring practice. Another type of choke coil which will be found eminently satisfactory for use in motor lines, telephone bell-ringing lines, etc., is that described on page 438 of September RADIO BROADCAST, in the columns of the Grid (and previously in the May issue of 1924). It was originally described by Mr. Van Dyck in his article entitled "Man-Made Static."

RADIO BROADCAST Photograph

A PORTABLE INTERFERENCE FINDER

Consisting of a stage of radio frequency amplification followed by a crystal detector. A collapsible loop will greatly improve the portability possibilities

INSTRUCTIONS FOR MOUNTING CONDENSERS

CONDENSERS which will stand a test voltage of 1000 volts d. c. may be connected across an alternating current or direct current circuit of 250 volts or less. On circuits which are protected by fuses of not more than 15 amperes capacity, no additional fuse is required for the condenser. On circuits protected by fuses of greater than 15 amperes capacity, a separated cutout base and small fuse (of approved type) not exceeding 15 amperes, must be installed between the condenser and each ungrounded power wire. Where condensers are not installed in metal boxes and are to be placed on wooden surfaces, they should be mounted on pads of asbestos at least $\frac{1}{8}$ inch thick, and these pads should be sufficiently large to extend beyond the clamps used for holding the condenser in place.

Where condensers are to be used on 550 volt circuits, two condensers of the approved type must be connected in series between the lines and the common point may be grounded. In such installations, the condensers are to be protected by 600-volt fuses not greater than 10 amperes in each live line, and both the condensers and fuses are to be enclosed in a grounded metal case. Where the condensers are to be connected to two-phase or three-phase circuits not greater than 600 volts, one condenser may be connected from each live line to ground and installed with fuses in boxes as stated above.

As these condensers contain wax, they should not be placed where they may be subjected to excessive heat.

Condensers when connected to a circuit as stated above have no objectionable effect on the circuit or the operation of any electrical apparatus and they do not consume any power.

APPROVED TYPES OF CONDENSERS

THERE are now many condensers on the market suitable for the purposes detailed in this article. Those chosen must be capable of standing a test voltage of 1000 volts d. c. At the time of the publication of this bulletin by the Department of Marine and Fisheries of the Dominion of Canada Government, special condensers having No. 14 rubber-insulated leads suitable for installing without metal boxes, were obtainable from the Radio Branch of the above Department, at cost.

TREATMENT OF TYPICAL CASES

IN MANY cases it is possible to make slight changes in the connections of the electrical apparatus causing the surge in order to use some existing apparatus as a choke coil and thus prevent the necessity of adding additional choke coils to the system.

A series commutator motor causing a surge by sparking at the brushes may have its leads reversed to reduce the radio interference. Where one wire is grounded, radio interference from such a motor is sometimes reduced by reversing the leads supplying the motor, so that one of the brushes is connected to the ground side of the line and the field coil is connected to the live side of the line. In this case, the field coil is used as a choke. It may also be necessary to place a condenser of one or two microfarads capacity across the brushes. This is shown in Fig. 3.

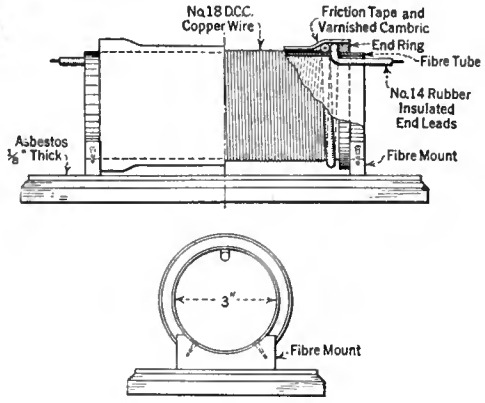
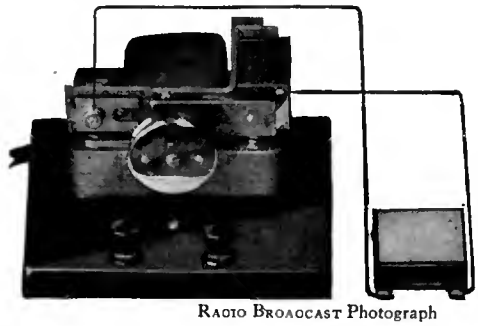


FIG. 1

Details for the choke construction. It consists of one hundred turns of No. 18 d. c. c. copper wire on a three-inch tube

In cases where neither side of the line is grounded, a choke may be inserted on the line connected directly to one of the brushes, while the field coil may act as a choke in the other line. In this case it is recommended to use two 2-microfarad condensers in series and ground the middle point according to the diagram.

In cases where it is not convenient to make connections with the brushes of a motor, the condenser may be placed across the line as near the motor as possible, and a choke coil may be inserted in the live line when necessary. See the instructions above regarding approved condensers and the use of fuses.

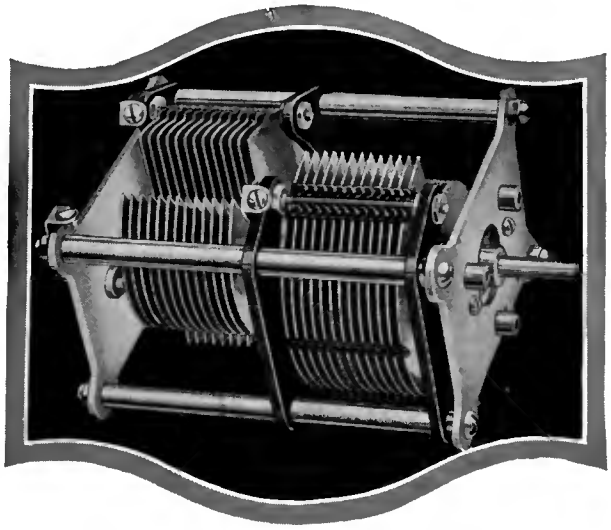


RADIO BROADCAST Photograph

FIG. 2

Showing condenser connection across vibrating contacts of a battery charger

The S. L. F. that doesn't "hog" panel space



The principal objection to many Straight line Frequency condensers now on the market is that they "hog" too much panel space; thus making it necessary to re-arrange other instruments on the panel or rebuild the set entirely to allow enough room for the scythe-like sweep of the S. L. F. rotor.

The new General Radio type 374 S. L. F. condensers eliminate entirely all such difficulties. They occupy the same panel space as the well known types 247 and 334 condensers—and no more. In fact they may be used interchangeably with those condensers since the mounting holes are the same.

By using smaller rotor plates of correct shape and double the number of plates General Radio condensers have a straightline frequency calibration curve without the mechanical disadvantages encountered in the average S. L. F. with fewer plates of larger area. The assembly of the type 374 condensers with respect to bearings, soldered-plates, and correct spacings are the same as the types 247 and 334.

For further description and prices ask to see them at your local dealer's or write for our latest Bulletin 923-R.

GENERAL RADIO COMPANY

30 State St. Cambridge, Mass.

For over a decade General Radio parts have been the universal standards of quality.

They have been developed by the same engineers who designed the precision apparatus now used as standard equipment in nearly all the leading commercial and technical school laboratories throughout the entire world.

Since 1915 the General Radio Company has supplied scientific instruments in ever increasing quantities to such prominent institutions as the General Electric Company, Westinghouse, Bell Telephone System, and the Bureau of Standards for use in electrical and radio research.

No one company in the history of radio has contributed more in laboratory equipment than the General Radio Company.

The same outstanding skill, materials, and workmanship are embodied in General Radio parts for use in the construction of broadcast receivers.

Through the merits of design, performance, and price General Radio instruments for the scientist or set-builder are universally recognized as the Standards of Excellence.

Every instrument made by the General Radio Company is thoroughly guaranteed.

GENERAL RADIO COMPANY

★ **GENERAL RADIO**

"Behind the panels of Better Built Sets"

★ Tested and approved by RADIO BROADCAST ★

The live side of a low voltage lighting circuit may be determined by means of a test lamp connected from ground first to one wire and then to the other. The lamp will light when connected from the live line to ground.

Battery charger of the vibrator type may be prevented from causing radio interference by connecting a condenser of ½ microfarad capacity across the vibrating contacts. This is illustrated in Fig. 2 on the previous page. In the case of battery chargers it is useless to put condensers

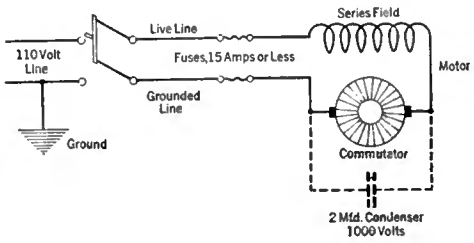


FIG. 3

Method of connecting a large capacity condenser across the brushes of a small motor

across the mains, as it is necessary to make use of the choke consisting of the wire and coil within the battery charger, to prevent this surge from getting out on the line.

Flashing electric signs may usually be prevented from causing radio interference by connecting condensers of from ½ to 2 microfarads capacity across the contacts of the circuit breaker. It is sometimes necessary, however, to add a choke coil at the line side of the circuit breaker and also connect the condenser across the contacts of the circuit breaker. As the radio interference from such sources depends upon the conditions of the installation it is necessary to make these few experiments, as suggested above, in each case in order to reduce the radio interference most effectively.

Sometimes the radio interference from a flashing sign installation is caused by sparking at the commutator of the motor which drives the flasher. This may readily be determined by the nature of the sound in the radio receiver and may be remedied by the method described for dealing with interference from commutator motors.

Internal combustion engine ignition systems may cause radio interference, but this is usually of a very local nature. Such interference may be considerably reduced by making the leads from the magneto or spark coil to the engine as short as possible and running them in a grounded shield, such as metal conduit or lead-covered cable. The frame of the engine, magneto, and all shields, should be thoroughly grounded.

Rotary converters sometimes cause radio inductive interference by producing a surge which travels out both on the alternating and direct current lines. In some such cases it may be necessary to introduce choke coils into the alternating current lines and put condensers across the lines between the choke coils and the converter. Before putting these choke coils in the alternating current lines, it is recommended to try the effect of condensers across the brushes as described previously for the case of commutator motors.

Electric ozonators which are used for purifying the air in large buildings and for bleaching purposes in flour mills, sometimes cause radio inductive interference by producing a surge which travels along the primary lines supplying the ozonator.

This interference may easily be eliminated by connecting two choke coils of the cylindrical type previously described, one in each of the low voltage lines placed as near as possible to the ozonator.

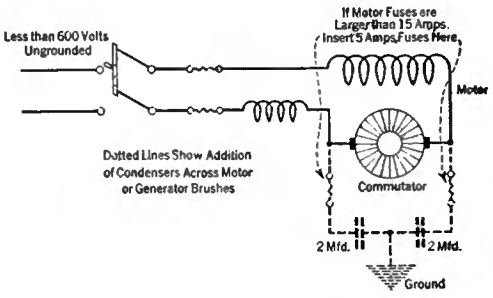


FIG. 4

Connection for two condensers in series across the brushes of a motor generator. The position for extra fuses, if the motor fuses are larger than 15 amps., is clearly shown

A List of Australian Broadcasting Stations

Here is a complete list of Australian broadcasting stations now active in that country. It is not generally known that one of these stations, that at Brisbane, Queensland, can vie with some of the important American stations as far as power is concerned, for they use 5000 watts. As will be seen by the list, three of the seven other stations use as much as 3000 watts. American stations are often heard in Australia, especially those situated on the Pacific Coast. We are indebted to Mr. A. W. Watt, editor of Australian Wireless Weekly, *for the appended list.*

LOCATION	OWNER	CALL SIGNAL	FREQUENCY IN KC.	WAVELENGTH IN METERS	POWER IN WATTS
Sydney, New South Wales	Farmer and Company Ltd.	2FC	261	1150	3000
Sydney, New South Wales	Broadcasters, Ltd.	2BL	857	350	500
Melbourne, Victoria	Australian Broadcasting Co. Ltd.	3LO	809	371	3000
Melbourne, Victoria	Associated Radio Co., Ltd.	3AR	789	380	500
Adelaide, South Australia	Central Broadcasters Ltd.	5CL	937	320	500
Perth, West Australia	West Australian Farmers Ltd.	6WF	240	1250	3000
Hobart, Tasmania	Associated Radio Co., Ltd.	7ZL	769	390	500
Brisbane, Queensland	Government Radio Service	4QG	779	385	5000

The broadcasting from the above stations is usually divided into four sessions, morning, afternoon, early evening, and evening. The exact times of these sessions, taking 3lo as an example, are as follows: Morning, from 11 a. m. to 2 p. m.; afternoon, from 3 p. m. to 5.15 p. m.; early evening, from 6 to 7.15 p. m.; evening, from 7.15 to 11 p. m., the program always concluding with "God Save the King." The difference between New York and Melbourne time is fifteen hours, thus, when it is midday in New York on a Monday, it is 3 a. m. Tuesday in Melbourne. Appropriate allowances must be made when comparison is being made between Melbourne time and United States time in points west of New York, and also for Australian points west of Melbourne.

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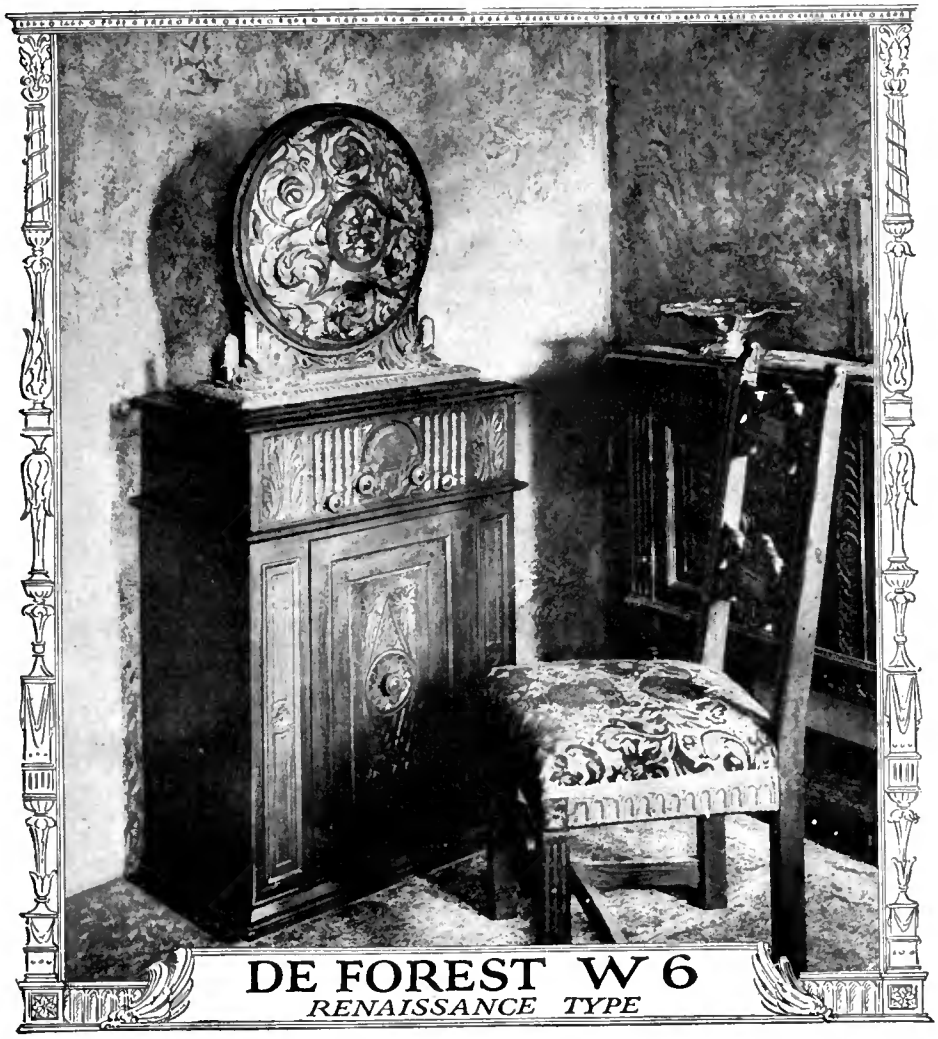
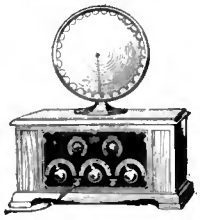
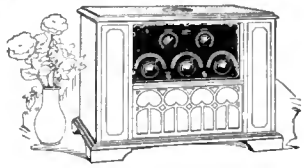


DE FOREST W 6
RENAISSANCE TYPE

DE FOREST AUDION
is the world standard in tubes. De Forest created the first successful radio tube, and his invention made broadcasting possible. The De Forest policy of a specific type tube for each socket insures finer reception and greater distance. Price, $3.



DE FOREST F-5 AW
A compact, powerful set in polished walnut that will bring joy to many a household. Gives rich volume, and has the capacity to separate stations positively so that you can pick the broadcast gems without interference. Extremely easy to operate. Price (minus tubes, loud speaker and batteries) $90.



DE FOREST F-5 M
A superfine 5-tube set in two color mahogany cabinet with built-in loud speaker and concealed compartments for "A" and "B" batteries. A great distance-getter, with uncanny power to tune in and out stations at will, and gifted with splendid tonal qualities. Extremely simple to operate. No howling or hissing in tuning in. An unsurpassed value at $110.

De Forest Radio Sets can be bought at prices ranging from $85 to $450.

De Forest Genius now *Humanizes* Radio!

MARVELOUS new circuit, just perfected, reproduces flawlessly the mellow, soft modulations of the human voice and captures the hitherto elusive overtones of the musical register . . . . tuning simplified . . . . a new ease in operation . . . . all embodied in the new and beautiful De Forest W5 or W6 Radiophones.

The voice of radio is no longer flinty and metallic, but mellow, human and musical—thanks to the development by Roy A. Weagant, Vice-President and Chief Engineer of the De Forest Radio Company, of a new and marvelous circuit.

This ingenious circuit, and all the joy it means to radio lovers, makes its first public appearance in the De Forest W5 and W6 Radiophones, masterpieces of cabinet art worthy only of a scientific development so outstanding.

So wonderful is the reproduction of tone in the De Forest W5 or W6 that only the presence of the lovely instrument dispels the illusion that the living artist is in the rooms.

Piano chords come to you with their full rich resonance—true piano tone. High notes dance, tripple and sparkle . . . clearly, distinctly... *musically!* Those brooding low notes, never caught in average reception, are heard distinctly—as though from the next room.

In the reproduction of orchestral music the full importance of the De Forest achievement stands out. For the first time you get the overtones as well as the middle tones . . . the majestic roll of the kettle drums, the crooning of the bass viols, the strident crash of the brasses and the piping heraldry of the cornets and trombones. A symphony orchestra heard over the De Forest W5 or W6 stirs the soul. No incoherence, no oscillating jumble of noise—every instrument, every octave, in its true value. *A magic achievement!*

To the lover of dance music the De Forest W5 or W6 brings more sprightliness, more beauties of syncopation . . . you should hear Vincent Lopez, Joseph Knecht, The Night Hawks, or any others over either of *these* instruments!

All the tenderness of song, every shading of the soprano's voice, all the pathos of the folk song—exquisite but elusive elements so much desired but lost in practically all present-day reception, are captured by these De Forest masterpieces.

To everything that is broadcast, the De Forest Radiophone gives animation, life and humanness.

But Tonal Supremacy is Not All—

Elbert McGran Jackson, renowned sculptor, architect and painter, put into this hand-wrought, hand-carved cabinet the spirit of radio, in design, in motif—it is not an adaptation of a phonograph. An image of charming individuality, it harmonizes with the setting of any home.

One unit, everything self-contained—not a wire in sight, nothing to connect . . . and *portable;* move it any place! Only charm and beauty for the eye.

The artistic conical reproducer is an inseparable part of the cabinet and its tonal mechanism peerlessly attuned to that of the Weagant circuit. There are just two controls for tuning, and these operate on one dial, which makes the normally perplexing task of "tuning in" extremely simple. There are special power tubes in the fifth and sixth sockets which can give you volume to flood an auditorium, if you desire it. And, at your fingers' tips, the means to tune in a far-distant station you want no matter how powerful nearby stations may be.

See the incomparable De Forest W5 and W6 at your De Forest dealer's or write for an interesting booklet describing these masterpieces in detail.

DE FOREST RADIO CO., Jersey City, N. J.

DE FOREST

The Greatest Name in Radio ★

DEALERS IN ALL CITIES AND RADIO COMMUNITIES

THE EPOCH-MAKING ACHIEVEMENT WHICH MAKES ORDINARY RADIO RECEPTION A THING OF YESTERDAY

★ Tested and approved by Radio Broadcast ★

THE GRID

A Department Devoted to Solving the Problems of our Readers

QUERIES ANSWERED

1. WHAT IS THE PROPER METHOD FOR PLACEMENT OF COILS IN A TUNED RADIO-FREQUENCY AMPLIFIER?—F. H. J.—Houston, Texas.

2. WHAT ARE THE PRECAUTIONS THAT SHOULD BE OBSERVED IN ERECTING AN ANTENNA NEAR POWER LINES?
C. A. C.—Buffalo, New York.

3. WILL YOU DESCRIBE A METHOD OF MEASURING THE RESISTANCE OF COIL UNITS TUNED TO PREARRANGED FREQUENCIES?—B. H. R. —Utica, New York.

4. WHEN I REPLACE THE 3-VOLT TUBES IN MY SET WITH 5-VOLT TUBES, THE SET OSCILLATES. WHY?
T. M. B.—Boston, Massachusetts.

COIL PLACEMENT IN AN R. F. AMPLIFIER

IN A receiver employing one or more stages of radio-frequency amplification, satisfactory results depend largely upon whether or not these amplifiers are properly neutralized. Now, neutralization depends upon several things. The internal capacity of the amplifier tube must be balanced; the wiring to the tube must be such that no coupling effects are obtained; and the several radio-frequency transformers should be so placed and located that there is no electromagnetic coupling between them. It is this last point which we will discuss here.

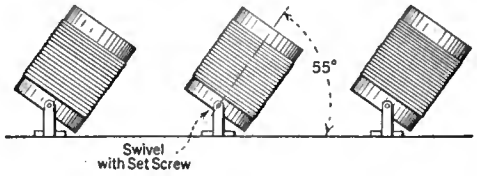


FIG. 1

Most of us have had an opportunity to view the inside of a neutrodyne and to observe the peculiar angle at which the coil units are turned. At such a setting there is a minimum of coupling between the coils. This placement can be approximated by the home experimenter in his own construction. Individual test must be made to determine the point at which satisfactory neutralization is obtained in the regular manner.

As an aid in obtaining the desired results, it is suggested that in the construction of a receiver the coil units be only temporarily fastened to permit ready change and variation in the angle at which they are to be set. See Fig. 1. If it is not possible to approximate this angle, which is about 55 degrees from the horizontal, or if there is plenty of space in which to construct the amplifier, then it is suggested that a right angle coupling between the coil units be employed. See Fig. 2.

It is most important that, in the construction of a radio-frequency amplifier, or a receiver containing one or more stages of radio frequency amplification, the tube sockets be so placed that the grid leads are as short as possible.

PRECAUTIONS IN ANTENNA ERECTION

THE other day a serious accident occurred in Waltham, Massachusetts, caused by a young man drawing an antenna wire across an electric power line. The fact that the line was insulated did not matter as his antenna wire soon cut through the insulation, and thus the current was communicated to his body. The problem of antenna installation has caused carelessness on the part of a great many fans throughout the country, and it has been the cause of many fatalities. The following general *"Don'ts"* relating to antenna erection are given in a paper by Mr. Clarence V. Purcell, of the Boston Edison Company, for the benefit of those who would profit by the example of others who have been unfortunate enough to become involved in some needless mishap:

Don't run an antenna over or under any other wires carrying an electric current of any sort, whether these wires be high tension wires, service wires, or telephone lines.

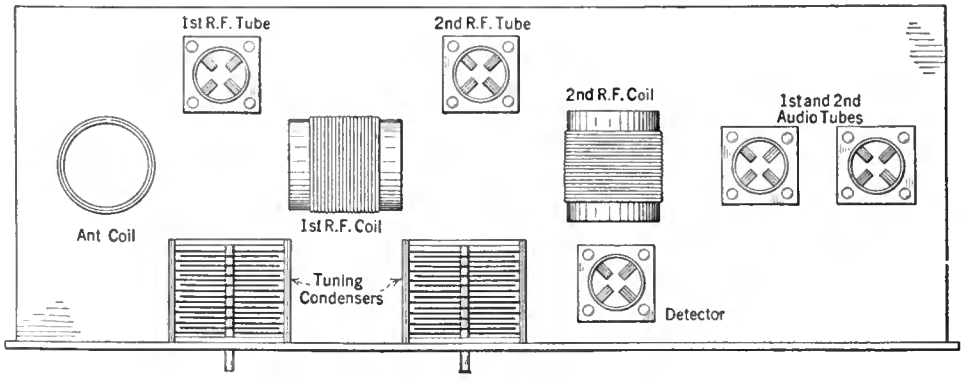


FIG. 2

Don't attach an antenna to any pole or tower to which other wires are attached, or climb or attempt to climb such poles or towers for any purpose.

Don't run an antenna over or across any public highway.

Don't attach an antenna to any electric light, telephone or telegraph pole, even though no other wires are attached thereto. If using an outside antenna, always comply with the regulations governing the installation of an approved lightning arrester. Such a device is inexpensive and easily installed.

Valley Tone

Radio Receiver

This new principle of radio is exclusive in the Valleytone

Appearance

The Valleytone is mounted in a solid walnut cabinet, finished in two tones with inlaid gold stripes. It may also be procured in beautiful console models. Special Valley tables with built-in loud speaker may be obtained for the cabinet model.

Valleytone Console Model

Valley table with built-in loudspeaker

Set the dials of a Valleytone for any station you choose. Bring in the signals strong and clear.

Then turn the dials one point beyond or back from the correct tuning. You merely diminish volume. The quality of the signals remains the same. There is no incoherent babble of noises.

Turn the dials two or three points either way from the correct tuning. Your program is gone.

Such tuning is possible only in the Valleytone. It is due to the *potential balance* method of preventing distortion and oscillation. . . a new principle for radio which is exclusive in the Valleytone 5-Tube Radio Receiving Set.

The *potential balance* gives a balanced tone to the Valleytone. The results are an amazing clearness and naturalness of reproduction. If you have never heard the Valleytone, a new experience in radio reception awaits you.

The *Valley Toroidal Coils* make possible a selectivity not previously achieved. Stations four or five meters apart can be brought in clearly and distinctly one after the other whether they are distant or local stations.

Before you buy a radio, hear the Valleytone. Judge it by results. Avoid regrets later by listening to the Valleytone now. Any authorized dealer will be glad to demonstrate the Valleytone for you.

VALLEY ELECTRIC COMPANY, *Radio Division*, ST. LOUIS, U.S.A.

Branches in Principal Cities

★

Valleytone Receiving Sets | **Valley Battery Chargers** | **Valley B-Eliminators**

Valley Electric

★ Tested and approved by RADIO BROADCAST ★

Don't borrow your neighbor's antenna by attaching your lead-in to the far end of his wire. You don't know what he is doing and besides, antenna wire is cheap and serves the purpose far better.

Don't attach your antenna to a kite. Don't use your telephone line for an antenna. Connection to an electric light socket is not encouraged or recommended; light socket attachments are approved.

MEASURING THE RESISTANCE OF COIL UNITS

HERE is described a method whereby those having the proper facilities may measure the resistance of coils tuned successively to several prearranged frequencies.

With the aid of a radio oscillator, a thermo-galvanometer and a resistance box, a curve, plotting resistance against frequency, may be

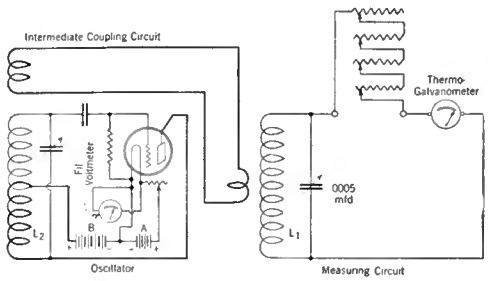


FIG. 3

made from the several readings obtained. The circuit diagram for the layout is shown in Fig. 3. To measure the resistance of a coil, the procedure is as follows, assuming that readings are to be taken at 1500 kc. (200 meters) 1200 kc. (250 meters) 1000 kc. (300 meters) and so on, for every 50 meters up the scale to 545 kc. (550 meters.)

Put the oscillator into operation setting its frequency control at 1500 kc. (200 meters). Couple the coil to be measured, L1, to the oscillator output coil L2. This will cause a deflection of the needle of the thermo-galvanometer. Now by varying the coupling between L1 and L2, the galvanometer reading may be varied to one of the numbered markings of the meter scale such as 20-40-60-70-80, etc.

Since the next step requires the addition of resistance to the measured circuit, until the reading of the meter drops to one-quarter of its original value, it is well to vary the coupling to a point where this division will be simple. At an original reading of 60 or 80, it is quite easy to add resistance to the circuit until the reading falls to 15 or 20. Resistance is added to the circuit by means of the controls on the resistance box which, until this time, had been set at zero. When the one quarter reading is obtained, reference is made to the resistance box and the resistance noted. This constitutes the resistance of the coil and the meter at that particular frequency. Usually the resistance of the meter is known and its value may be deducted from the reading obtained.

This whole system is repeated for each frequency point to be measured.

TUBES AND R.F. COILS: HOW THEY SHOULD BE MATCHED IN A RECEIVER

TO OBTAIN maximum efficiency in a receiver using radio frequency amplification, it is necessary to have transformers designed for the type of tube used in the set. This statement has been amply justified as the result of exhaustive tests made by independent engineers who were interested in the problem.

If a receiver is using the C-299 or UV-199 type of dry cell tubes, with proper transformers, and is changed over to the C-301-A or UV-201-A

DISTANCE
THE OBEDIENT SLAVE TO YOUR DESIRES

Upon request, we will gladly mail descriptive folder

APEX mastery over the most advanced radio engineering principles makes distance the obedient slave of your desires and places at your instant command the whole continent of radio enjoyment.

The infinite care and skill employed in perfecting the mechanical construction of APEX Radio Apparatus is radiantly reflected in the rich beauty of design, harmony of proportion and elegance of finish that stamp all APEX sets with an unmistakable mark of master craftsmanship.

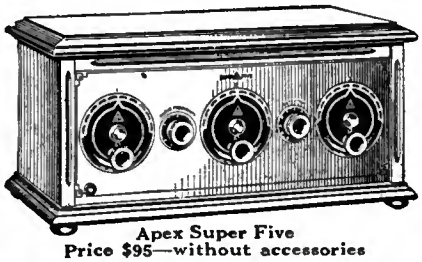
You are cordially invited to inspect this complete showing of Quality Radio Apparatus. Only a dependable merchant is given the APEX dealer franchise. Your APEX dealer will gladly make a personal demonstration of APEX Quality Radio Apparatus.

APEX ELECTRIC MFG. CO.
1410 W. 59th St., Dept. 1204 CHICAGO, ILL.

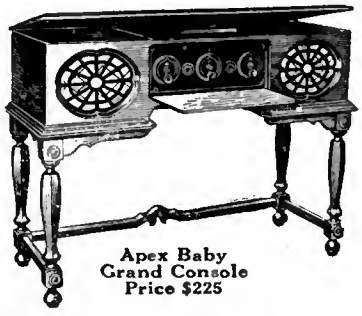
Also makers of the famous APEX Vernier Dials and APEX Rheostat Dials which are sold by every good dealer in Radio.

APEX
Quality Radio Apparatus

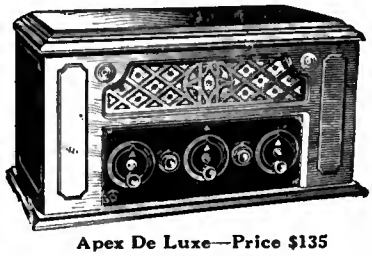
Apex Entertainer
Price $22.50



Apex Super Five
Price $95—without accessories

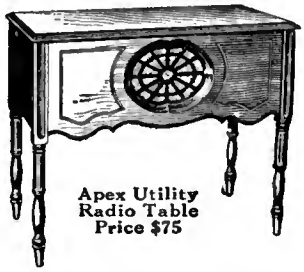


Apex Baby Grand Console
Price $225



Apex De Luxe—Price $135

Apex Console Entertainer
Price $27.50



Apex Utility Radio Table
Price $75

Prices West of Rockies Slightly Higher

Canadian Prices Approximately 40% Higher

type of tubes, it will be necessary to change the radio-frequency transformers also, if equally efficient results are to be obtained.

This is made necessary by the fact that the characteristics of the tubes vary according to their internal construction. In the UV-199 tube, the elements are very close together, making it possible and advantageous to use more wire on the primary of the transformer. The tendency for a vacuum tube having a tuned input circuit to oscillate, is proportional to the inductive load or the number of turns on the primary of the transformer in the plate circuit.

If the tubes were replaced with the C-301-A or UV-201-A type, the circuit would become unstable and oscillate readily, due to the difference in construction of the elements of the latter type of tube. Fewer turns of wire should be used on the primary of the transformers. The curve of the transformer will fall off at one end of the scale and result in poor amplification of either the high or low waves, if the proper type of tube is not used. This is due to the capacity of the input circuit of the tube, which varies in different tubes. As this is shunted across the secondary winding, it has sufficient tuning effect on that winding to shift the area of maximum amplification from the desired band.

When the tube characteristics are matched up with the correct amount of wire on the primary of the transformer, then the circuit will cover the whole wave band evenly, with good amplification. In some types the core of the transformer is filled with finely powdered iron or iron laminations. The use of iron in the core broadens tuning so that the transformer may be used over the entire wave band, without the need of a variable condenser for tuning.

When Writing to the Grid—

A TYPEWRITTEN letter, written on one side of the paper only, is to be preferred, as it aids in the quick formation of a satisfactory reply.

Don't fail to send a stamped addressed envelope with your inquiry.

Don't send a second inquiry about the first.

Don't include questions on subscription orders or inquiries for other departments of Doubleday, Page & Company.

In asking questions give us all the information that will aid in advising you. If the question relates to apparatus described in RADIO BROADCAST, give the issue, page number, and figure number of the circuit diagram, etc.

Be explicit yet brief.

GRID INQUIRY BLANK

Editor, The Grid
RADIO BROADCAST
Garden City, New York

DEAR SIR,

Please give me the fullest information on the attached questions. I enclose a stamped envelope.

☐ I am a subscriber to RADIO BROADCAST and therefore will receive this information free of charge.

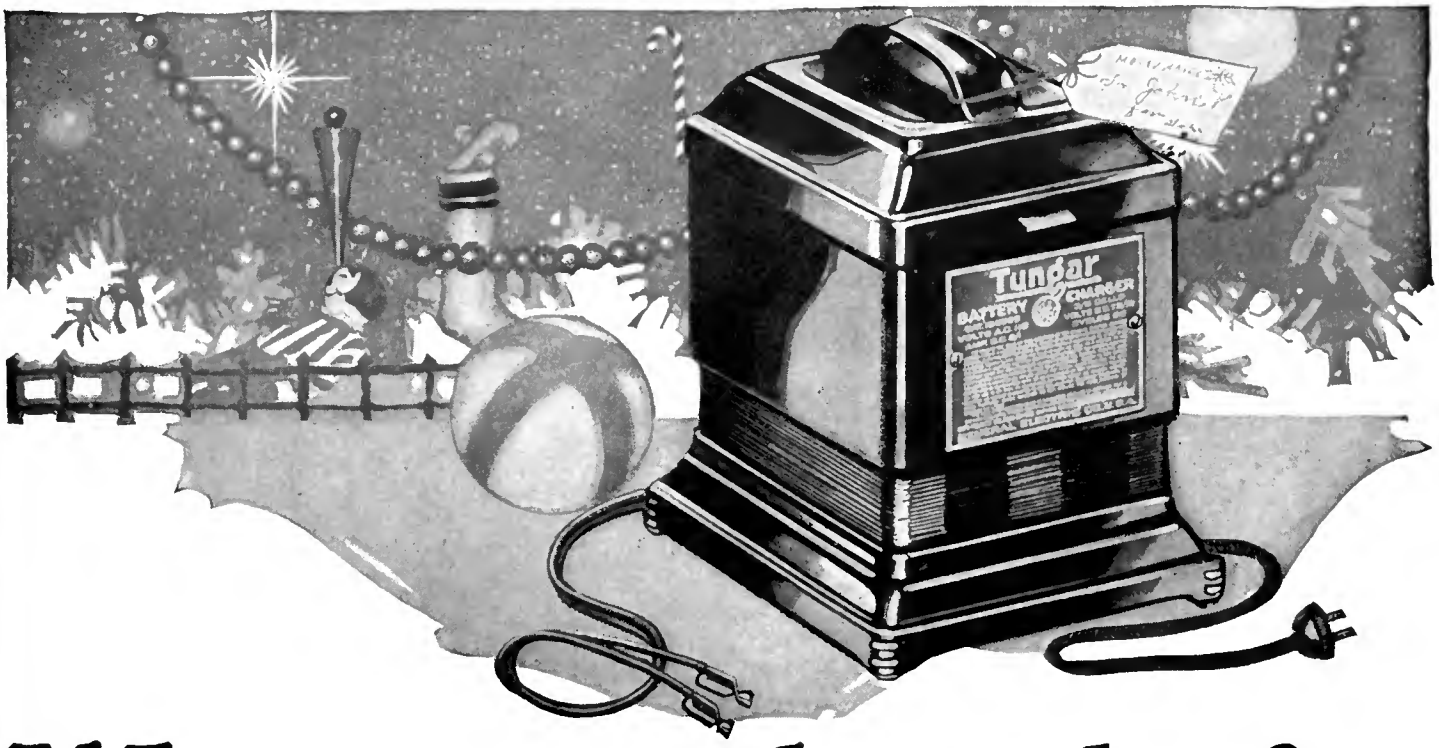
☐ I am not a subscriber and enclose $1 to cover cost of answers.

NAME .....

ADDRESS .....

.....

G. D.



What to give the radio fan

Give him a two-ampere Tungar if he has a storage battery *of any kind.* It will charge all his radio batteries and his auto battery, too.

Or, for bigger jobs, give him a five-ampere Tungar—built to do the same work but to do it more than twice as fast.

Every man who has a storage battery wants a charger. And every man who wants a charger wants the original General Electric bulb charger—the Tungar.

The Tungar is a G-E product, developed in the Research Laboratories of General Electric.

The new Tungar charges any make and size of storage battery: radio "A" and auto batteries, and "B" batteries as high as 96 volts in series.

Prices

Two ampere size . $18.00
Five ampere size . $28.00

60 cycles . . 110 volts

Tungar

REG. U.S. PAT. OFF.

BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Division
General Electric Company, Bridgeport, Connecticut

GENERAL ELECTRIC

★ Tested and approved by Radio Broadcast ★

A KEY TO RECENT RADIO ARTICLES

By E. G. SHAULKHAUSER

THIS is the second instalment of references to articles which have appeared recently in various radio periodicals. Each separate reference should be cut out and pasted on cards for filing, or they may be pasted in a scrap book either alphabetically or numerically. A brief outline of the Dewey Decimal System (employed here) appeared in the November RADIO BROADCAST.

R113. TRANSMISSION PHENOMENA. TRANSMISSION PHENOMENA.
Popular Radio, Sept. 1925, pp. 199–206.
"How the Air Affects Radio," E. E. Free.

In a simple non-technical way the author tells us how the two theories of wave propagation, the Heaviside Layer theory and the Gliding Wave theory, may affect radio transmission. Probably both theories are correct. Apparently the ions and free electrons in the air account for fading, bending, and absorption. Sir Joseph Larmor, on October 27, 1924, stated that he believes most of the phenomena pertaining to wave reflection occurs about fifty miles above the earth's surface. How free electrons may affect radio energy distribution is explained in greater detail.

R113. TRANSMISSION PHENOMENA. ABSORPTION.
Popular Radio. Sept. 1925, pp. 207-211.
"How Radio Dead-Spots are Found by a Wandering Broadcasting Station," J. O. Perrine.

The distribution of radio wave energy about a broadcasting station located in a city, has been determined with the aid of a mobile receiving set. Energy received is compared with that given out by a local oscillator, and field strength is recorded in microvolts per meter. The area about the Washington, District of Columbia station, WCAP, within a radius of 50 miles, is shown in diagram with contour lines. These tests have given very valuable and interesting results, showing effect of ground condition, buildings, hills, and various conducting materials found in the earth, on the direction and intensity of the wave.

R080. COLLECTIONS, TABLES, MISCELLANIES. TABLES
Popular Radio, Sept. 1925, pp. 221-226.
"Useful Charts for Amateurs," Lieut. C. C. Todd, jr.

Simple and valuable information to guide the constructor in designing coils and determining proper size condensers to cover certain wavebands, is contained in this article. Eight charts show the relation between capacity, inductance, wavelength, and coil turns, to cover both short and long wavelengths. The information is very well presented and the diagrams are clear.

R800 (530) PHYSICS ATOMS
Popular Radio, Sept. 1925, pp. 232-236.
"The Atom," Sir William Bragg.

Article No. 2 deals with the nature of gases. The arrangement of the electrons in various atoms, their number, and how the various combinations account for the different elements, is described. Models illustrate the facts outlined in a very simple way. The author relates the theory of the electrons and atoms and the part they play in our present day research, in simple language.

R360. RECEIVING SETS FREED-EISEMANN.
Popular Radio. Sept. 1925, pp. 244–254.
"How to Get the Most out of Your Ready-Made Receiver," S. G. Taylor.

The new Freed-Eisemann five tube receiver, NR20, is discussed, illustrated, and described in great detail. A description of the theory, operation, and equipment, with plenty of photographs and diagrams, give the set owner all the desired information. The B battery life for this set, using various sizes of B batteries, is shown in a table.

R304.1 WAVEMETERS. WAVEMETERS, *Oscillating*.
Popular Radio. Sept. 1925, pp. 267–271.
"An Oscillating Wavemeter," S. G. Taylor.

A description of an oscillating wavemeter, using a vacuum tube in a simple oscillating circuit, is given. Parts required, and size of coils to use in order to cover frequencies from 9091 kc. (33 meters) to 498 kc. (602 meters), are listed. The instrument is valuable in measuring capacities and inductances. The circuit diagram shown is the modified Hartley.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, *RX-1*.
Radio Engineering. Sept. 1925, pp. 433–441.
"How to Build the RX-1."

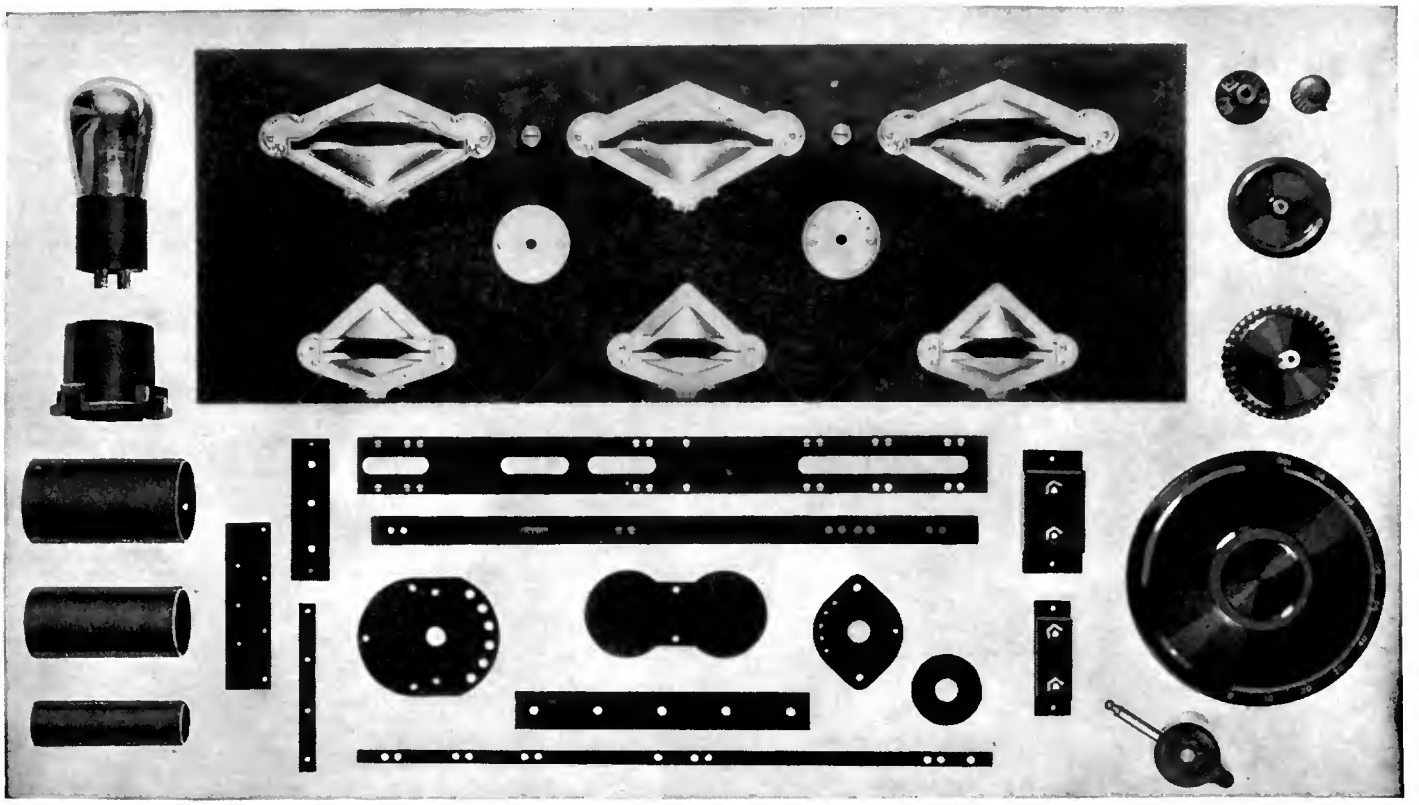
This receiver is one especially developed in the Darien Laboratory. It is a non-regenerative four-tube set known as the RX-1 receiver. The receiver was designed to give easy control, good quality, and precise tuning, together with plenty of volume. Diagrams and data are ample to permit the constructor to build this receiver. The best parts available are listed, the cost of these being only about $32.

R720. PROCESSES. MOULDING BAKELITE.
Radio Engineering. Sept. 1925, pp. 455–458.
"Why Not Do Your Own Moulding."

The article describes the equipment necessary for moulding bakelite parts on a rather small scale. The process is not difficult and the equipment can be installed in small establishments without excessive cost. The method used in making molded parts is described in detail. Photographs of the machinery are shown.

R384.1. WAVEMETERS. LECHER WIRES.
QST. Sept. 1925, pp. 11–12.
"Practical Lecher Wires," E. C. Woodruff.

Description and arrangement of Lecher wires with constants of construction are given in detail, showing diagram. In making measurements of waves the wires are connected to a vacuum tube circuit as shown in Fig. 1, and a milliammeter in the plate circuit indicates resonance. A calibration chart and graph show the method of using these parallel wires.



Imagine a Radio Set stripped of these parts

What a useless collection of wood, wire and metal it would be. Realizing that the parts and accessories shown here are wholly or partly of Bakelite, gives you a vivid picture of its importance to Radio.

To-day Bakelite is used in a greater variety of radio parts than ever before—and the number grows constantly. This dominance of Bakelite in radio reflects the experience and the opinions of radio manufacturers, great and small.

Radio set and parts manufacturers have every facility for testing all insulation materials and over 95% have standardized on Bakelite. This indicates how really important it is for you to make sure that the set or parts that you buy are Bakelite insulated.

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R084. TABLES. CHARTS.
QST. Sept. 1925, pp. 16–17. *Ind. & w. l.*
"Designing the Secondary Coil," G. H. Burchill.
Using double cotton covered wire, the inductance and wavelength of cylindrical coils, closely wound, can readily be determined with the aid of the chart in the form of a graph. A simple description of coil design and method of procedure is given.

R800 (535.3). PHOTOELECTRIC SELENIUM CELLS. PHENOMENA
Radio Engineering. Sept. 1925, pp. 442–443.
"Selenium and Photoelectric Cells," S. Wein.
The third chapter on selenium cells gives the construction of different types of cells by various scientists: Tainter, Bell, Mercadier, Townsend, and Cherry. References are listed.

R356. TRANSFORMERS. TRANSFORMERS.
QST. Sept. 1925, pp. 21–24.
"Transformers and Reactors in Radio Sets," R. H. Chadwick.
In the first article on transformers and reactors, the author takes up the general theory, regulation, and efficiency, and describes the construction and operating principles of various types of commercial transformers. The leakage reactance is a governing factor in proper transformer design. Useful information for users of these instruments.

R342.15. AMPLIFIER TRANSFORMER. AMPLIFYING
QST. Sept. 1925, pp. 27–29. TRANSFORMERS.
"High Ratio and High Amplification," R. S. Kruse.
Some misunderstood principles about audio and radio-frequency transformers are cleared up by the author. Stage to stage amplification depends on the regeneration as well as the transformation ratio and the tube constants. When the transformer is largest, both regeneration and amplification are strongest. A 2:1 transformer may give much better amplification than a 6:1, depending upon design. Diagrams illustrate the points under consideration.

R402. SHORT WAVE TRANSMITTERS. SHORT WAVE
QST. Sept. 1925, pp. 30–32. TRANSMITTER.
"A Power-Amplifier Transmitter for the Low Waves," W. H. Hoffman.
The circuit arrangement in a Colpitts oscillator, using an added power amplifier, is described. The transmitter operates well on very short wavelengths. It transmits a very steady frequency and with the apparatus recommended, has a tuning range from 14990-3894 kc. (20-77 meters). Since the set uses UV-202 tubes it can be operated on storage or dry batteries, and used as an emergency layout. Operating adjustments and list of parts required, including circuit diagram, give complete construction data.

R113.4. IONIZATION; HEAVISIDE LAYER. HEAVISIDE
QST. Sept. 1925, pp. 33–34. LAYER THEORY.
"Is There a Heaviside Layer?" G. W. Pickard.
A brief discussion concerning some of the transmission phenomena, with particular reference to various theories on reflection and refraction, is contained in a letter to *QST* by the writer.

R512. RADIO BEACONS. LIGHTHOUSE,
RADIO BROADCAST. Oct. 1925, pp. 719–724. *Radio.*
"And Now—The Radio Lighthouse," J. C. Young.
Radio service to ships at sea has become absolutely necessary. Radio signals help guide ships when near the coast and give bearings when needed. What advances have been made in guarding against danger, what pleasure and enjoyment has been derived through the use of radio to those sailing the waters, is well pictured in this article.

R140. RADIO CIRCUITS. ROBERTS
RADIO BROADCAST. Oct. 1925, pp. 725–731. CIRCUIT.
"New Developments and Experiments with Receiving Circuits," K. Henney.
The Roberts Knockout receiver offers possibilities for development along many lines. In this article some of the experiments carried on at the RADIO BROADCAST Laboratory with this circuit, are discussed. How a fifth tube may be added, how the reflex stage may be eliminated, how the circuit is neutralized, how regeneration may be employed in either detector or amplifier, are changes that may be tried with success.

R007. 2. U. S. RADIO INSPECTION SERVICE. RADIO
RADIO BROADCAST. Oct. 1925, pp. 743–744. CONDITIONS.
"Guiding the Good Ship Radio," D. K. Tripp.
An interview with W. D. Terrell, Chief Supervisor of Radio, concerning radio conditions in the U. S. at present, reveals his views about the department's attitude toward the amateur, the broadcaster, and the service both can render toward bettering conditions in radio.

R132. AMPLIFYING ACTION. AMPLIFYING
RADIO BROADCAST. Oct. 1925, pp. 745-750. PRINCIPLES.
"Some Remarks on Audio Amplification," G. C. Crom, Jr.
Good radio reception depends upon proper amplifier design. The functions of each part in the amplifier circuit are discussed in detail. Good parts must be used for best reproduction. Distortion may be produced by any one of four things as stated. High plate voltages are recommended and are of advantage when proper C battery voltages and by-pass condensers are inserted, as shown in Fig. 2.

R373. 2. MICROPHONES. MICROPHONE
RADIO BROADCAST. Oct. 1925, pp. 769-770. PLACING.
"More About How to Place the Microphone."
Methods of placing microphones for picking up band and orchestra music in and out of the station studio, are shown. In particular, the placing of several microphones at the Lewisohn Stadium in New York City and on the campus of New York University, in order to broadcast music from large organizations, is of interest.

R375.3 ELECTROLYTIC RECTIFIERS. RECTIFIERS,
RADIO BROADCAST. Oct. 1925, pp. 774–780. *Chemical.*
"Notes On Chemical Plate Supply Units," J. Millen.
The chemical rectifier here described, employs two or more jars in order to handle output voltages up to 150 volts and enough current for the receiver, at the same time giving absolutely no line hum in the output circuit. The discussion covers all phases of construction and operation in a very thorough manner. List of parts and diagrams of circuits and complete unit are added.

Fine Radio **TOBE** Apparatus

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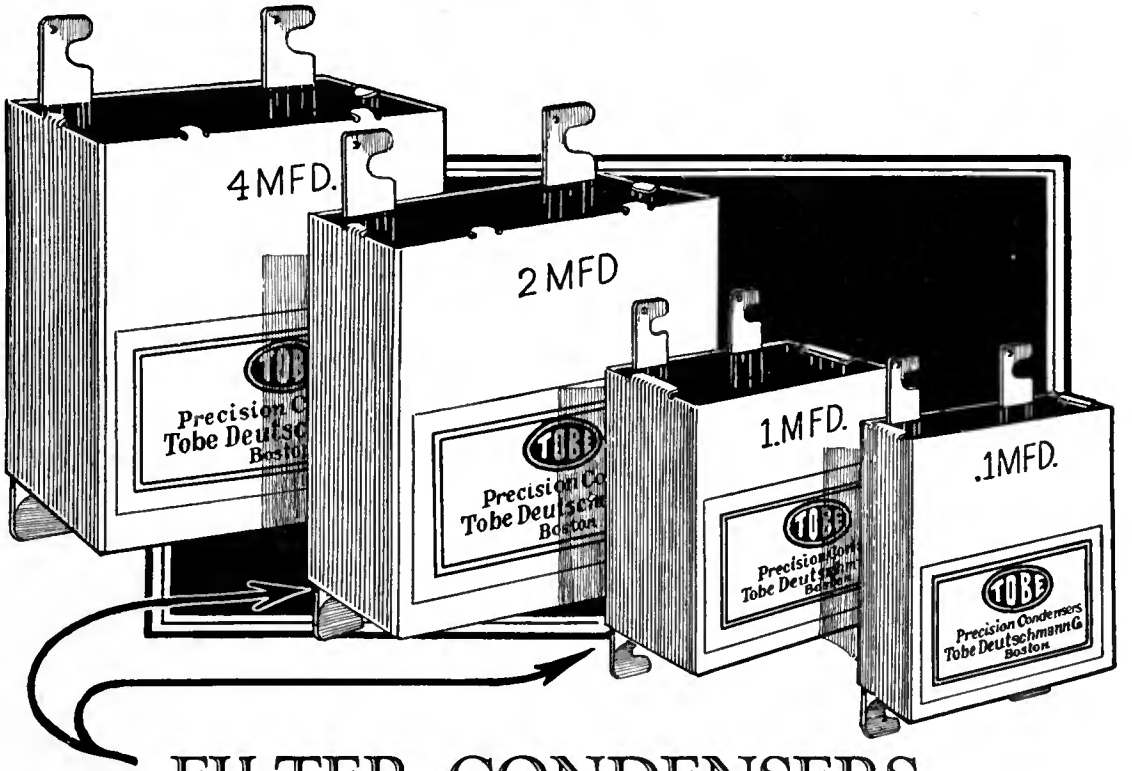

FILTER CONDENSERS

recommended for Raytheon Plate current circuits

RADIO BROADCAST'S article in this issue on "An Improved Plate Current Supply Unit" shows that the following TOBE condensers can be used in building the set: 5 type 708 and 7 type 709.

Any 'B' battery eliminator circuit depends very largely for its operating efficiency upon the filter condensers used. TOBE condensers alone possess all of the following favorable characteristics:

Will operate at voltages up to 700 D. C. without breakdown or overheating.
High megohm resistance—indicating perfect insulation.
Capacities guaranteed to be within 5% of accuracy.
Extreme heat or cold has no effect on TOBE condensers.
Compact and handsome in appearance.

Tobe condensers are better condensers—distinguishable by their silvered finished case. Ask your dealer for them by name "TOBE."

.1 M.F.D. Type 705	*Price* $ .70
1. M.F.D. Type 708	*Price* 1.25
2. M.F.D. Type 709	*Price* 1.75
4. M.F.D. Type 711	*Price* 3.75

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R550. BROADCASTING. SUPER-POWER STATIONS.
Radio Broadcast. Oct. 1925, pp. 761-768.
"A Debate: *Resolved,* That 500-watt Stations Are Not Sufficient for Program Service," Affirmative: Mr. Dreher. Negative: Prof. Williams.
The pros and cons of so-called super-power stations, is given in two articles. Much information is contained in both, especially in regard to power and noise level.

R113.1. FADING. FADING SIGNALS.
Radio News. Sept. 1925, pp. 278ff.
"Concerning the Nature of Fading," J. H. Dellinger.
The problem of fading has become more serious than the problem of static, primarily because so much fading occurs on the high frequencies (1500 kc. and up) where much research is being done at present. The Bureau of Standards has undertaken a series of tests to determine the cause of fading. It is probably due to the shifting of the upper atmospheric conducting surface.

R582. TRANSMISSION OF PHOTOGRAPHS. PHOTOGRAPH TRANSMISSION.
Radio News. Sept. 1925, pp. 278ff.
"See With Your Radio," W. B. Arvin.
The Jenkins-Moore system of television is described. A photoelectric cell converts the black and white of a picture into electric currents while a lighting device, the Moore lamp, picks up these currents and changes them back to light and shadow on the screen. The breaking up of the picture for transmission is done with the prismatic disc, a very simple method. Synchronism is accomplished with synchronous motors at both ends. This system is said to be the best one developed to-day, and was demonstrated at Washington last June.

R323. GROUND AND UNDERGROUND ANTENNAE UNDERGROUND ANTENNAE
Radio News. Sept. 1925, pp. 301ff.
"Underground Radio," W. H. M. Watson.
Experiments with underground antennas with frequencies of from 5996 kc. (50 meters) to 1666 kc. (180 meters) are described in detail, with varying results. Good transmission distance is possible with low power input after proper adjustments are made and antenna placed properly. The antenna is very directional.—An article on underground and under-water antennas, is reprinted from Dec. 1919, *Radio News* showing what was accomplished along this line several years ago.

R381. CONDENSERS. CONDENSERS, *S. L. F.*
Radio News. Sept. 1925, pp. 308ff.
"More About Straight Line Frequency Condensers," S. Harris.
A general discussion concerning condensers, in particular the straight line frequency condensers, is presented to clear up certain points. The question of low minimum capacity for definite sized condensers, of condenser resistance when plates are nearly all the way out, and of tuning with straight line frequency condensers, is considered.

R140. RADIO CIRCUITS. REGENERATIVE CIRCUITS.
Radio News. Sept. 1925, pp. 310ff.
"Single-Tube Circuits," L. W. Hatry.
The author reviews regenerative circuits, inductive and capacitive, using one tube. All other circuits are merely combinations of these simple circuits. A good understanding of these, makes the "dynes" and "plexes" comparatively simple. The Reinartz, the ultra-audion, the Cockaday, and others, receive considerable attention in this discussion.

R430. INTERFERENCE ELIMINATION. INTERFERENCE REDUCTION.
Radio News. Sept. 1925, pp. 290ff.
"Directional Reception Reduces Interference," P. C. Hoernel.
A method of reducing interference is here described, utilizing loops for directional reception. The system is developed by Mr. Friis of the Bell Telephone Company. In order to neutralize or reënforce the voltages obtained from the two loops, the latter are mounted on a long turntable at some distance apart (depending on wavelength). Fig. 3 shows the general form of the directional characteristics, and Fig. 1 the circuit used. Several photographs give an idea of the general layout. The tuning is simple and the results obtained were very good. Amateurs and experimenters can amplify along these lines.

R375. DETECTORS AND RECTIFIERS. RECTIFIER TUBE.
Radio News. Sept. 1925, pp. 293ff.
"A New Neon-Filled Rectifier Tube," J. Riley.
The tube used as rectifier for B battery eliminators has two electrodes of aluminum, a rod and a cylinder, and contains neon gas at a pressure of six millimeters of mercury. Its action in d. c. and a. c. circuits is discussed in detail and illustrated by diagrams. Other possibilities of the neon lamp are enumerated and offer a field of research.

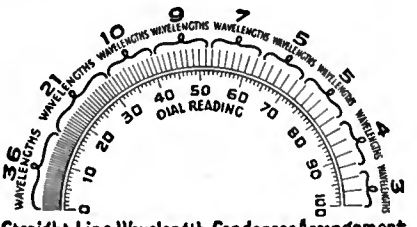
R351. SIMPLE OSCILLATORS. OSCILLATOR.
Radio Journal. Sept. 1925, pp. 12-15.
"A Laboratory Oscillator," H. W. Leighton.
The author describes the construction of a laboratory oscillator and gives some of its uses. The circuit is shown in Fig. 1. Calibration of the oscillator is simple when a standard wavemeter is available. Measurements of transformers and filter for use in super-heterodynes are made according to Fig. 2, and curves plotted showing how one can determine just how to select the proper apparatus to match. Small fixed condensers can also be measured with this oscillator.

R343. ELECTRON TUBE RECEIVING SETS. RECEIVER, *Browning-Drake.*
Radio Journal. Sept. 1925, pp. 14.
"New Type Browning-Drake," Bill Massaggee.
The constructional details of the Browning-Drake receiver are described, particular attention being called to several minor details which nevertheless are essential if the set is to operate well. A proper design of the coils used is essential. Extreme selectivity and sensitivity is claimed for the 4-tube set in comparison to other sets of similar size. (Further details in Oct. issue)

R360. RECEIVING SETS. GREBE CR. 17
Radio Journal. Sept. 1925, pp. 15.
"The New Grebe CR-17," M. Best.
Photographs and wiring diagram of the Grebe short wave receiver, including a short description of the operating principles, is given.

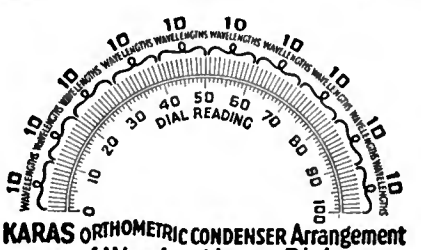
Ordinary Condenser Arrangement of Wavelengths

Ordinary straight capacity condensers crowd 70 of the 100 wavelengths into the first 30 points of the dial.



Straight Line Wavelength Condenser Arrangement

With straight-line-wavelength condensers 57 of the 100 wavelengths are crowded into the first 30 points of the dial.



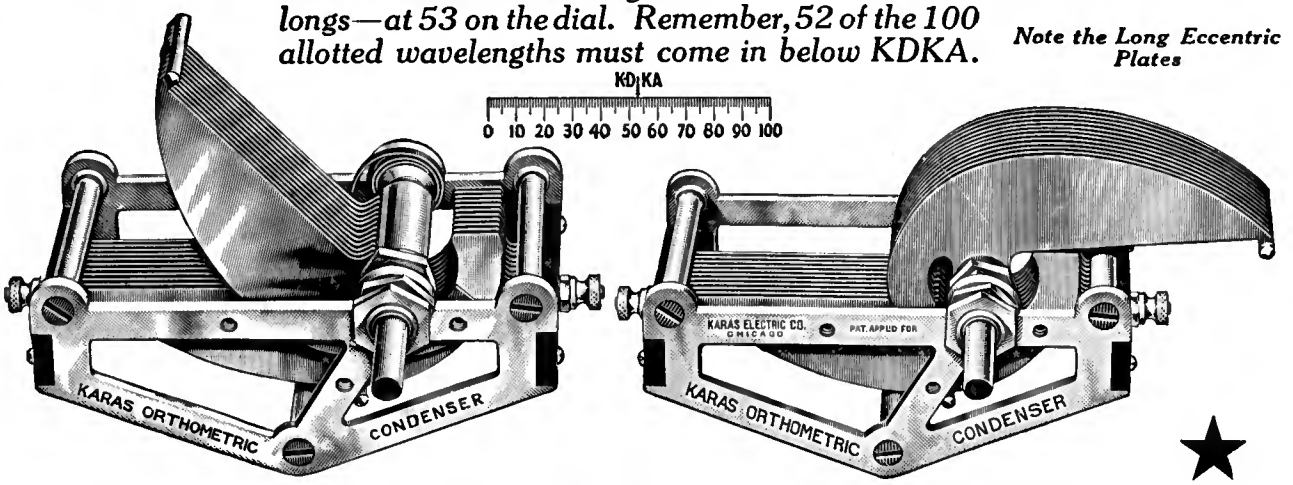
KARAS ORTHOMETRIC CONDENSER Arrangement of Wavelengths on Dial

The New, Scientific Karas Orthometric Condensers insure absolutely equal separation on the dial of all wavelengths throughout the entire broadcasting range.

Tuning Marvelously Simplified with Karas Orthometric Condensers

The condenser that brings in KDKA where it belongs—at 53 on the dial. Remember, 52 of the 100 allotted wavelengths must come in below KDKA.

Note the Long Eccentric Plates



Spreads Stations Evenly Over the Dial — *No Crowding Whatever*

THE Karas Orthometric Condenser positively separates all adjoining wavelengths by EQUAL distances on the dial, giving you the full benefit of the 10 Kilocycle frequency separation fixed by the Government.

Ordinary condensers jam 70 of the 100 Government allotted wavelengths into the first 30 points of the dial — even straight-line-wavelength condensers crowd 57 of them below 30.

With Karas Orthometrics, each point on the dial corresponds exactly to one of the 100 allotted wavelengths. The result is marvelous simplicity in tuning — better, clearer reception — you get all the side bands without interference.

The Karas Orthometric stands absolutely alone! — an eccentric condenser, scientifically designed for present day broadcast receiving sets—the Last Word in making REAL SELECTIVITY POSSIBLE.

The Karas Orthometric is a "job" that will delight the eye of the mechanical critic. It is made entirely of brass — frame and plates all die stamped — plates, patent leveled and solidly bridged to insure permanent rigidity and alignment. Every joint throughout is soldered. Grounded frame and rotor, with stator plates supported on hard rubber insulation. Tapered adjustable cone bearings, spring copper pigtail connection, automatic stops — in short, a condenser that is both theoretically and mechanically perfect.

If Your Dealer is Not Yet Supplied, Order on this Coupon

We are supplying Jobbers and Dealers as fast as the output of our factory permits. If your dealer is not yet supplied, order direct on the coupon. You need send no money with your order. Condensers will be delivered C. O. D., and you receive them subject to our unconditional guarantee of satisfaction. Why run the risk of delay? Order NOW!

Money Back Guarantee

Karas Orthometric Condensers are unconditionally guaranteed to give you absolute satisfaction. They may be returned for full refund any time within 30 days.

SIZES AND PRICES	
23 plate, .0005 Mfd.,	$7.00
17 plate, .00037 Mfd.,	6.75
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Please send me ---------- Karas Orthometric Condensers, size ----------at $----------each. I will pay the postman the list price, plus postage, on delivery. It is understood that I have the privilege of returning these condensers any time within 30 days if they do not prove entirely satisfactory, and you will refund my money at once.

Name ----------

Address ----------

Dealer's Name ----------

If you send cash with order, we'll send condensers postpaid.

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Is Your Set A Blooper?

How to Prevent Your Receiver Causing Interference and Thus Spoiling Your Neighbor's Reception

THERE are still many single-circuit bloopers in use, although the general trend in design, as far as commercially made receivers are concerned, seems to be toward receivers which are almost incapable of causing interference, however carelessly handled. The excellent instructions appearing below have been specially prepared by the Radio Branch of the Department of Marine and Fisheries of the Dominion of Canada, for circularization among all Canadian broadcast listeners. On the back of all Canadian receiving licenses is the following note. "When using a receiver of the regenerative type for the reception of radio telephone programs, please avoid increasing regeneration to the point at which the receiver begins to oscillate, otherwise you will cause interference with neighboring receiving equipments. Are you doing your best to observe this?" *The point is that many owners of receiving sets capable of radiating squeals, cause such interference purely from inadequate knowledge of the handling of their sets, and it was for their benefit that this circular was printed. These instructions should help many readers of* RADIO BROADCAST *who are looking for clear directions on how properly to use their regenerative sets.*—THE EDITOR.

HOW MUCH INTERFERENCE A RECEIVER CAN CAUSE

A RECENT survey of radio broadcast reception conditions in the more populated centers of the Dominion of Canada indicates that approximately fifty per cent. of the "preventable interference" which prevails, is caused through the incorrect operation of regenerative receiving sets by the broadcast listeners themselves.

The survey further indicates that most of the interference is due to a lack of knowledge of correct methods of adjusting a regenerative receiving set, and it is accordingly hoped that a material reduction in the same way may be effected if the broadcast listeners can be persuaded to coöperate in an endeavor to clear the air of regenerative whistles, and, with this end in view, the following instructions for operating this class of receiving set have been drafted.

WHAT IS REGENERATION?

THE principle of regeneration, as used in radio receiving sets, is that a part of the output of the detector vacuum tube feeds back into its own input and thus greatly increases the volume of the signal.

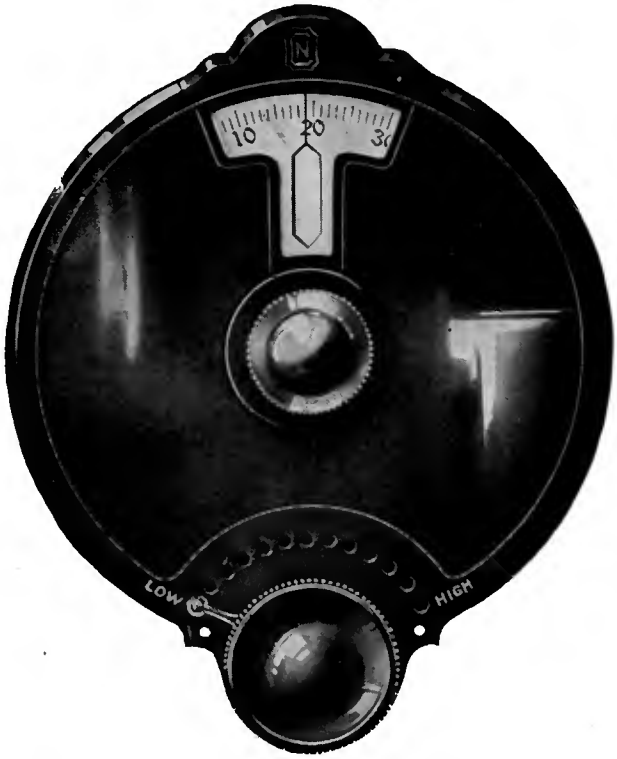
The electric waves reaching the receiving set from the transmitting station travel down the antenna wire through the primary coil in the set and so to earth down the ground wire. The weak electric current resulting from this influences the vacuum tube in such a way as to set it functioning.

The resulting output from the plate circuit of this tube is fed back in such a manner as to set up a "field," or "influence," in the part of the circuit connected to the input (the grid) of the tube. This "field" induces in the input circuit a current of electricity of the same frequency as that of the received electric waves. The energy, therefore, which comes down the antenna wire is automatically strengthened by an impulse from the output of the detector tube.

NATIONAL Velvet Vernier DIAL

Type B, Variable

(Patents Pending)



Positive Control
Easily Mounted
Gearless

Variable Ratio
Velvety Smooth
Graceful Design

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With This NEW National Type B, Velvet Vernier Dial, *YOU* Control the Reduction Ratio!

WHAT a difference in the tuning of your set when you replace your plain dial with a new NATIONAL Type B Variable (patents pending). You'll be astonished.

Any ratio you desire, from a minimum of 6 to 1 to a maximum of 20 to 1 is instantly obtained by shifting a small lever. Note how it separates the stations operating on the lower wave lengths.

Easily mounted on the $\frac{1}{4}$" shaft of any standard type of variable condenser. The only tool you need is a screw driver.

The same velvety smoothness, the same freedom from backlash, the same mechanical drive as the famous Type A Velvet Vernier Dial, (patents pending). Price $2.50.

The NATIONAL KIT

for the popular circuits and hook-ups gives amazing results to amateur set-builders.

Comprises the NATIONAL CONDENSER and the wonderful BROWNING-DRAKE TRANSFORMER. Complete in one package, Price $22. Makes a most welcome Christmas Gift.

Write for Bulletin 106 R. B.

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W. A. READY, *President*

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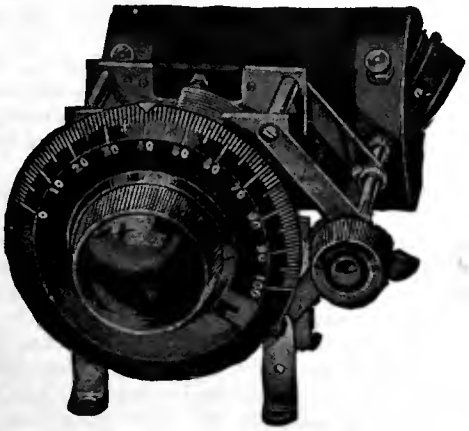
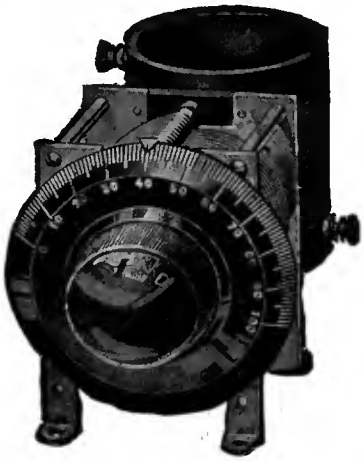


NATIONAL Tuning Unit
Type B D-2



NATIONAL Tuning Unit
Type B D-1

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WHAT IS OSCILLATION?

UNLESS controlled, this action will continue until the saturation point or climax is reached, the tube then being said to be in a state of oscillation. When a receiving set is in oscillation, it causes howling and squealing in your own and your neighbor's receiving sets. Regeneration should therefore never be allowed to proceed to this point as it then constitutes a public nuisance. On commercial receivers, regeneration is not always described by this name, and the dial which controls this feature of the equipment may be designated by any of the following terms: Regeneration; Reaction; Tickler; Feedback: Amplification; Varind; Sensitivity, etc.

When a radio receiving set in a state of oscillation is being tuned to a broadcast station:

(1) It causes whistles in radio receiving sets, of all types, which are tuned to the same station. This interference may be heard up to a distance of several miles.

(2) It distorts the quality of your own music.

(3) It uses more B battery power and therefore the life of the B battery is reduced.

(4) It tends to reduce the life of the detector tube.

When a radio receiving set, in a state of oscillation, is exactly tuned to a broadcast station, it is said to be in the state of zero beat. This distorts the broadcast reception and also interferes with neighboring receiving sets which are tuned to the same station.

In a word, regeneration carried to oscillation causes great annoyance to your neighbors, poor reception and expense to yourself, and has no advantages whatever.

DOES YOUR RADIO RECEIVING SET CAUSE INTERFERENCE?

THE interfering whistle which you hear in your receiving set may originate in your own set or it may be interference caused by your neighbor. In order to determine this point you may make the following test:

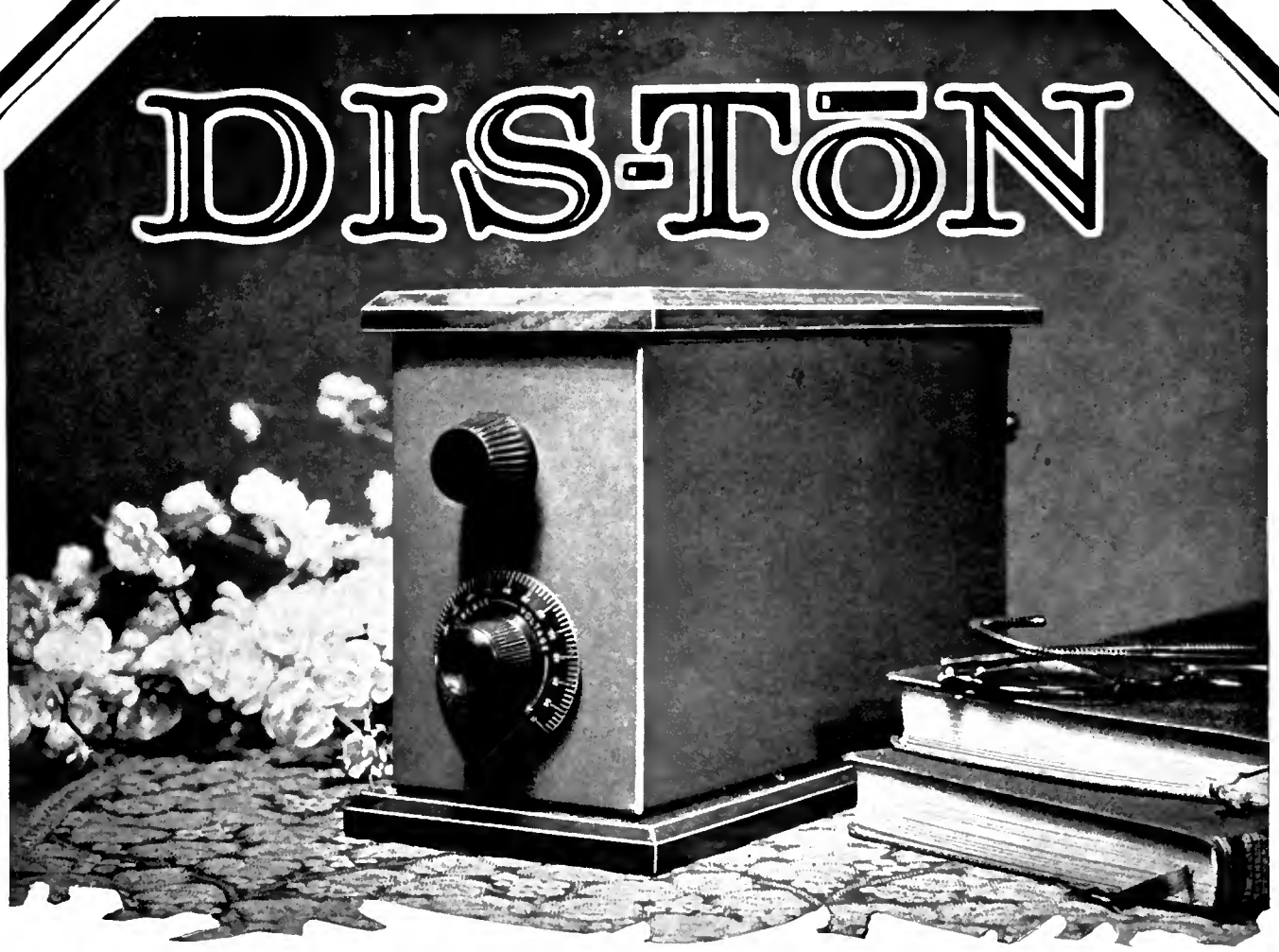
Leave the regeneration control in a fixed position, slowly rotate the tuning dial, and note particularly the change in sound of the whistle. If the whistle rises and lowers in pitch sympathetically with the movement of your tuning dial it indicates that your receiving set is in a state of oscillation and probably causing interference to other sets. On the other hand, if the whistle does not change in pitch corresponding to each movement of your tuning dial, but simply varies in volume, the whistle is not caused by your receiving set, but is interference produced by some other oscillating receiving set in the neighborhood.

Many so-called non-radiating receivers will, under certain conditions, radiate and thus cause interference. Make it your business to see that your set is not causing trouble.

If you are in doubt as to whether your set can cause interference you can check the same by making the following test, but be careful to do so at a time when only a few people are listening in, so as not to cause annoyance:

Call a neighbor on the telephone and ask him to listen in on a particular station at a prearranged time and then tune your own set to the same station. Turn up your detector tube filament to normal and put the regeneration control to its maximum; move your tuning dial five times slowly across the point corresponding to the tuning of that station, then telephone your neighbor and ask him if he heard the interference corresponding to these five movements of the dial on your receiving set. If he heard your interference, the probability is that hundreds of others have also been annoyed at times by radiation from your receiving set. You should

DIS-TŌN



Employs no fluids of any kind. Uses only one rectifying tube. Separate adjustment for detector and amplifier tubes. Handsomely finished in rich velvet-green Duco with solid walnut, satin finish top and bottom. Ample continuous "B" current for one to ten-tube sets.

★

Remarkable Tone Quality – – Amazing Volume and Selectivity– *without "B" Batteries*

Dis-ton, in place of "B" Batteries, is guaranteed to improve the overall efficiency of your set. It provides constant "B" current at proper potential for your particular receiver circuit, tubes and loud speaker.* Dis-ton is noiseless in operation—no crackles and popping such as you get with run down "B" Batteries—no hum of any kind to distort the finest aria or drown out the faint signals from distant stations.

A self-contained electrical instrument using A C

Dis-ton is trouble free—the special Trans-Filter Unit is sealed in, protected against tampering and deterioration. It can't wear out. Consumes only eight watts from the nearest lamp socket and puts your "B" load on the big, powerful, carefully watched generators of your central station. You can rely upon Dis-ton to give you the best from your receiver.

Without attention of any kind after simple initial adjustment to your set—Dis-ton insures you the equivalent in performance of new "B" Batteries every time you listen in.

Dis-ton requires no change in the internal wiring of your set to secure either utmost efficiency or entire safety. Accidental improper connections can't result in tube "burn outs."

DIS-TON complete ready for operation 110 volt, 60 cycle $40.00
Other voltages and cycles on application

Know how much DIS-TŌN adds to radio

The advantages that Dis-ton will give you are outstanding and unusual. You have the opportunity to verify them all on your present receiver. A Dis-ton demonstration is yours for the asking. Send for Leaflet B and full details as the first step to greater radio enjoyment this season.

DIS-TON KITS Essential Parts for Home Builders 110 volt, 60 cycle $28.50
Other voltages and cycles on application

RADIO PRODUCTS, Inc.

Dept. RB **Richmond, Ind.**

*Dis-ton *will not make a "single tube" into a "super-het," but it will modernize the performance of any of the good, older receivers in an amazing fashion.*

★ Tested and approved by Radio Broadcast ★

therefore learn how to operate without causing this interference.

ADJUSTING A REGENERATIVE SET

IF YOU will take the trouble to observe the rules which follow, you will obtain greater satisfaction and enjoyment from your radio receiving set, and at the same time cause minimum annoyance to your neighbors.

(1) Practise on tuning *powerful stations first* and do not try to pick up weak distant stations until you become expert.

(2) *Use both hands*, one hand for the regeneration control and the other hand for the tuning control.

(3) Keep the regeneration control always just *below* the point of oscillation, your set is then in the most sensitive condition. This is the reason for using your two hands for tuning.

(4) If your set then accidentally breaks into oscillation, turn *back* the regeneration control at once.

(5) Do not try to *find* a station by the *whistle*. If your set is tuned just below the whistling point, the signals will come in *clear* and your regeneration control can then be tuned a *little* further to increase the volume.

(6) Do not *force* regeneration in an attempt to obtain loud speaker volume from a set not designed for the purpose.

(7) Do not *force* regeneration in an attempt to hear stations beyond the range of your set; be content with those you can really hear.

The fact that you once heard a distant station on your receiving set is no indication that you can hear this station regularly, for occasionally a radio broadcast from a distant station is received with extra strength due to some freak condition. When you have tried to tune-in to a station in the correct manner for a minute or two and are not able to hear it, do not unduly increase your regeneration and persistently wiggle your dials, for in so doing you may be causing annoyance to some other broadcast listener who would otherwise be able to hear this distant station on his multi-tube set.

If you are not satisfied with the range your present receiver is giving you and providing local conditions are satisfactory, the only remedy is a more sensitive receiver or the addition of more tubes to your exisiting set. Don't at your neighbors' expense, try to force your receiver. Besides being unfair to your neighbors, you are also spoiling your own quality.

You can accordingly assist in eliminating these whistles by:

(a) Learning to operate correctly yourself.

(b) Not allowing children, who are not old enough to understand the correct method of operation, to cause interference from your set. (A crystal set causes no interference).

THE LICENSE

ALL radio receiving sets in Canada are required, by law, to be licensed. Licenses are issued yearly and are required to be renewed on the first of April each year. They may be obtained for one dollar from local Radio Inspectors, many Post Offices, many Radio Dealers, or from the Radio Branch, Department of Marine and Fisheries, Ottawa, Canada.

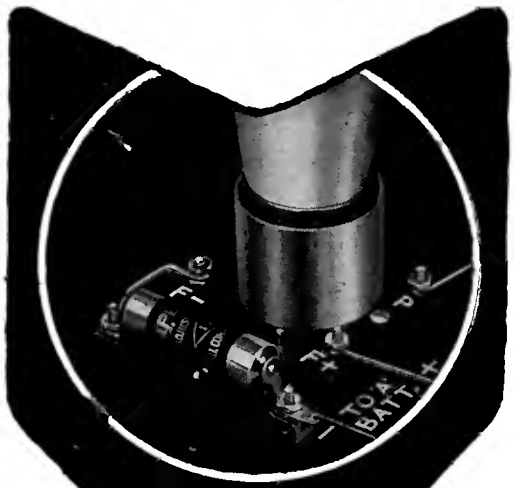
The proceeds of the license fees are used to maintain an inspection staff for the administration of radio and for the improvement of radio conditions in the Dominion.

For the benefit of listeners who are desirous of obtaining this article in circular form, it should be stated that copies may be had, on request, from the nearest Canadian Radio Inspector, or direct from the Radio Branch, Department of Marine and Fisheries, Ottawa, Ontario, Canada.

★ AMPERITE

REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat



A BASIC Need in Every Circuit

BECAUSE—AMPERITE not only modernizes any set—it keeps it modern.

1—Eliminates Hand Rheostats, thereby simplifying control.
2—Permits use of the latest types of tubes or any combination of tubes.
3—Simplifies and reduces set-wiring, thereby making for greater compactness and avoids losses.
4—No moving parts, hence no grinding noises; clear and full tones.
5—Prolongs tube-life by keeping filaments at a constant temperature.
6—No filament meters needed.
7—Brings the most out of each individual tube—automatically—no guessing.
8—Makes every set-owner a master operator, no knobs to turn.

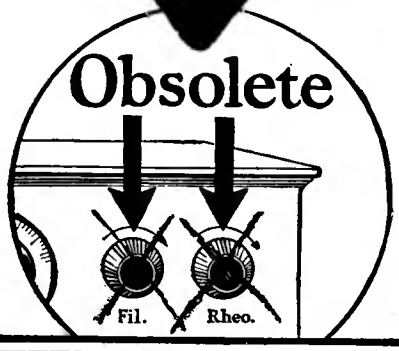
Write today for FREE *Hook-Ups*

Sold Everywhere
$1.10 complete with mounting

AMPERITE is used in every popular present-day construction set. Why? Because of its many outstanding exclusive features, and because it solves the perplexing problem of tube-control—COMPLETELY and AUTOMATICALLY.

For the new tubes:

Amperite No. 112—for the UX-112 and CX-112
Amperite No. 120—for the UX-120 and CX-120



Radiall Company

Dept. R.B.-13 50 Franklin Street New York City

Mf's of "TUNE-RITE" Straight-Line-Frequency Dial

Be sure that the set you buy or build is equipped with AMPERITE.

WHAT OUR READERS WRITE US

Say "Pico" Instead of "Micro-Micro-Farad"

WHY not adopt and familiarize the prefix 'pico' for 'micromike?'" wrote Mr. F. I. Anderson in the September RADIO BROADCAST (page 662). "Thus, instead of saying a 'triple-o-five' condenser, for an instrument of 500 micro-micro-farads, let us say 500 picos, which is correct and simple, if we once get used to it. To be precise, we should say pico-farads, but we could drop the farads once we get used to the pico end of it." From Robert S. Kruse, technical editor of *QST*, comes a letter informing us that he is heartily in agreement with this idea and has already taken steps to make it take on definite shape.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

I want to enter an enthusiastic endorsement of the idea expressed by Mr. F. I. Anderson on page 662 of your September issue. By a strange coincidence we received this issue on the exact day when we had been discussing the extremely unsatisfactory nature of the micro-micro-farad. This letter is only to offer you my personal coöperation in anything you would care to do along this line, although we have already half formed a plan of more general technical coöperation. This plan has now been submitted to our Executive Committee which is investigating its practicality.

Very truly yours,
ROBERT S. KRUSE.
Technical Editor, *QST*.

Radio Developments in New Zealand

WE ARE always pleased to hear from our readers abroad and we think that fans in this country are interested to know what progress is being made in foreign parts too. There is a certain amount of satisfaction in knowing that one's local station is heard regularly in some remote spot of the globe, and perhaps a certain amount of chagrin when one reads that such and such a station may be heard very well, in New Zealand for example, while the native fan, who may be merely two or three thousand miles nearer, is unable to receive it. We wonder what percentage of East Coast fans have received KGO, KFI, and KPO, as often as Mr. Haggett has?

DOMINION RADIO COMPANY
WELLINGTON, NEW ZEALAND

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

Just a few lines to express my appreciation of your excellent magazine. I have always found it an ideal publication in every way. I have just received the July issue and I think it is the best yet. I was very sorry to learn of the death of Miss Mix, as her column was of great interest to us. Broadcasting here is not of a very high order just yet, but this year will see New Zealand with one of the best broadcasting services in the world. Parliament is making provision this session for the erection of several main stations and several satellite relay stations. The revenue is derived from fees to be

Perfect Precision!

Radio technicians and engineers as well as seasoned amateurs know that "General Instrument" is satisfied with nothing short of *perfect precision.*

For example: The General Instrument laboratories developed the eccentric type straight line frequency condenser at great expense—only TO ABANDON IT!

Try to rotate an eccentric type straight line frequency condenser and note the effect on the bearing and then you will realize why "General Instrument" discontinued the eccentric type and created the CONCENTRIC straight line frequency condenser.

CONCENTRIC straight line variable condensers represent the latest development in condenser engineering. Observe the even distribution of weight of the rotor plate.

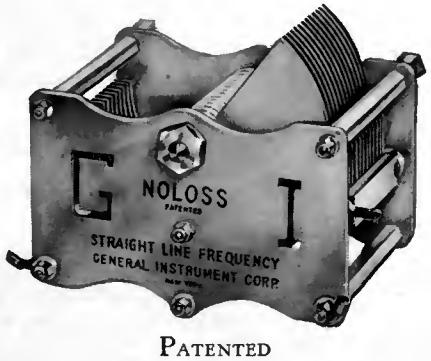
"General Instrument" thinks more of its reputation than the cost involved in creating a perfect instrument. Hence—the CONCENTRIC straight line frequency condenser.

STATOR

CONCENTRIC Straight Line Frequency Condenser

(Pyrex Insulated)

The perfect instrument created by General Instrument. Type 80.



PATENTED

TYPE 40

THE INIMITABLE RHEOSTAT

Built only by General Instrument, this rheostat can NOT be imitated. To get it, you must make sure of the name "General Instrument."

OBTAINABLE AT BETTER CLASS RADIO DEPARTMENTS ★

General Instrument Corporation

Manufacturers of Laboratory Equipment

423 Broome Street New York City

★ Tested and approved by RADIO BROADCAST ★

charged listeners-in which will be the equivalent of nearly five dollars. At the present time my company is running the broadcasting stations in this city and local companies are doing the same in the other towns, but that will cease of course when the new Broadcasting Company (now in course of formation) is ready. The reception of American stations here is achieved nightly using only single "valve" sets, and loud speaker volume using one stage of radio, detector and two of audio. I have heard KGO, KPO, KFI, and others using a Kennedy Model XV Receiver and have logged any number of "Yanks" on a low loss set of my own construction. I am at the present time building a RADIO BROADCAST Phonograph receiver as described in your paper. I expect great results from it and no doubt you will be pleased to hear how I get on with it. This quarter of the globe is excellent for reception as is evident by the long distance records made by New Zealanders. At the time of writing we are expecting the arrival of the American Fleet here and I have already heard their "sigs." from Lieutenant Schnell's short wave set.

The "star" on your advertisements means a lot to us here in New Zealand. We cannot tell what is the latest apparatus and whether all the goods one sees advertised are what they are supposed to be, but in buying for this firm I have never once fallen in when guided by the "star." We have up to the present only handled small quantities of goods but we anticipate an increased volume of business this year. Thordarson, Belden, Na-ald, Peerless, Daven, Bell, Walnart, and Federal are amongst the lines we handle and we are satisfied that they are the best. So you can see what a valuable guide your paper is to us who "have no mother to guide us", as it were. We all enjoy your column "As The Broadcaster Sees It"—it is a scream.

Wishing you all the success you deserve with your excellent paper.

Very truly, yours,
R. J. HAGGETT
Wellington, New Zealand.

The O'Connor Frequency-Changer

THE O'Connor Frequency-Changer, which was described fully in the June and August, 1925, RADIO BROADCAST, has caused much comment, and we have received numerous letters from readers who have had success with this circuit. By its use it is possible to convert any existing receiver to a super-heterodyne, and thus increase range and selectivity. Used in combination with a neutrodyne receiver it is possible to efficiently reduce the number of tuning controls to two, instead of the usual three. Here is a letter from an enthusiastic constructor.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, New York.

SIR:

I have read with interest the controversy relative to the O'Connor Frequency-Changer, and as to its being a dud I can give evidence to the contrary.

I have one of the first ones made in this territory and what it did to my five-tube neutrodyne is more than satisfying, in selectivity and volume and distance, and I had what was considered an exceptional set before.

Atlantic City, Elgin, Providence, and Pittsburg come in between two degrees on the dial, and with no interference.

Detroit and Toronto come in within half a degree on the dial, also with no interference. I am getting Fort Worth nightly now, and practically all stations above 500 watts in power.

Very truly, yours,
C. F. RODGERS,
Conneaut, Ohio.

Straight Frequency Line Tuning

Marks a new era in Radio progress—
Sweeping country like a tornado—
Fans welcome it with open arms—
Irresistible demand growing by leaps and bounds—

★

KARAS Started It
— and KARAS Is Carrying On!!

When we sprung the Karas Orthometric Condenser on a restless, hungry radio public—we knew we had started something. But we scarcely expected to be snowed under with such a literal avalanche of orders.

We inaugurated Straight Frequency Line Tuning at the psychological moment. Radio Fandom was waiting hungrily for something new. And here was something—not only new—but so perfectly simple—so thoroughly scientific—so downright sensible, that everyone wanted KARAS Orthometric Condensers at once.

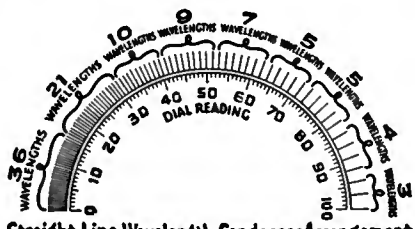
Our scheduled production was like a drop in the bucket. Buyers pleaded—cajoled—even threatened. Our plans were doubled, trebled, quadrupled. But it all took time. KARAS Orthometric Condensers could not be thrown together. It took months to train gangs to build them with the absolute *precision* KARAS demands. So tens of thousands had to wait or buy other makes, hurriedly assembled to supply the demand we had created.

NOW—after months of preparation we are able to produce enough KARAS Orthometric Condensers to take care of at least a fair share of the demand. This announcement is an apology to those who were disappointed. A note of thanks to those who have waited. And a promise of revelation to those who have not yet discovered the marvelous advantages of Straight Frequency-Line Radio Tuning.

How KARAS Orthometric Condensers *Simplify the Tuning of any Radio Set*

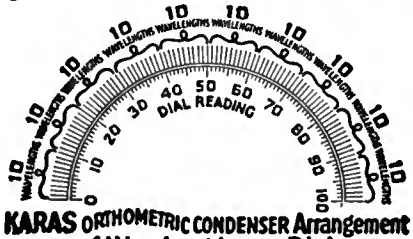
Ordinary Condenser Arrangement of Wavelengths

Ordinary straight capacity condensers crowd 70 of the 100 wave lengths into the first 30 points of the dial.



Straight Line Wavelength Condenser Arrangement

With straight-line-wavelength condensers 57 of the 100 wavelengths are crowded into the first 30 points on the dial.



KARAS ORTHOMETRIC CONDENSER Arrangement of Wavelengths on Dial

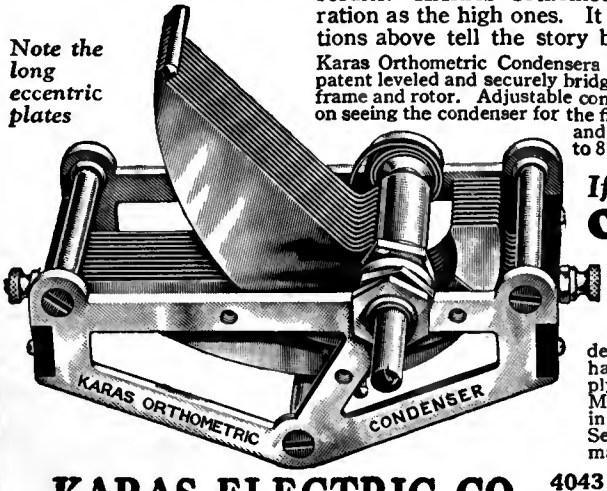
The New Scientific Karas Orthometric Condensers insure absolutely equal separation on the dial of all wavelengths throughout the entire broadcasting range.

Sizes and Prices—
23 plate, .0005 Mfd., $7.00
17 plate, .00037 Mfd., 6.75
11 plate, .00025 Mfd., 6.50
5 plate, .0000972 Mfd., 6.50

Government regulations separate all stations by an equal interval of 10 kilocycles. Old type condensers—straight line capacity and straightline wavelength—warped this uniform arrangement—crowding a lot of low wavelength stations into the first few degrees on the dial. Difficulty in tuning—confused heterodyning interference—garbling of programs—these were the results. KARAS Orthometric Condensers give low wavelength stations the same equal separation as the high ones. It is the last word in making ***real*** selectivity possible. The illustrations above tell the story better than words.

Karas Orthometric Condensers are both theoretically, and mechanically perfect. Made entirely of brass—plates patent leveled and securely bridged to insure permanent rigidity and alignment. Every joint soldered. Grounded frame and rotor. Adjustable cone bearings. Spring copper pigtail. In short, so beautiful a job that one engineer, on seeing the condenser for the first time, smilingly inquired, "How many jewels?" As proof of their mechanical and electrical efficiency, Karas Orthometric Condensers will hold a charge for from 6 to 8 hours, as against one hour to an hour and fifteen minutes for ordinary condensers.

Note the long eccentric plates



If your dealer hasn't secured a stock of Karas Condensers

Order on this Coupon!

Most good dealers everywhere, sell Karas Orthometric Condensers. If your dealer happens to be one who hasn't secured them, we will supply you direct on our 30-day Money-Back Guarantee. Just fill in and mail this coupon at once. Send no money. Pay your postman on delivery.

KARAS ELECTRIC CO., 4043 North Rockwell Street CHICAGO, ILLINOIS

For more than 30 years makers of PRECISION Electrical Apparatus

Karas Electric Co.,
4043 N. Rockwell St., Chicago

Please send me.....Karas Orthometric Condensers, size.....at $.....each. I will pay the postman the list price, plus postage, on delivery. It is understood that I have the privilege of returning these condensers any time within 30 days if they do not prove entirely satisfactory, and you will refund my money at once.

Name.....

Address.....

Dealer's Name.....

If you send cash with order, we'll send package postpaid

★ Tested and approved by RADIO BROADCAST ★