On the Air

A MAGAZINE OF RADIO"

25¢

In This Issue—

THE INSIDE STORY OF WOC. Illustrated -- FELIX ANDERSON JOINS OUR STAFF -- TUBE REJUVENATION -- GOOD COILS -- PAUL GREEN -- McMURDO SILVER -- JOSEPH CALCATERRA

June 1925

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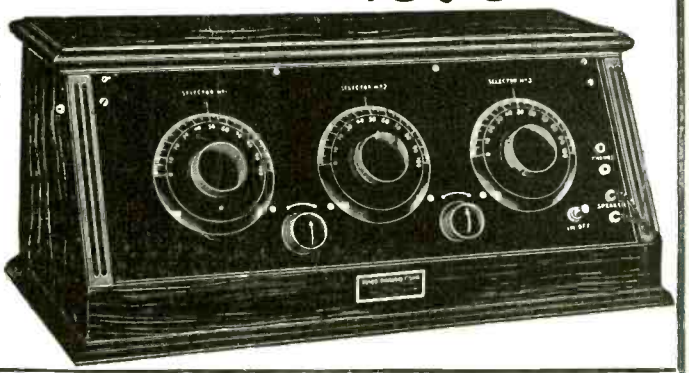

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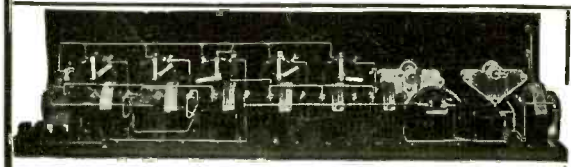

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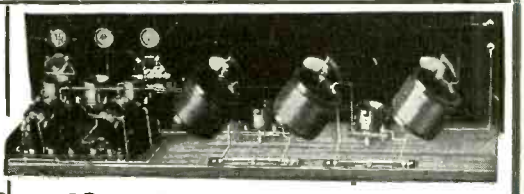

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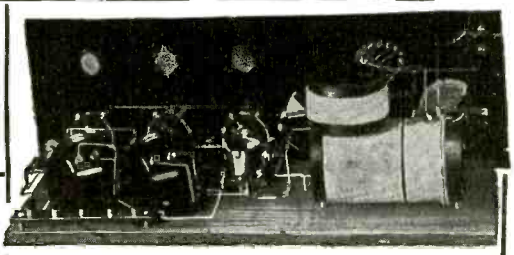

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- 2 Double Circuit Jacks
- 2 3-in. Bakelite Dials
- 1 Grid Leak and Mica Cond.
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- 1 Bakelite Binding Post Strip
- 7 Binding Posts
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RANDOLPH RADIO CORPORATION

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On the Air
A MAGAZINE OF RADIO

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In Which We Complete Our First Volume

* * *

THIS ISSUE of ON THE AIR is the twelfth number and completes what is known in the publishing art a "volume." Each of the twelve past numbers constituting this volume represent to us an individual lesson, an experience and a step toward a more thorough understanding of what a *good* radio magazine should consist of. That we have learned our lessons well is abundantly exemplified in the comparison of our first issue and this one.

* * *

FROM A modest and unpretentious start, ON THE AIR has grown to a publication of exceptional worthiness; the past issues have inspired a quality of confidence among the reading public that is rare indeed. We quite frankly maintain that only loyalty on the part of our readers and friends could foster this growth. Our part consisted of nothing more than complying as best we could to the wishes and desires of those who read and criticised constructively. To them we tender our most sincere thanks and express the hope that what we have learned will enable us to serve them more effectively and completely in the future.

* * *

WE HAVE taken new and larger quarters to accommodate this exceptional growth; this exhibition of acclaim on the part of our followers. Mr. Felix Anderson, whose technical contributions to radio are known to hundreds of thousands of radioists, joins our staff this issue to oversee and direct our future technical policy. Already his influence is markedly felt in the pages of this issue. Mr. Anderson's experience in helping and counseling radio fans covers a period of many years, and his experience in the radio publishing business indicates that our readers are in for many rare treats along reading lines. Mr. Frank O. Balch assumes the duties of advertising director, and advertisers are assured of courteous and exceptional service from his department.

* * *

FROM TIME to time, new, interesting and instructive features will be added, and as we close this volume, we are filled with a sense of pleasure over the rosy outlook for the new one which we are now compiling.

THE EDITOR.

On the Air
A MAGAZINE OF RADIO

VOL. 1 JUNE, 1925 No. 12

This Is Station WOC, "Where the West Begins"

By EDGAR H. TWAMLEY

Edgar H. Twamley

BACK in the fall of 1921, a young man from Pennsylvania alighted from the Rock Island train at Davenport, Ia., and made his way to the top of Brady Hill to enroll as a student at the Palmer School of Chiropractic. He had just left Uncle Sam's naval service and had traveled the seven seas as a first class radio operator.

One day during a lecture the thought of a radio station at the Palmer School came to him. He hastened to the president of the school, Dr. B. J. Palmer (known throughout the chiropractic world as "B. J."), and laid his ideas before him. "B. J." saw reason in the idea and told the young man to go ahead.

He went ahead and shortly a De Forest transmitter (at that time, rated at 1,000 watts input power) was installed and which used a system of modulation different from that in general use today, and which was only as efficient as a 200-watt set today. This outfit, however, demonstrated fully what a better transmitter would accomplish. In less than six months this equipment was replaced by a 500-watt transmitter just developed by the Western Electric Company and a much more elaborate antenna system was installed.

This set was highly satisfactory at that time and many records of long distance reception were secured, and, in fact, many previous records were shattered.

Progress in radio research, however, did not stand still and a few months ago when the Western Electric Company announced the new 5,000-watt transmitter (now reckoned in output instead of input) WOC was one of the first stations to place an order, build new high antenna towers, new buildings to house the new equipment, and increase the station staff. The new station went on the air, officially for the first time on last Christmas eve, December 24, 1924. The young man has also remained with WOC since the station was merely a dream in his mind, four years ago. The dream came true and he is now studio director at one of the most powerful and best equipped stations in the world.

"Welcome, Come In," is the sign that greets the visitor on leaving the elevator at the Up-E-Nuf Roof Garden upon which the buildings of WOC are located. Immediately adjacent is another which warns to "Silence" as WOC is on the air. Hundreds of thousands of people from coast to coast, from Texas to Toronto and beyond, might have their enjoyment spoiled by a careless noise. Stepping from the entrance to the broadcasting studio out onto the open air roof garden, one's attention is at once drawn to the great mast-like steel towers supporting the antenna, and the antenna itself, hanging unbelievably rigid 165 feet above the level of the roof on which the towers stand, or 200 feet above the street.

THE other connection, so necessary for radio transmission—the ground connection—while not at all conspicuous, is really much more elaborate than the antenna system. The ground connection is made by a network of heavy cables which are bonded to every part of the steel towers of all the buildings within the field of the antenna, and these are, in turn, connected by a similar network of cables to the extensive system of pipes which comprise the water supply system of the city of Davenport. From these pipes the ground connection finds its way to the Mississippi, "The Father of Waters."

Five rooms are required to house the various parts of equipment which comprise the broadcasting station, and, in addition, the station's room includes a spacious reception room and studio. The total floor space provided by the seven rooms is over 1,800 square feet. All parts of the station are accessible to the sightseer; those parts to which the casual visitor is not admitted being provided with large plate glass windows through which all equipment and apparatus may be seen without any interruption or interference with the program which is in progress.

The reception room is open at all times and visitors or friends of the performing artists may sit in this room and listen to the program by means of a monitoring cone, the latest and most efficient type of loud speaker, provided for the purpose. It is in this room also, that artists await their turn between appearances on the program.

Adjacent to the reception room is the broadcasting studio which is accessible through a sound-proof door on which a brilliantly illuminated "Stop" light appears during the broadcasting of a program. Both the reception room and studio are specially constructed to elimi-

(Continued on page 14)

St. Louis Schedules First Radio Show for October, 1925

Colin B. Kennedy Heads Association in Charge of Plans; National Manufacturers Are Enthusiastically Supporting Project

By Harry La Mertha

THE thing most needed in St. Louis for the good of the radio industry has come to pass. A trade association has been formed and it all came about through the efforts of one Tommy Convey of Chicago, organizer, promoter and successful producer of an "Atlantic City Board Walk" in St. Louis a few years ago.

Convey, flushed with two or three recent radio successes in other cities, like many others, had heard that St. Louis is a close dealing factor in the radio world. Undaunted by the outlook he decided to see if he could not awaken interest in a radio show, which he proposed to hold in this city in the fall.

Colin B. Kennedy, Harold Wrape and Harry Sachs, W. A. Ward and "Ajax" Cumming welcomed the opportunity with outstretched arms. Bob Bennett and Loren Wood, neighbors in the Syndicate Trust Building, held lengthy confabs and out of it all there has grown the young and lusty "St. Louis Radio Trades Association."

No sooner was it organized than a series of meetings were called, and now there looms up on the horizon all the prospects in the world for a radio show in St. Louis which will outrank anything ever before attempted and which bids fair to eclipse many other events of the sort held by trades organizations in St. Louis.

MISS ENA GREGORY

Elected "Baby Wampus Star" of Hollywood for 1925, Miss Gregory has just completed a tour of the middle west, making personal appearances before "movie" audiences. She has broadcasted her experiences over various radio stations, including WTAS, and is now back "on location" in Hollywood, under the direction of Maurice Tourneer

THE movement has progressed rapidly in the few weeks since the first meeting was called to discuss the radio situation. First, a radio show was decided upon and definitely announced to be held at the Coliseum the week of October 12, 1925. Space for sale in the Coliseum for exhibition purposes was taken immediately by nearly every jobber in the city.

Dozens of manufacturers throughout the country have wired intentions of taking part. The result is that in less than three weeks hardly any space remains to be sold, and the fact that substantial checks have been received from all of the proposed exhibitors leaves no doubt as to the success of the enterprise.

Colin B. Kennedy was elected president of the Trades Association after the gang looked around to find a popular and unbiased leader to head the organization.

KENNEDY, just before leaving St. Louis for a short business trip, explained the aims of the new organization as follows: "The St. Louis Radio Trades Association is organized not for profit but to function as an educational association for the betterment of the trade, for increasing the education of radio in St. Louis and the West and Southwest territory.

"We have planned many constructive activities in addition to the holding of an elaborate radio exhibition in October. We expect to furnish a clearing house of information that will be of value to all members of the radio trade and its associated industries and a protection to the public.

"By organization we hope to bring about better merchandising, closer co-operation, truth in advertising, better legislation, minimum freight rates, exchange of credit information, and we are going to safeguard our members against fake advertising schemes."

GOOD COILS

By
FELIX ANDERSON
Technical Editor

This authoritative discussion giving a host of information on a popular subject should be of great interest to our readers — It handles the subject of coils from not only a theoretical standpoint but from an experimental and practical one as well.

EARLY in 1924, radical changes took place in the field of inductance design in the radio profession. Previous to that time, it was customary to wind the coils of a receiver on any type of a form regardless of what the inherent efficiency of the finished product would be.

Early in December, 1923, several men, prominent in amatuer transmitting circles conducted tests with what was then the first "low-loss" devices, and as fortune would have it, discovered that the results were in accordance with their calculations. Low wave lengths required the careful attention to minor details, low powers necessitated apparatus that made use of every iota of energy. As research entered into still shorter wavelengths, it was discovered that the frequency became so high, that imperfect dielectrics and insulative materials within the fields of the coils became so hot as to charr, melt and even burn. The experiments furnished abundant proof that something was radically wrong with the way we were making our coils.

Measurements determined that losses via the moulded mud route, the imperfect dielectric route, by distributed capacity, and by coupled resistance were great indeed. Now every progressive set builder and experimenter knows that a coil must conform to the following requirements,

Figure 2. A space wound tuner of excellent design that sacrifices electrical efficiency wisely for greater mechanical strength

in order that it may be classed as an efficient inductance.

A Good Coil

First, a coil must have LOW distributed capacity. Signal energy must not be dissipated by the condenser action of the adjacent turns.

The field of the coil must not be spread over the entire set so as to couple resistance into the circuit. In other words, it must be wound in such a manner as to keep the field within reasonable limits.

The inherent ohmic resistance of the wire should be as low as possible, and eddy currents should not be existent due to the use of wire conductors that are too large.

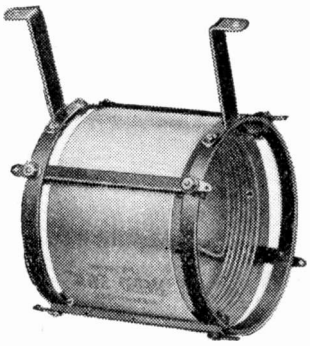


Figure 1. This coil is an excellent example of a manufactured inductance embodying a great many of the principles discussed in this article

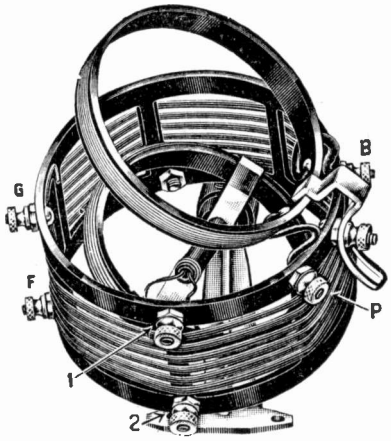


Figure 3. Adherence to the factors of efficient inductance is the outstanding feature of the coil illustrated above. It combines reasonable strength with low losses

A good coil should have a minimum of insulating dielectric within its field. In this connection, it is well to say that coils wound on solid forms, heavy tubing or coils that have elaborate mounting frames are not efficient.

The Lorenz Coil

The Lorenz or "low loss" coil found its origination as being closest to these specifications. Its physical construction is such that no turns are adjacent, hence lower distributed capacity is effected. In addition, it has little insulating material within its field, with a resultant of higher efficiency. The dangers involved in the use of a coil of this type are chiefly the great possibility of shorted turns due to the system of winding, and inability to standardize sizes, since each coil has its own little peculiarities.

Some manufacturers contend that pancake coils of various constructions are, and always have been vastly superior because of their adherence to the specifications comprising efficient coil design. Tests however prove that this is not entirely true. The only real comparative argument in favor of pancake coils lies in their compactness, measurements showing that with respect to restricted fields and distributed capacity, there are many coils of other mechanical character that exceed them.

When Coils Must Be Good

Before I go on with the specifications of coils that I believe are most advanced along the lines just mentioned, it would be logical to determine just when it is absolutely necessary to use coils of low loss construction. Stuart Ballantine, the eminent radio authority contends that the resistance of the input circuit should always be

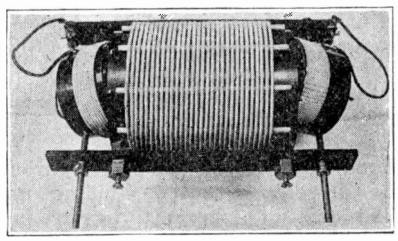


Figure 4. All the illustrations on this page are examples of the specifications for good coils as set down in the accompanying article. This is another example of what the factors set forth

low. As we approach an oscillating condition in regenerative receivers, this factor can be somewhat disregarded, since regeneration and oscillation has a tendency to cut down the input resistance. Nevertheless, whether the circuit is regenerative or not, it is of great importance that the secondary circuit be highly efficient—receptions of weak and unmeasurable signals will support this contention. Our receivers are not supposed to oscillate, and therefore we must make our tuning circuits efficient. It is of utmost importance that the input circuits of radio frequency receivers, especially in the neutrodyne classification, that the tuning circuits be as efficient as mechanical limitations will permit. Since no

regeneration exists in a properly balanced circuit, the inherent resistance of the circuit remains unchecked; the result is that many DX signals are dissipated by the resistance of the circuit, and are not relayed to the phones.

Good Home Made Coils

The nearest approach toward the ideal inductance of the low loss variety at the present time is probably the Westman-Mandley space wound cylindrical coil. Another is the Sanderson space wound cylindrical inductance, which from a standpoint of mechanical strength is possibly a little better.

The drawing in Figure 5 illustrates quite plainly the first type of inductance. The coil is not especially difficult to wind, but requires patience since the spacing and support is accomplished with knotted spring. The Westman-Mandley coil is wound on a form very similar to the type used for Lorenz winding. Quarter inch dowels or brass rods are driven into a hard wood base about an inch thick. These dowels should be quite firm, so that there will be no tendency for the rods or dowels to bend inwardly. The number of dowels is not important, being dependent upon the diameter of the coil. The object is to use enough of them to produce a circular coil, and yet not impair the business of knotting which is the basis of the entire inductance.

After the form has been made, the wire (preferably of a large size) should be hooked around one of the dowels, and the winding should proceed, the tension being just enough to make the coil firm, yet not so much that it will bend itself around the dowels. Proceed winding until the required number of turns have been wound. No definite figures are available as yet on the exact number of turns required for broadcast reception, but it is safe to assume that 50 turns of No. 18 DCC on a 3½ inch form will amply cover the band. The engineer's way is to wind too many turns, and then strip off turns until a 360 meter station comes in at about 40 on the dial of a 23 plate (0.0005 mfd) condenser. This method is the practical way to proportion coils.

A piece of chalk line about four times the length of the coil is then cut. Raise the bottom turn of the coil and slip the cord under, pulling an equal amount of cord each side of the turn. Then tie a simple half hitch knot with the two ends of the cord, reversing the positions of the ends. A second "half-hitch" knot is then tied, with the next turn of wire inside of the loop formed by the knot. The illustration shown at Figure 6 makes the method of tying thoroughly plain.

The process is continued until all of the turns are firmly secured in this fashion. It is a wise policy to use one of the dowels as a guide, and it is also important that all the knots be made with the same tension. Five or six such series of knots running the length of the coil will make it thoroughly firm and self supporting, and at the same time keep the amount of insulating material down to a minimum. The knots keep the wires at the proper spacing, and lower the distributed capacity of the inductance to a degree where it can be considered as non-existent.

To prevent absorption of moisture, the string should be thoroughly waxed or paraffined. Waxing makes the tying process of construction somewhat less difficult, the knots keeping their tension more readily. In this manner the coil conforms with the requirement regarding low insulating and R. F. losses.

The field of the coil is nearly as uniform as one wound on a tube form, and if it is properly dimensioned with respect to length and diameter, no trouble should be encountered with stray energy.

The frame is left up to the constructor, no doubt by this time you have several efficient low loss ideas in mind. Remember, however, that a good coil can be spoiled by a poor support, so keep it down to a minimum.

The Sanderson Coil

For those fans who would not spare trouble in the attainment of inductance perfection, the Sanderson coil, developed by Prof. J. C. Sanderson of the University of Minnesota, is entirely in order.

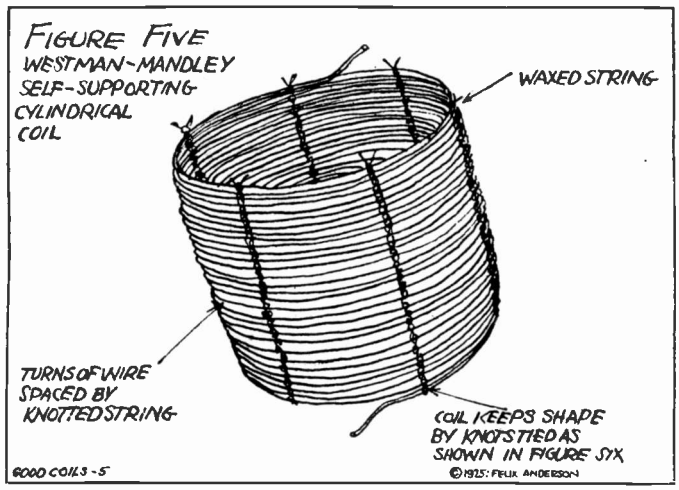
The initial ohmic resistance of the coil is kept low by the use of large wire, preferably No. 16 or No. 18 DCC, tests having demonstrated that these sizes are probably the most efficient for all around broadcast work.

The form upon which the coil is to be wound consists of a cardboard tube approximately the diameter of the finished inductance. Usually this is in the neighborhood of three or four inches. The tube is split into three longitudinal sections with a sharp knife, and gummed tape is then used to back up the cuts just described. This is done in order that the cardboard former may be removed when the coil is finished, without wrecking the finished product.

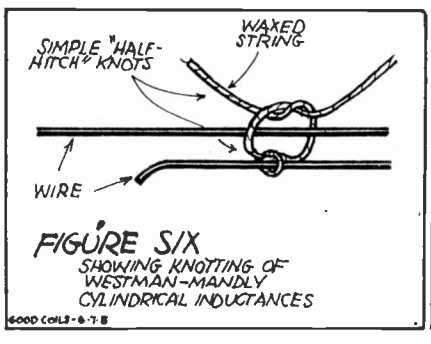
Celluloid Supports

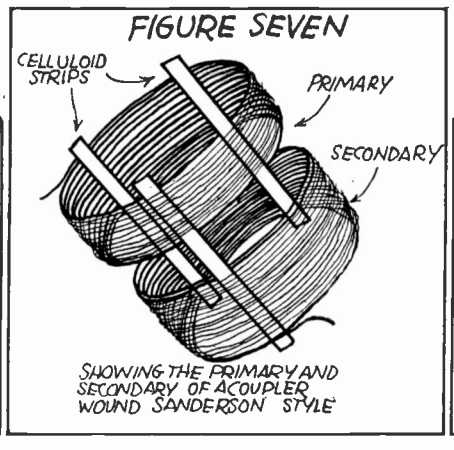
Three strips of celluloid about three-sixteenths of an inch wide are then laid on the outside of the cardboard tube, and the winding is started. In

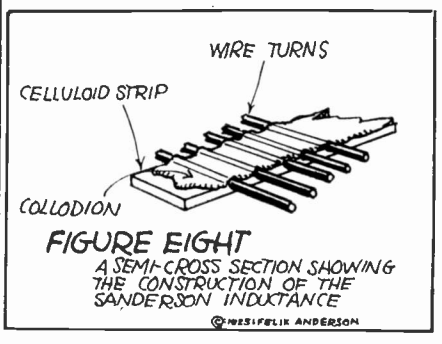
(Continued on page 29)

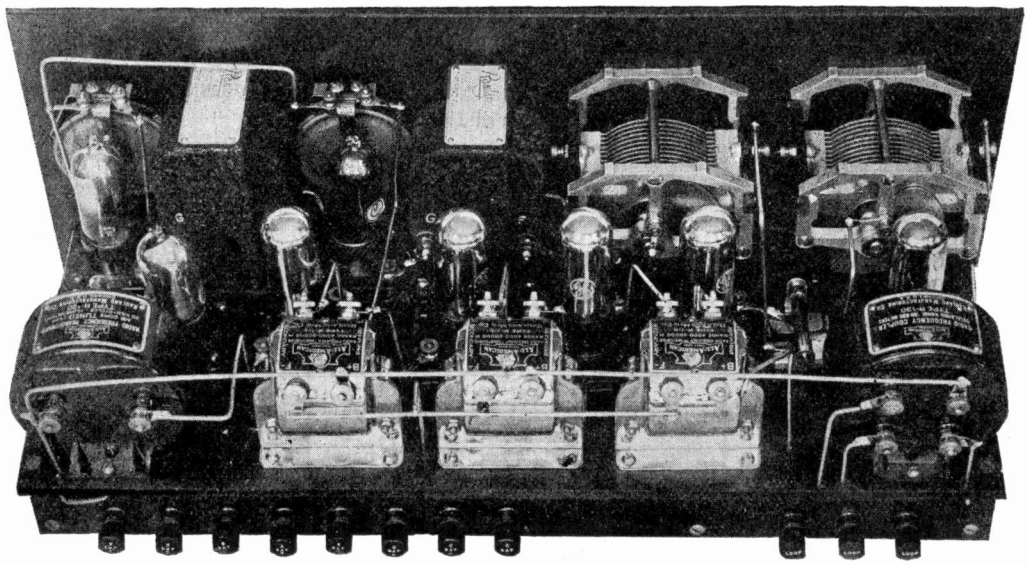


The cut above illustrates the construction of one of the low-loss inductances that is finding a place in the field of radio coils with increasing popularity. The device is very efficient. Below left shows how the knots are tied to effect the spaced winding of the coil just mentioned. The Westman-Mandley coil is wound on a former much like the basket weave inductance. Figure 7 shows the Sanderson coil, illustrating how coupling is effected, and Figure 8 gives an idea incidental to the mechanical construction









Here's How to Make a

SUMMER COTTAGE SUPER-HET

BY JOSEPH CALCATERRA

A Portable Super Built on a Small Panel that Gives Exceptional Results

CIRCUITS still come and go, but none as yet have appeared to challenge the supremacy of the Super-Heterodyne for long distance broadcast reception and extreme selectivity. It is doubtful whether very much in the way of improvement has ever been added to the original Super-Heterodyne circuit brought out by Major Armstrong. Very great improvement has been made, however, in the panel layouts of sets embodying this circuit, and especially in the construction of transformers and other instruments used.

For the benefit of those who are not familiar with the Super-Heterodyne principle, we will outline in this section the few fundamental facts which should be understood before attempting to build or operate a "Super."

Every experimenter who has built a radio frequency amplifier for radiocast wave lengths appreciates the strong tendency of vacuum tubes used for this purpose to go into self-oscillation, producing howls which immediately drown out the signals. Various methods of preventing this oscillation make up a large part of the new discoveries in radio circuits during the past year or two. In addition to the trouble from howling there is always the alternative of (1) the tuned transformers, introducing a control for each stage, or of (2) untuned coupling with its requirement of a broad tuned radio frequency transformer, and some unavoidable sacrifice of selectivity.

ALL OF these well-known difficulties in the practical application of radio frequency amplifiers are avoided entirely, and very great selectivity obtained, by the Super-Heterodyne circuit. In employing it, we no longer seek to amplify, at all, the oscillations of very high frequency which constitute the "carrier-wave" of radiocasting, but instead we immediately reduce all such high frequency waves to a pre-determined lower frequency, which is low enough so that the tendency to oscillate is no longer troublesome, and still high enough so that it is not audible to the ear. When once reduced to such a frequency, the signals can be amplified through as many stages as desired —each one much more effective, and decidedly more stable, than even the best stabilized short-wave stage.

The method by which radiocast waves of anywhere from 550 kilocycles up to 1,350 kilocycles or more are reduced to an intermediate frequency of from 30 to 50 kilocycles, is the fundamental idea of the Super-Heterodyne. It follows entirely from the fact that if two series of vibrations are presented at the same time, and their frequencies are nearly the same, another frequency is produced equal to the difference between the first two frequencies. The common example of this is in the tuning of a piano. If the two strings of one of the low notes on a piano—say the lowest "C," which should vibrate 32 times per second—are not exactly in tune with each other, one of them may perhaps be vibrating 33 times instead of 32. This will result in the production of a beat-frequency of one vibration per second; that is, the sound will be heard to grow louder and fainter once every second.

IN THE case of the Super-Heterodyne, the variable frequency is produced by an electron tube called the oscillator. Connected to a circuit which is tuned by a variable condenser, it generates continuous wave oscillations of any desired radio frequency over the range to be received. Then, if we are tuning in to a 1,000 kilocycle station, and are using an intermediate frequency of 30 kilocycles, it is only necessary to tune the oscillator to generate either 970 or 1,030 kilocycles, and if this oscillator circuit is then coupled into the tuner of our receiving set, the two frequencies together will combine to produce the desired 30 kilocycle wave. Then all we have to do is to introduce also into the

(*Turn to next page.*)

circuit the primary of a sharply tuned transformer, commonly known as a filter, and the secondary of the filter will send out a voltage which oscillates at the desired beat-frequency, these oscillations carrying, by the variations in their amplitude, the sound waves from the radiocast. This low-frequency carrier-wave is amplified through as many stages as may be desired, with little or no tendency to howl, and can then be rectified in a detector tube as usual and conducted to the loud speaker or audio amplifier, as an ordinary telephone current.

Selectivity and Tone

It should be remarked, however, that tone quality has been considered paramount throughout this design; while the selectivity noted is fully up to the best Super-Heterodyne practice, it is believed that the tone quality obtainable even with distant stations is a distinct advance. Two features contribute largely to this—the use of broad tuned transformers in the intermediate stages, and the use of the laboratory-grade audio transformers which have recently been placed on the market. In spite of this use of some rather high-priced parts, the entire set can be built at an expenditure for parts (not including tubes, batteries, etc.) of not exceeding seventy-five dollars.

Simplicity of control is another point which has been carefully worked out in this design. Besides the two familiar major controls there are only three minor ones. Yet the sensitiveness is not perceptibly less than that of any of the well-known complicated Supers; a loop antenna not more than 18 inches in diameter has brought in two-thousand-mile reception, even in warm weather.

The photograph shows the appearance respectively of the top and bottom of the set, and drawings are given which show the layouts respectively of the back of the panel, top and bottom of sub-panel and binding post panel.

Wiring Diagram Numbered

A wiring diagram is also given, on which the parts are identified by the same numbers used in the drawings. This circuit does not differ very much from the standard circuit; it has a special method of loop connection by which a certain amount of regeneration is introduced, under control of a small variable condenser (No. 6 in drawing). This sharpens the tuning to a marked degree.

All of the parts used in a Super-Heterodyne must, of course, be high grade in order to get the results one expects from the circuit. It is not necessary to use the laboratory-grade audio transformers shown in the pictures, but since these are larger than standard transformers, the latter can be mounted in the same space with no difficulty whatever. However, it is the writer's belief, founded on a wide experience with many radio sets, that since the audio transformers used have such a fundamental influence on the tone quality of the set and yet do not represent in any case a very large percentage of its cost, it is never wise to use anything but the best in the way of audio transformers.

Few Wires

It will be noticed in the photographs that there are very few wires visible from the top of the set, and this feature adds greatly to its appearance. The effect is obtained chiefly through the device of reversing some of the binding post screws on the sockets. All of these posts which are shown on the sub-panel by slotted screw heads instead of by knurled nuts are thus reversed, and the wires are attached below the sub-panel. In some cases other connections are made also on top of the sub-panel, a soldering lug being here inserted under the screw head for that purpose. The reversed terminal screws going through the sub-panel are sufficient to fasten the sockets to the panel without using additional screws for the purpose.

After all of the parts and binding posts are connected to the three panels, and the binding post panel is attached by metal brackets to the sub-panel, the greater part of the wiring can be completed to best advantage before attaching the front panel. It is best to begin with all of the wires which can be con-

(Continued on page 29)

LIST OF MATERIALS

No. of Pieces	Name of Items
1	Front Panel, Bakelite ...
1	Sub-Panel, Bakelite .....
1	Binding Post Panel, Bakelite
1	Cabinet for 7"x18" Panel, 7 or 8 inches deep.
2	Bremer-Tully, Type L (23-Plate), Variable Condensers .....
1	Carter, No. 30, Rheostat....
1	Carter, No. 6, Rheostat.....
1	Pair Benjamin, No. 8629, Self-Supporting Brackets.
1	Chelton, No. 850, Midget Variable Condenser .....
2	Dubilier, Type 656, By-pass Fixed Condensers
1	Brass Angle Bracket, each let 1 inch long; hole in each leg ¾ inch from the bend. Standard brass bracket obtainable at most radio or hardware stores
2	Carter, No. 101, Single Circuit Jacks .....
1	Carter Imp. Switch.....
1	Dubilier Fixed Condenser
2	Rauland-Lyric (All-American) Audio Transformers.
8	All-American or Pioneer Sockets for UV 119 or C 299 tubes .....
2	Dubilier Fixed Condensers with grid leak mounting clips .....
1	Daven 2-Megohm Grid Leak .....
1	Daven 5-Megohm Grid Leak .....
1	All-American Type R-130 Radio Frequency Coupler.
3	All-American Type R-110 Long Wave Radio Frequency Transformer .....
1	Type R-120, 10,000 Meter Tuned Radio Frequency Transformer .....
2	Univernier Dials, with Dial Plate having ¼-inch hole.
3	Eby Ensign Binding Posts with "Loop" marking....
2	Eby Ensign Binding Posts with "C" Battery marking.
6	Binding Posts, one of each of following markings: "C Batt."; "A Batt."; "A Batt." "B Batt."; "B. Batt. Det."; "B Amp.".....

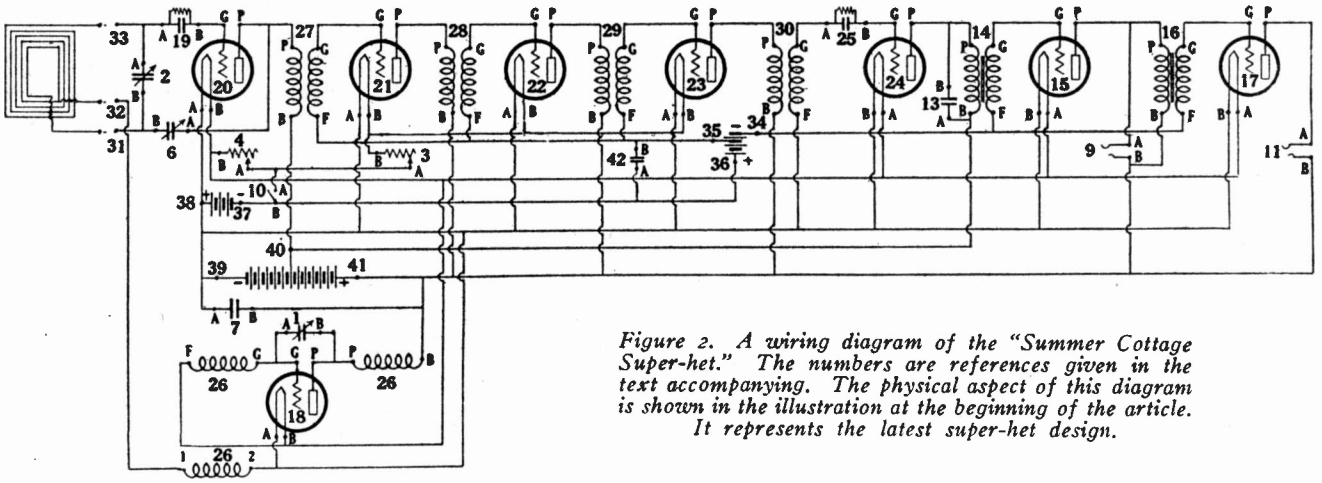
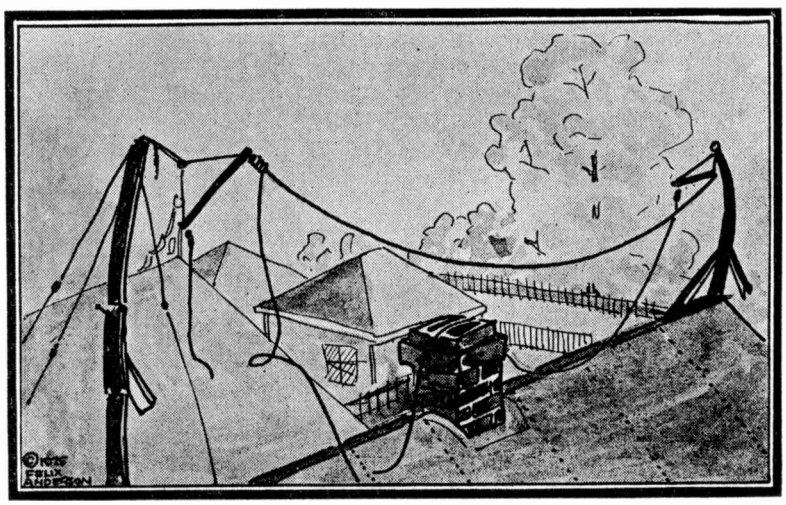


Figure 2. A wiring diagram of the "Summer Cottage Super-het." The numbers are references given in the text accompanying. The physical aspect of this diagram is shown in the illustration at the beginning of the article. It represents the latest super-het design.

Let's fix

That Thing on the ROOF

Does Your Aerial Look Like This ?



By Radio Operator 29744

Some last minute news on antenna construction

RADIO receiving outfits, no matter what circuit they use, require the use of some system or other for the interception of the electrical impulses which carry the programs we desire to hear. The arrangement employed may be in the form of an outdoor elevated wire, or it may be a series of turns wound on a frame, and called a loop.

In this article, I want to give the dimensions and factors that comprise the specifications of what is generally accepted as the ideal outdoor antenna.

In Figure 1, I am showing what is accepted in professional circles as the "model" or ideal receiving aerial for all-around broadcast reception. Reference to the illustration will reveal that a single wire is advised. The reason given for this recommendation is that a single wire of the correct length has sufficient capacity and inductance to provide for efficient reception of all of the present broadcast frequencies. In restricting the system to one wire, we also alleviate the nuisance of undue static interference and objectionable artificial interference.

The wire itself should be of a good grade of hard copper or phosphor bronze, having a reasonably high mechanical strength. Number 12 gauge is preferred, though nearly equal results are obtained with the No. 14 gauge. Copper is especially prone to corrode when exposed to weather, and does so with especial vigor in localities where the air is apt to be saturated with smoke and chemicals. Corrosion in antennas introduces objectionable resistance to the signals which are to traverse the length of the wire, and this resistance is highly detrimental to receptions from weak stations.

Protect the Wires

THE remedy is fortunately a simple one, consisting merely of protecting the wire with a coating of enamel or insulating varnish. Enameled wire can now be obtained in radio shops, and its use is highly recommended. In event that it cannot be obtained, give the system a light but thorough coating of non-conducting varnish covering all the exposed surfaces.

This advice may seem a little far fetched, but tests prove conclusively that the trouble is entirely justified, comparative results being a heavy argument in favor of protected antennas.

While we dwell on the subject of resistance, it is well to remind the constructor that all joints should be spliced in the approved manner, and thoroughly soldered. A better way is to run the wire from the free end of the system down to the point where it enters the house without a break. At the junction with the lead-in insulator, the wire should be fastened firmly and soldered. In event that a break in the wire is unavoidable, be sure to scrape the enamel away at the point of junction, since the electrical energy will not travel through the insulating material.

Length vs. Height

THERE has been much discussion relative to the subject of the proper height and length of the antenna system, with the final compromise that the greatest results are obtained with a short, low aerial. A system of this kind is less addicted toward collecting heavy charges of atmospheric electricity (static), and has inherently a reasonable degree of selectivity.

In any case, for the best results, the antenna should not be longer than 100 feet, overall length. This overall length *includes the flat top portion* or the part horizontal to the ground, and the *lead-in wire*. In this connection it is also well to remember that if the receiver is to be operated on the third or fourth floor of a building, the aerial may be made shorter without loss of efficiency since the ground lead will assist in the business of collecting signal strength as well as the regular aerial.

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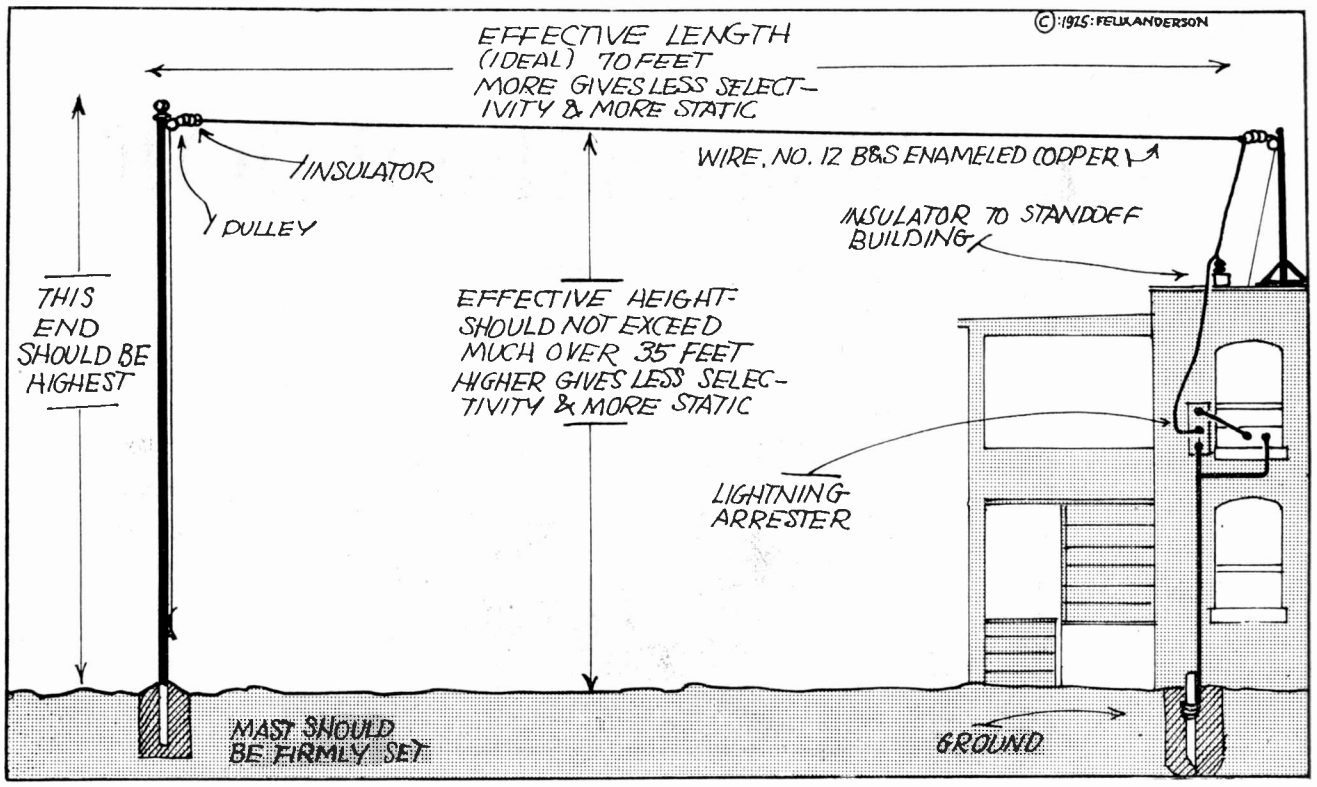


Figure 1. The cut above illustrates what is generally accepted as the ideal dimensions for the average broadcast antenna. Note that the system makes provision for lightning protection, a feature that must be observed

Aerials should be strung free and clear of trees, other antennas, power wires and other absorptive material, since they exercise a tremendous influence upon the effectiveness of an antenna. Never should the system be elevated over high-tension power lines, and it should always be at right angles to other current-carrying wires and antennas. This not only applies to the effective horizontal portion of the aerial, but to the lead-in as well.

Once inside the building the lead-in should be as short and direct as possible. Keep it clear of the walls by installing standoff insulators at frequent intervals, and never, if you want to get consistent results, never let the antenna lead touch absorptive materials.

This Article Fully Answers All Those Hard, Perplexing Aerial Problems

The insulators of the aerial should be of a good grade of pyrex or glazed porcelain, and should be taken down at least once a year and cleaned of grime. The lead-in tube should be of a good porcelain tubing (glazed) and should protrude at least five inches either side of the wall it penetrates.

The Insurance Underwriters specify the use of an approved lightning protector, and the installation of this instrument should not be neglected. A well insulated antenna has the property of accumulating heavy charges of atmospheric electricity which can do untold damage to the apparatus connected to it. If the system is not properly grounded when not in use, the accumulated charge may become of sufficient strength to discharge into some inflammable material with the result that fire may be started. This explains the real danger of lightning with respect toward radio reception. The actual danger does not lie immediately in the bolt striking the system, but in the vigorous charges which the aerial may store during the passage of an electrical storm. It is well to say that the danger exists in winter as well as summer, since I have witnessed many pyrotechnical displays of charges of static electricity in *midwinter* in Chicago.

Slant Is Important

VERY often local circumstances will require that an antenna have a decided tilt or slant to the horizontal wire, due to the fact that one of the two supports for the stretch is higher than the other. When this is unavoidable, remember that the free end of the antenna should always be the highest, the lead-in being at a lower elevation if possible. The reason for this is due to the action of the radio impulses traveling over the surface of the earth in setting up opposing currents in the wires, the voltage node being at the highest points of the system. If the lead-in end is highest, the efficiency will be lowered, due to this opposing current law.

The antenna supports themselves should be of good rigid construction, and so designed that they will stand considerable overload. Any average person with a knowledge of mechanical principles can devise a suitable support for the antenna system, provided he gives the matter a little thought. This phase of antenna erection is often badly neglected, and as a result, we have failures—usually at a time when the radio system means most to us.

Glance over the house tops as you travel through a district crowded with radioists. A hasty observation of the antennas they have erected will not afford a pleasing view. Haste makes waste, so make a good job of the supports.

Increase the life of your Tube by

TUBE REJUVENATION

By Paul Green*

PRIOR to March 1st, 1923, the filament construction of radio tubes was such that while they gave fairly efficient service as detectors and amplifiers, their normal life was comparatively short and they were easily burnt out.

The commercial release of the thoriated filament vacuum tubes entirely changed the situation. The 201-A, 301-A, UV-199 and C-299 types of tubes have the property of high electron emission and exceptionally long life. The filaments of these tubes possess a coating which results from the action of heat on the thorium in the wire, which brings it to the surface in the nature of a film. The tube is dependent for its proper operation on the condition of this thorium coating on the filament.

Why Tubes Go Bad

One of the chief advantages of these tubes is that a moderate excess of filament voltage does not burn them out but merely paralyzes them. The same effect is brought about gradually through normal use. In both cases the thorium on the surface of the filament has been exhausted. New thorium can, however, be brought to the surface by means of "rejuvenation."

Tube deterioration begins with the first instant's use, and within a comparatively short time a very noticeable "falling off" has taken place, which is made apparent by the radio set giving less volume and poorer quality. Most owners of sets make the mistake of thinking that because a tube is 100% efficient when it is taken from the dealer's shelf it will continue to deliver with the same efficiency until it is burned out. Long before this occurs most tubes cease to function properly and are said to be exhausted or "dead." The *burning life* of these tubes is, however, so great that they may be rejuvenated repeatedly, and as often as necessary to keep them at full efficiency and thus tend to increase the *effective life* of the tube equal to its burning life.

Symptoms of Falling Off

During the period of "falling off," the average radioist will usually turn his filament current to a higher value in an effort to force the tubes to perform as they should. This usually results in noisy, unsatisfactory reception, and but serves to hasten the further deterioration of the tube. From the foregoing it will be seen that a tube may be rendered inoperative either because of excessive filament voltage (paralyzation) or from continual use (exhaustion), and in a large majority of the cases a combination of the two phenomena.

Figure 1. This compact, inexpensive "Tube Rejuvenator" has just made its appearance on the market. It can be attached to the house current, and represents a means of keeping the tubes "pepped" up

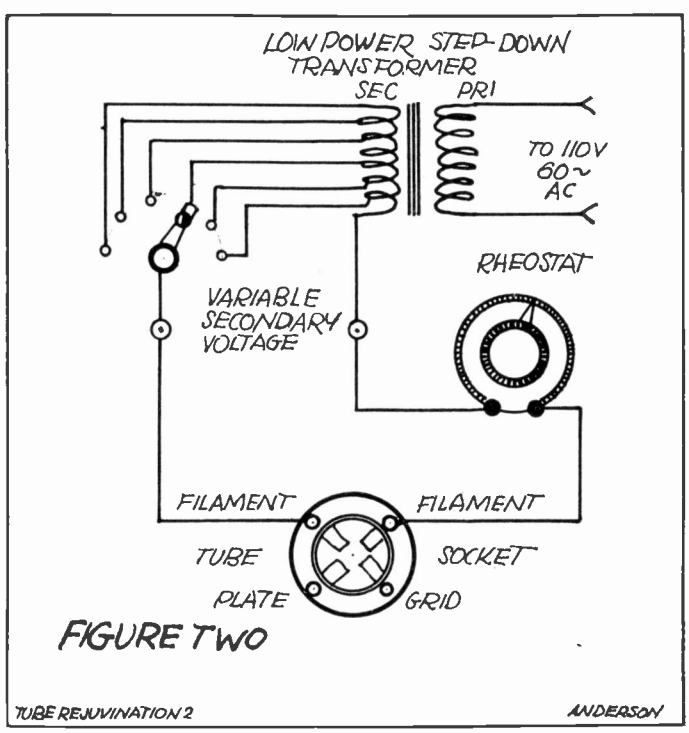


Figure 2. The engineer's diagram of the Tube Renewer, showing how the radioist can make his own "Rejuvenator" with a few inexpensive and easily acquired parts

THE process of rejuvenation or the process of "making the tubes come back to life" consists of burning the filament of the tube at a normal or sub-normal temperature, in order that the thorium in the filament wire may be brought to the surface for use in the relaying of the radio frequency currents between the filament and plate.

Thoriated filaments have this virtue —that of recuperating; and the "boiling" literally simmers this element to the surface for useful work.

The usual process consists of disconnecting the plate battery and burning the filaments without a plate potential. By this method the filament of the tube is heated to a red hot temperature, but there exists no strain on the thorium contained in its physical makeup, since the plate battery is not connected, and none of the thorium atoms depart from the filament to lodge on the plate of the tube.

The process continues for a period of around twenty to thirty minutes, depending upon the nature of the exhaustion and paralyzation, whereupon the plate battery is again connected, and the tube again functions at apparently normal efficiency.

A. C. Current More Effective

Tests prove, however, that the battery method, which utilizes direct current to promote this rejuvenation, is not as effective and complete as when alternating (house current) is used. Direct current supplied by the batteries, when used to renew the tubes does not, tests indicate, give the results that alternating current can furnish. In alternating current, the current and voltage reverses and drops from maximum to zero in most cases sixty times per second. Between each reversal and rise of potential, there is a period—a fraction of a second when there is no current and no voltage flowing through the circuit; it is this advantage that the A. C. method gives. Sixty times a second, the filament, when connected to an alternating current source, is heated to a red hot temperature, and as a distinct advantage it also has a slight opportunity to cool sixty times per second likewise. It appears that this pulsating nature of the current favors the rearrangement of the electrons of the filament, and produces at the end of the rejuvenating process a greater

* Jefferson Electric Co., 505 S. Green St., Chicago.

number of thorium atoms on the surface of the filament wire. This is exactly what we seek.

Simple Method to Use

ONE of the simplest methods to use in employing the house current to accomplish this "renewing" process of the tubes is to procure a small toy transformer with variable voltage taps on the secondary winding. Many of them are on the market that are excellently suited to the purpose. The other apparatus required is a socket to fit the tube you are going to "boil," and a rheostat having a resistance of about 30 ohms. There is at present on the market a carbon disk type of universal nature that fits all tubes. This apparatus is connected as is illustrated in Figure 1, and the plug is screwed into a light socket. The variable voltage lever on the transformer is set at the desired voltage for the tube used, which should be normal operating value, and the tube is inserted into the socket. *Care should be taken that the voltage is not above normal*—normal voltage is indicated on the box of the tube. Then turn the rheostat to a point where the current is somewhat below normal (from operating experience you can tell just about how bright the tube should burn) and let the tube burn this way for about 15 minutes. At the end of the fifteen minutes the tube should give nearly normal results if there is any hope for its renewal at all.

A "Tube Rejuvenator" suited exactly to the requirements outlined above has been marketed by a prominent transformer manufacturer, its design comprising the idea of use for the "fan" at home. This device illustrated in Figure 2, is well worth the attention of owners of multi-tube receivers, especially those who practice radio listening with economy.

It consists of a transformer with a variable voltage regulation device, which permits use with both the standard and peanut tubes. Sockets are provided for either the 201A, 301A or UV or C199 tubes, and the levers need merely to be set for the type of tube to be renewed. The unit is provided with a cord and plug for attachment to the house lighting mains. With such a unit, all that is necessary is to connect the device to the house main, set the voltage switch at the proper value, and then insert the tube into the socket. A watch is kept handy, and the tube is timed. Eleven minutes is usually sufficient to bring a tube back.

This renewing process can be repeated many times before the tube shows a drop in efficiency, provided it is intelligently done. In tests made for the purpose of determining the effective length of the life of radio tubes, rejuvenation has been repeated as high as *sixty or seventy* times without the tube showing any marked drop in effectiveness. The curves shown

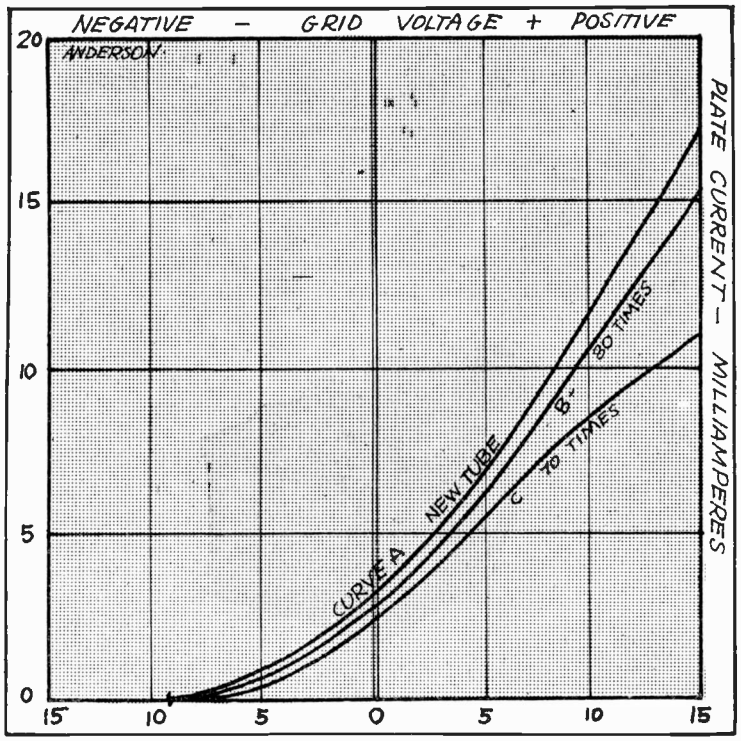


Figure 3. The above curves of a standard vacuum tube which had been rejuvenated 70 times, serves to indicate that exceptionally long operating life is attainable when the tube is renewed at regular intervals

in Figure 3 give an idea of what the practical value of such "renewing" is. Curve A represents the normal efficiency of a new tube. Curve B was taken after the tube had been rejuvenated *thirty* times, with a loss of only 12% in efficiency. Under the direct current method this value would have been considerably lower. The real test is shown in the third Curve C, which shows the tube 84% efficient after being renewed *seventy* times—you can well guess that the time elapsed between the 70 renewals must have been considerable.

PAUL GREEN
Tells How To Renew Your Tubes

"Dud" Tubes Cause Troubles

After a set of radio tubes have been giving service all winter, they are in no position to properly detect and amplify the weaker signals of summertime. Rejuvenation of such tubes will tend to greatly improve summer radio reception and make it possible for everyone to enjoy the splendid summer programs.

Multi-tube sets, notably superheterodynes, radio frequency receivers and neutrodynes are so largely dependent upon maintenance of tube characteristics for satisfactory reception that periodic renewal is an imperative necessity. Neglect of this will mean that the set will gradually become lower in efficiency, presenting new and baffling ailments.

One weak tube in a circuit that uses several tubes on a universal rheostat control, will keep the entire set of tubes from functioning properly—because of the excessive potentials applied to the normal tubes in an effort to get the best out of the weaker one. The tube manufacturers explicitly specify that greatest results are obtained only when the values of current specified by them are maintained.

American Radio Products Lead in Foreign Markets

THE world leadership the United States has won in so many fields, particularly those which require electrical and mechanical genius, supported by large production made possible by ample capital, is being demonstrated again in the radio field, according to Edward H. Jewett, and widely known in industrial circles.

Until now American manufacturers have had all they could do to meet the demands of the domestic market. The rapid growth of the radio production structure, however, has made it possible to give a look abroad. According to Mr. Jewett, the same measure of superiority that so many American manufacturers hold all over the world is being attained by American-made apparatus.

"The volume of radio exports will reach a very fair figure this year," he said. "By 1926 they will be very large, indeed. While radio audiences in countries outside the United States are not as large as they are here, they are growing tremendously and as they grow they are appreciating more and more the value of the leaders among radio sets and parts and horns in this country.

"Most of the foreign countries have had rigid barriers against the importation of our radio products. These barriers are succumbing before the popular demand.

"If the United States holds to its present trend of preferring quality apparatus, thus ensuring a high standard, there is no reason why we should not dominate the radio trade of the entire world."

The Improved Deresnadyne Circuit

Part 2—Parts Required and Panel Layout

By Harry J. Marx

(*Continued from our last issue*)

IN BUILDING the set, the first point of importance, after the circuit is understood, is the selection of the parts required. It is useless to take particular pains in getting the best of some parts and then neglecting the rest by buying the first thing that is offered. Low-loss variable condensers have been discussed to such an extent that the average fan has almost become fanatical on the subject. How many are taking the same pains in purchasing their audio frequency transformers? Don't buy the maximum ratio type, unless you are willing to accept distortion as a price for volume. Low ratios will always give you good quality amplification.

A little shielding between the variable condensers and the panel will do lots of good, so don't leave it out because it adds a little more work. Have you ever stopped to consider how many manufactured sets use shielding? The manufacturer wouldn't put it in if it wasn't worth while.

In buying fixed condensers, get good ones. Cheap condensers rarely are accurate in capacity value. If you were buying a tire for an automobile, would you buy one from a firm who guessed at the size and then let you try it out to see if it would fit the wheel? By-pass condensers must pass a specific current; changing the capacity may limit the functions they are intended for. In buying tube sockets, get the kind where the springs make good positive contact with the prongs on the base of the tubes. Poor contact between spring and prong, especially in the two radio frequency stages will make more trouble than can be imagined.

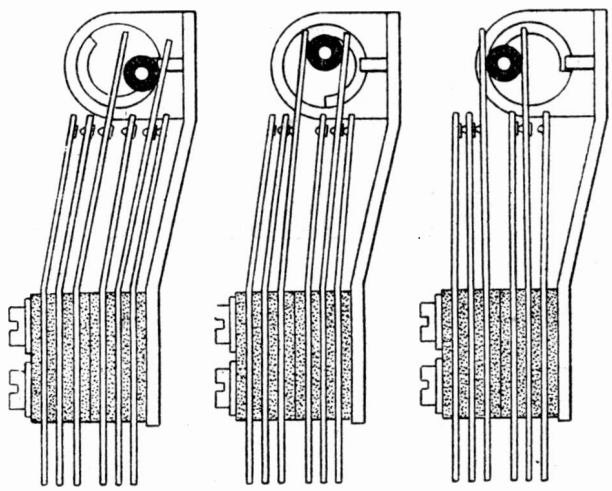
THE special resistance, variable from zero to 200,000 ohms, must be of the non-inductive type. A wire-wound type if possible to this high value would not only be impractical but would have an inductance value that would affect tuning. The special switch not only acts as a battery switch, but also connects the loud speaker for one or two stages of audio frequency amplification as desired. If desired the regular jack system and a battery switch can be substituted. No provision is made for plugging in headphones as they are unnecessary, all tuning in can be done with the loud speaker.

List of Parts

1—Panel, $\frac{3}{16}$ x 7 x 26.
1—Battery post strip, $\frac{3}{16}$ x 1¼ x 8.
1—Ant. and gnd. post strip, $\frac{3}{16}$ x 1¼ x 2½.
1—Selector jack strip, $\frac{3}{16}$ x 1¼ x 2¾.
1—Baseboard, ½ x 9 x 25¾.
3—Pcs. metal shielding, $\frac{1}{32}$ x 3¼ x 5¾.
12—Metal spacer tubes, ⅛ I.D. x ¼ O.D. x 1¾.
6—Midget jacks, J-1, 2, 3, 4.
2—Midget plugs, P-1, 2.
9—Binding posts.
1—Set 3 Andrews paddlewheel inductances, L-1, 2, 3.
3—Variable condensers .00025 mfd., C-1, 2, 3.
5—Standard tube sockets, V-1, 2, 3, 4, 5.
1—Grid condenser with clips .00025 mfd., C-4.
2—Fixed condensers .5 mfd., C-5, 6.
1—Fixed condenser .001 mfd., C-7.
1—Rheostat 6 ohm, R-1.
1—Variable resistance 0 to 200,000 ohms, R-2.
1—Fixed grid leak 5 megohms, R-3.
1—Stage control switch, SP. SW.
2—Audio frequency transformers, low ratio, AT-1, 2.
3—Dials, 4 inch.
1—Cabinet, to fit.
Miscellaneous wire, terminals, screws, etc.

The Stage Control Switch

THE stage control switch presents some interesting features. The illustrations, figures 3, 4 and 5, show the OFF, SOFT and LOUD positions.



OFF FIG. 3 SOFT FIG. 4 LOUD FIG. 5

PART 2

In the OFF position, the A battery connection is open. In turning the knob to the SOFT position the A battery connection is closed and the loud speaker is connected to the plate of tube V-4. When the knob is turned to the LOUD position, the plate of tube V-4 is connected to the plate terminal of audio transformer AT-2 and the loud speaker is already in the plate circuit of tube V-5. In the SOFT position one stage of audio amplification is used, while the LOUD covers both stages. The Andrews Radio Co. is now placing on the market a kit of parts for this Deresnadyne set.

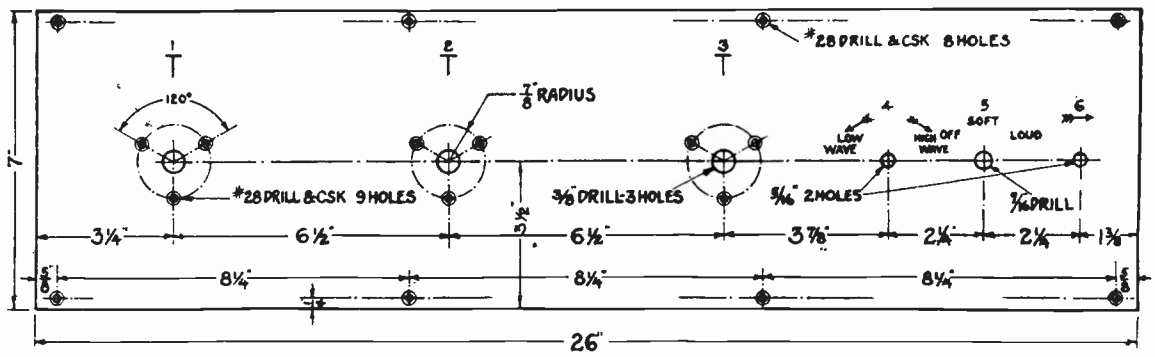


FIGURE 6
PART 2

The Panel Lay-out

The use of a seven by twenty-six inch panel permits satisfactory spacing of the three variable condensers and the paddlewheel coils so as to avoid coupling in the radio frequency stages. Trying to save a few inches of panel stock and crowding the apparatus close together will soon convince the constructor of his foolishness when he starts operating the set. Compactness may be desirable but not at a sacrifice of quality and efficiency.

All told there are only six units that mount on the panel. The three variable condensers are kept to the left as shown in figure 6. The next knob is the variable resistance, then comes the stage control switch and last the rheostat, which controls the lighting of all five tubes.

Plate Balance Control

LITTLE has been said about the variable resistance called the plate balance control. In order to secure maximum efficiency at high wave-lengths, the paddlewheel inductances have their primary turns so proportioned as to give maximum amplification without oscillation. A variable resistance is connected in series between the plate coils and the B battery terminal to prevent oscillation at the lower wave-lengths. Across this connection to the negative filament terminal is a by-pass condenser. This condenser closes the plate circuit to the filament of the tube. The voltage of the B battery determines the energy in the plate circuit. This by-pass condenser prevents any radio frequency currents from flowing through the resistance —*hence the resistance does not broaden the tuning.*

This variable resistance provides a means of reducing this voltage and thus the plate circuit energy. At high wave-lengths, with the knob turned to the right the deresonance of the plate coil stabilizes the circuit. When turned to the right the resistance is zero. As the tuning approaches the lower wave-lengths, and gets closer to the natural resonance point of the plate circuit the set approaches the oscillation point. Now, by turning the knob to the left, resistance is inserted between the plate and the battery, thus lowering not only the voltage, but also the plate energy and thus preventing self oscillation. By keeping just below this oscillating point, the maximum radio frequency relay amplification is obtained with wonderful clarity of tone. It likewise acts as a volume control.

The Inside Story of Station WOC

(Continued from page 3)

nate street noises and to prevent overtones and echoes which might interfere with the quality of any program being produced in either room; for this purpose both rooms are provided with heavy tapestries hung around the entire room and even one's steps are hushed by a deep pile carpet on the floor.

IN A SMALLER room at one end of the broadcasting studio is the first real evidence of the massive equipment which comprises the broadcasting mechanism. This room is provided for the announcer, and for apparatus which controls the various microphones located in the studio. The method of control at this point has undergone extensive changes and improvements over the methods used in the earlier days of broadcasting. The announcer is separated from the studio by a partition so constructed as to prevent the passage of any sound. He may, however, observe everything that takes place in the studio through a series of glass windows. During the broadcasting the announcer has under his control the group of microphones in the studio and these are so placed in that room at the beginning of the program that he is able to handle, by means of convenient controls, almost any situation which may arise in the studio at any time. A by-product of the transition to this more adequate means of studio control is an arrangement whereby the announcer may speak to either the reception room or studio at will without his voice being heard on the air; likewise the operators, two rooms distant, who handle the control of volume and other parts of the apparatus so necessary to the proper performance of any station, are able to keep in constant touch with the studio and the announcer, through the extensive monitoring system which has been worked out.

A new idea has been made use of in the operation of the studio itself. Here advantage has been taken of the well-known psychological effect which lighting has upon the artist, particularly those accustomed to public appearances; for example, the commonplace use of footlights on the stage when the artists appear for their performance. This idea has been adapted to the broadcasting studio at WOC and is accomplished by means of dual room lighting. The ordinary system of indirect lighting in both the studio and announcing booth have been supplemented by a group of direct lamps which are illuminated only when the microphones in that particular room are actually connected to the transmitter. The

(Continued on page 18)

WOC *Who's Who "Where The Tall Corn Grows"* WOC

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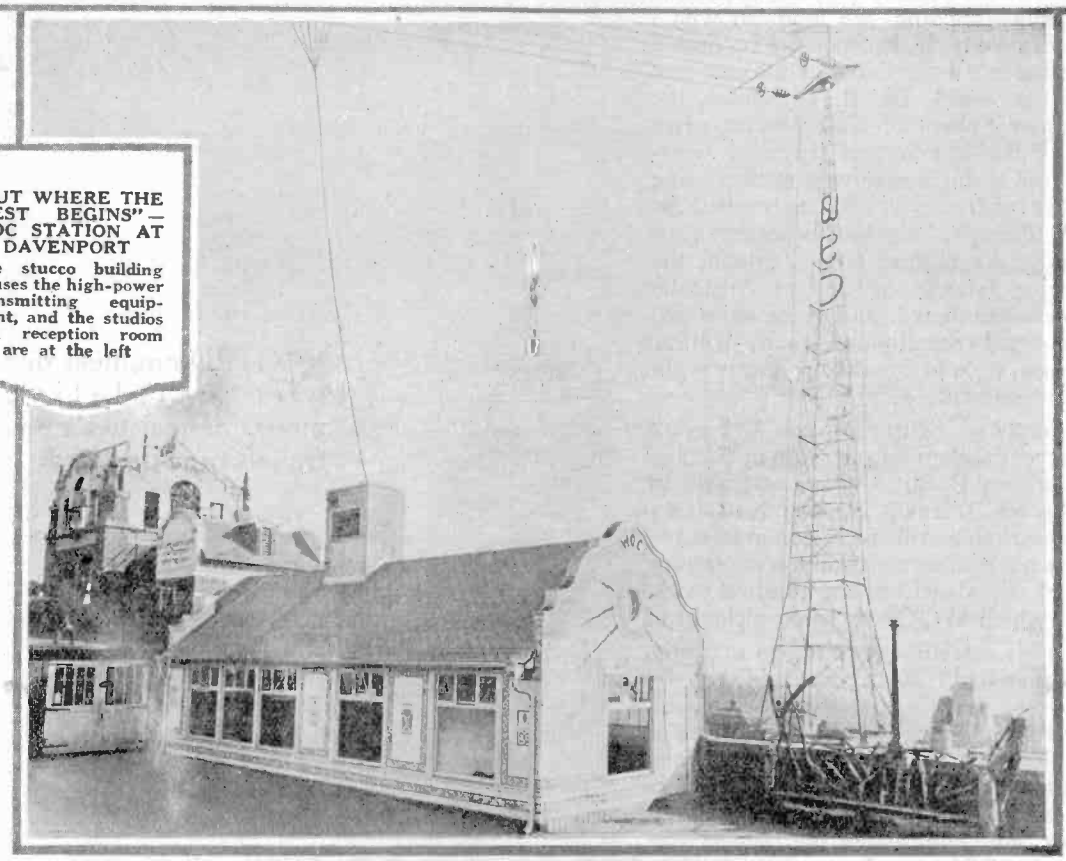

"OUT WHERE THE WEST BEGINS"—WOC STATION AT DAVENPORT
The stucco building houses the high-power transmitting equipment, and the studios and reception room are at the left

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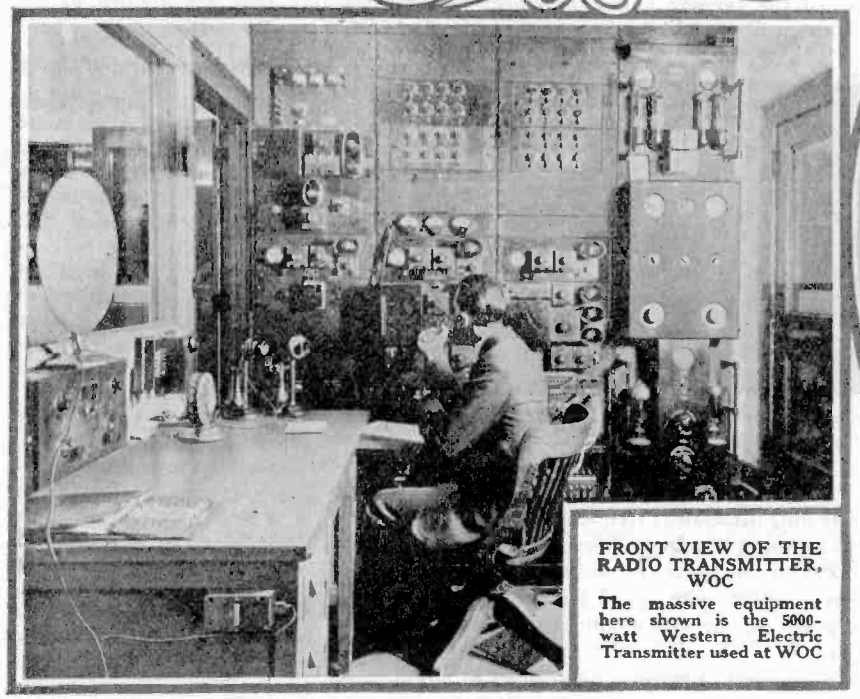
"This is WOC, the Palmer School Station, Davenport, Iowa." "Announcer B. W. S." is here seen in the studio control booth



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The massive equipment here shown is the 5000-watt Western Electric Transmitter used at WOC

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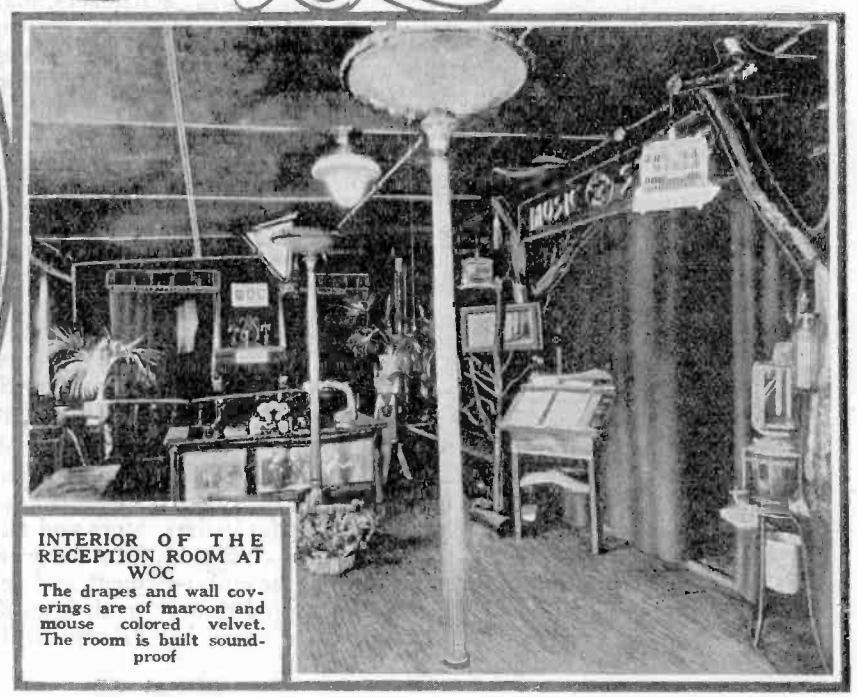
"Aunt Jane" has radiated her personality into the lives of thousands

B. J. PALMER, OWNER AND ANNOUNCER, WOC
Like other station owners, notably "The Boss" of WTAS, he is on the "mike" at intervals

ERWIN SWINDELL
Musical director and pianist of wide repute, to whose efforts are due the well balanced musical programs for which this station is noted



INTERIOR OF THE RECEPTION ROOM AT WOC
The drapes and wall coverings are of maroon and mouse colored velvet. The room is built sound-proof

The Inside Story of Station WOC

(Continued from page 14)

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Here at WOC is a fortune in dials, plates and coils, panels, transformers, and amplifiers, batteries, motors and generators, all assembled with a large staff of operators and technicians who manipulate them—frequently into the wee, small hours—in order to give entertainment and instruction to the world and his wife. The truth is evident in a telegram once received at WOC, "Broadcasting is the symbol of unselfishness."

ALL Tones Equally Accentuated with

RESISTANCE COUPLED AMPLIFICATION

NOTED engineer discusses relative merits of resistance vs. transformer method.

By McMurdo Silver
Assoc. I. R. E.

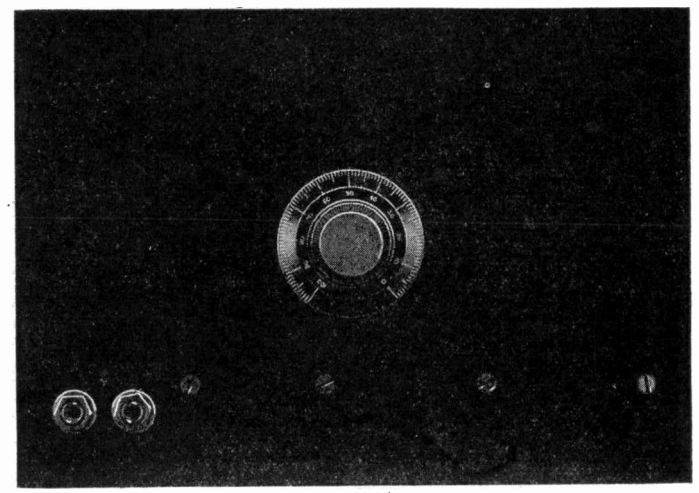

Figure 1. A front panel view of the resistance coupled amplifier as described in the accompanying text. This amplifier is the least noisy of any type yet devised.

WHEN radio first came into popularity, the influence of the telegraphing amateur was most strongly in evidence in audio amplifiers. Amateurs desired, not quality of reproduction, but high amplification per stage. In fact, the ideal audio amplifier for telegraph reception would be one that would accentuate to the greatest possible extent only the particular frequencies used for modulating the transmitting wave.

Because of these requirements, practically nothing but transformer coupled audio amplifiers were in use, the transformers themselves generally having a step-up ratio of six to one or ten to one. Their design was such that they amplified best at some hump in their curve. Then, as broadcasting came in, requirements changed, and the desirable amplifier for this class of reception was one that would amplify uniformly all frequencies from sixty to six thousand cycles.

Transformer design was improved, with a general tendency among manufacturers and designers to reduce the step-up ratios used. This resulted in the present day transformers which amplify with very good uniformity all frequencies between two hundred and six thousand cycles. But even in the best of audio transformers, there is a very decided drop in amplification below two hundred cycles, which becomes greater as the frequency decreases. At sixty cycles, the amplification of the average audio transformer is practically negligible, as compared to its amplification at frequencies above two or three hundred cycles.

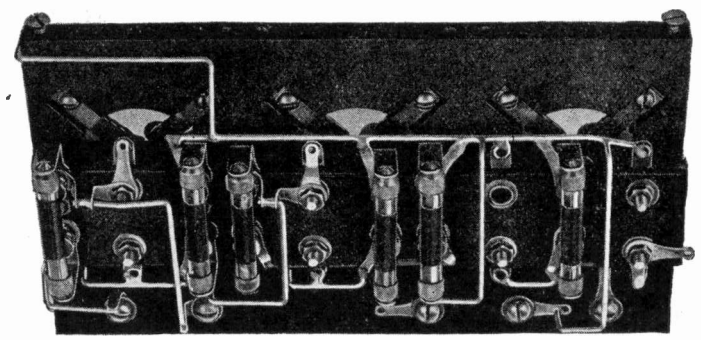

Figure 2. A rear bottom view of the amplifier apparatus bracket, showing how the sockets overlap the bakelite shelf. This method is used to shorten connections

Due to the inherent characteristics of resistances, when used for coupling purposes in an audio amplifier, substantially no discrimination takes place in favor of one range of frequencies at the expense of another range, as in a transformer coupled amplifier. Transformers cannot be built to give absolutely uniform amplification due to the resonance characteristics of the windings that must be used, and this is the reason why practically all of the finest broadcasting stations used resistance coupled amplifiers to amplify their programs before they are applied to the actual transmitter itself.

Comparative Amplification

In actual practice two stages of transformer audio amplification are about all that can be used, due to the building up of noise in the system; and the fact that such an amplifier in conjunction with a good receiver will give plenty of volume for loud-speaker operation. However, three stages of resistance coupled amplification will be required to give the same or slightly greater volume, since the voltage amplification is lower than in a transformer coupled amplifier. This will be appreciated when it is realized that one transformer and one tube will give a voltage gain of about 18. When the second stage is added, using exactly the same equipment, this figure falls off due to certain inherent characteristics of such systems. Therefore we can allow a gain of 18 in the first stage

(Continued on page 26)

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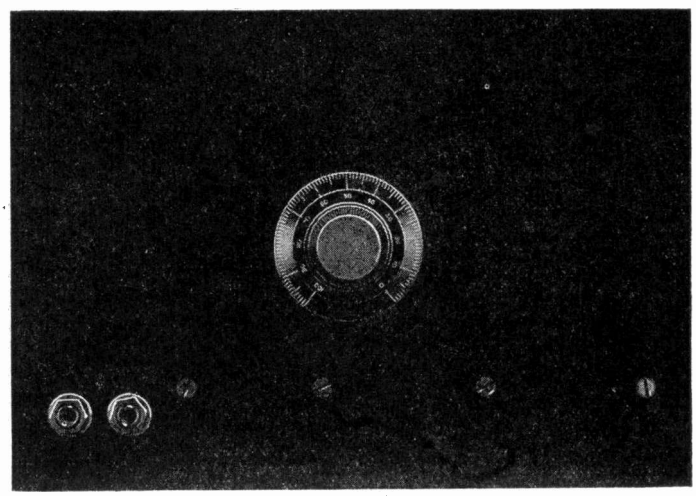

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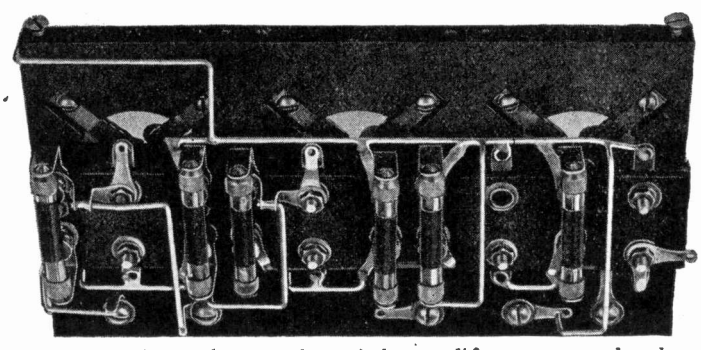

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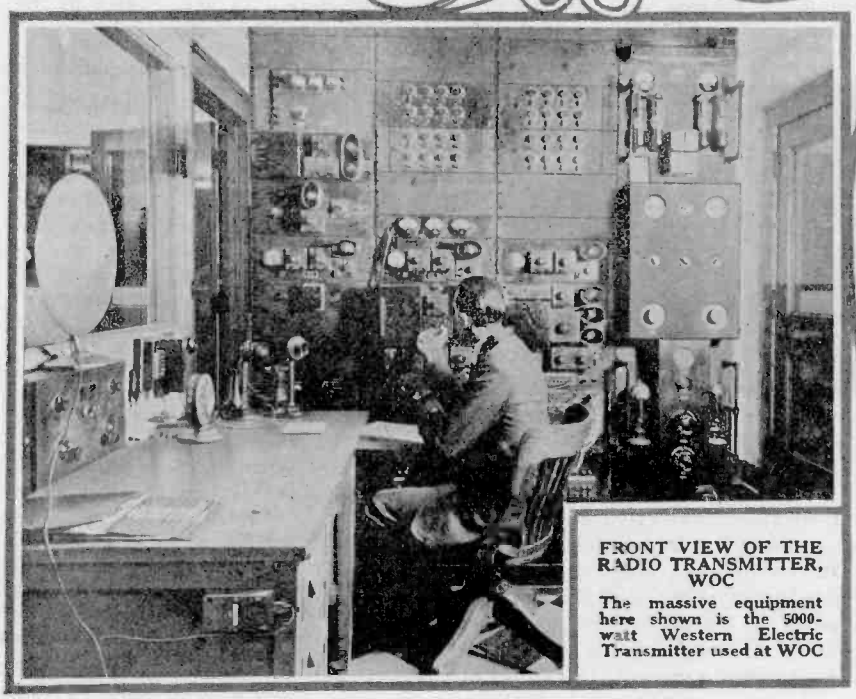

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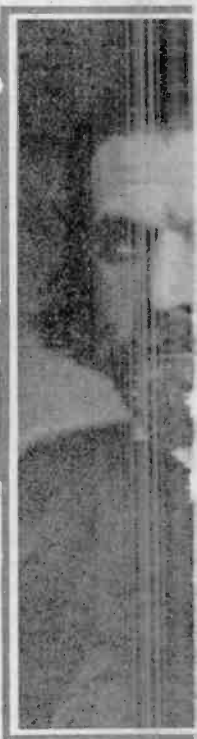

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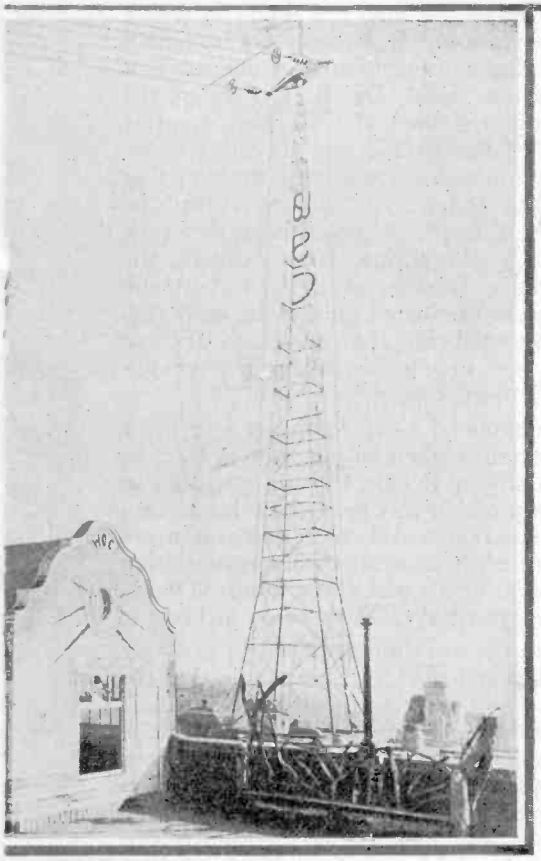

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The Technical Editor to the Broadcast Listener

H. S.—I have a five-tube neutrodyne receiver and wish to ask whether a change in "B" battery voltage makes it necessary to rebalance the set. Also, please tell me what plate current is consumed by a UV-201A tube when operating at 50 and 100 volts, respectively?

Answer—A change in "B" battery voltage does not affect the balance of a neutrodyne receiver. A UV-201A tube consumes 1.7 milliamperes at 50 volts, 7.5 milliamperes at 100 volts.

W. B.—Will you kindly tell me, if you can, how I can make my three-circuit regenerative receiver more selective? The set is made up of the following parts: One 23 plate series aerial condenser, one variocoupler, one 23 plate secondary condenser and a plate variometer.

Answer—The only practical way to increase the selectivity of any receiver, aside from placing a wave trap in series with the aerial, which in reality does not increase the selectivity, is to increase the efficiency of the parts used in the set. In other words, if the parts of your set are not the best obtainable, the selectivity of your receiver may be increased by substituting better parts.

Y. G. O.—What is meant by inductive coupling?

Answer—Inductive coupling is a term applied to the coupling of two circuits or currents by means of induction. The most concrete example of this type of coupling is the variocoupler with its primary and secondary.

M. R.—At present a WD11 is being used in my two-circuit receiving set and the filament flickers. Is it possible that this is a defective tube?

Answer—In all probability the reason the filament flickers is due to a poor rheostat, which is not making good contact being used. A filament wire may also be loose in the base of the tube.

W. A. F.—Is it possible to build a transformer with a ratio of 20 to 1 for DC current? The transformer is to be used for supplying the plate voltage to a regenerative receiver.

Answer—It is impossible to build a transformer for use on a DC current circuit due to the fact that DC current does not alternate and thus there would be no flux to induce a current in the secondary of the transformer.

ON THE AIR QUESTION BOX

ON THE AIR will gladly answer all questions pertaining to your radio difficulties. Those questions which hold the most general interest will be published on this page. If you wish your questions answered personally, send a self-addressed stamped envelope and our technical experts will be glad to analyze your difficulties and send you a solution. Address your communications to "Questions," On The Air, Kimball Hall, Chicago.

C. L.—How many broadcasting stations are located in Zion, Ill., and what are their call letters?

Answer—At present we know of only one station in that city, namely WCBD.

F. B.—Is it possible to construct a "B" battery from flashlight cells?

Answer—Yes. They may be constructed by breaking the batteries in separate cells and connecting them all in series. There will be approximately one and a half volts to the cell.

V. D.—It has been noticed that in some radio receivers the rheostat is connected in the negative lead of the "A" battery and in others in the positive lead. Which is correct?

Answer—The filament rheostat is connected in the negative lead of the "A" battery. This is done in most every radio receiver now available to the radio public.

J. W.—I have a three-circuit tuner, condenser across the secondary cell, which does not respond to station on wave lengths above 500 meters. Can this set be loaded? If so, how?

Answer—If a small inductance coil of about fifteen turns is fastened to one side of the plate variometer and connected as shown in the accompanying diagram the set will respond to the higher wave stations. The switch shown to short circuit this additional inductance coil must be installed according to the diagram so that the short wave stations can be tuned in by cutting this coil out of the circuit.

B. L.—Does the thickness of the wire used in an inductance coil have any effect on the inductance of the coil, provided the number of turns is kept constant?

Answer—For the same style coil, if when smaller gauge wire is used, the turns are wound so that they touch one another the inductance of the coil will be increased, since the number of turns per unit length is increased and the inductance varies with the square of this number. But if the smaller wire is used and the turns spaced, so that the coils have the same length, the inductance of the coil will be the same as with the larger wire; the only effect will be an increase in the resistance of the coil.

W. J. R.—I have been using a 120-foot inverted "L" type antenna, and now find it necessary, on account of moving to a new residence, to use a "T" type antenna. What length should the "T" aerial be to give results equal to those obtained with the former antenna?

Answer—The "T" type antenna, with a flat top length of about 120 feet, should prove very satisfactory. One advantage that this type of antenna has over the inverted "L" type is that it is less directional, and therefore with your new antenna of approximately the same length as the old one you will probably receive more stations than before.

J. T., Jr.—There are a few points I would like to have cleared up about a counterpoise when used in connection with a radio receiving set. First, the relative distance between the aerial and counterpoise and the counterpoise and ground; the width of the counterpoise and aerial and length of each; the importance of the exact centering of the counterpoise under the aerial, and last, should the signals be appreciably reduced in strength?

Answer—For receiving purposes the distance between the aerial and counterpoise should be at least thirty feet, and more if possible. There is no specific law governing the height of the counterpoise from the ground, and equally as good results are obtained from about one foot to about twelve feet in most cases. The usual height is about eight feet, however. The width should be as great as possible and the counterpoise contain about twice as many wires as are in the aerial. The counterpoise need not be centered directly under the antenna, the main idea being to have a capacity between the counterpoise and the ground. The usual location for a counterpoise, however, is under the aerial.

COLEMAN GOETZ

Coleman is the new announcer for "Willie TAS," the Villa Olivia Broadcasting Station, Elgin, Ill. He assumed his new duties a month ago, when "Willie, Tommy, Annie and Sammie" were broadcasting from the Blackstone Theater, Chicago, and has become one of the most popular announcers in the middle west. Mr. Goetz is on the air every night from Kimball Hall, Chicago, the remote control studios of the Elgin station.

Who's Who in Ladies' Radio

Miss Laura Rygel is the official stenographer of the WBCN staff. She writes the artists' letters to the fans and handles their business correspondence, besides having charge of a great deal of the secretarial work of the station.

Miss Grace Cassidy is secretary of WLS. She has her headquarters out at the offices of the Sears-Roebuck Agricultural Foundation, Arthington and Homan avenues. In addition to her duties as secretary, she is "paymaster" of the station. During the recent campaign to raise funds for the tornado relief she did all the work of checking up on the $207,000 sent in to WLS.

Miss Martha Meier is an assistant to Mrs. Grace Viall Gray, director of the Homemakers' Hour of WLS. She books all the entertainment used by Mrs. Gray. She also is a clever pianist and appears on the programs.

A true Canadian, Miss Ruth Jarvis, adds her pleasant personality and manners to the WBCN environment each night from the telephone switchboard.

Short-Wave Sets in Demand in South Africa

Radio dealers in South Africa have cabled to America for 500 short-wave receivers that will be able to tune in on stations which broadcast regularly on short waves. South African fans have been hearing these stations often.

Radio Drama at KGO Yields Playwright

From the radio drama to a successful playwright, producing on Broadway, New York, is the story of Dan Totheroh, former star of the KGO radio players, known to millions by the sound of his voice, whose play, "Wild Birds," is now running in Cherry Lane Playhouse, New York City.

The Allen-Bradley Company announces the removal of its Chicago office from their old quarters in the Cable Bldg., to Room 912 Great Northern Bldg., 20 West Jackson Blvd. The old phone number Harrison 8090 is retained.

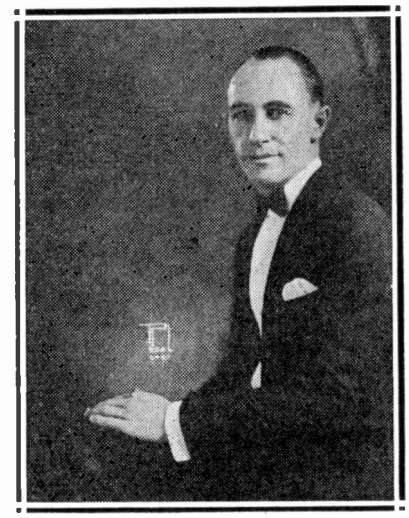
Helps Select Artists

A very big share of the work of getting together the Congress Hotel classical programs each Saturday night, and which are broadcast by Westinghouse station KYW, falls upon Miss Betsy Brown, assistant to Mr. Richmond Harris, who personally supervises the talent his company provides. She is a talented pianist. During 1924 and thus far in 1925 she has given short talks on "Music and the Welte-Mignon."

Miss Ethel Alexander is the secretary of the Hotel Sherman studio of WLS, the Sears-Roebuck station. She takes care of all the correspondence which comes to the station and has to answer thousands of questions of visitors. She is a sort of general "reception committee."

In Catherine A. Gustavus, WBCN has a "chancellor of the exchequer," who has a record of eleven years' service with the owners and operators of WBCN. Nearly all the financial details of the station are handled by her.

Mrs. William Kuykendall personally answers most of the radio mail for WLS. She is on the job at 8 o'clock in the morning and scarcely ever has a breathing spell the entire day. Mrs. Kuykendall also acts as secretary to Mrs. Grace Viall Gray, director of Homemakers' Hour.



EDDIE CAVANAUGH

One of the most popular radio entertainers in the country. He has just been appointed program director of the WTAS and WCEE radio stations at Elgin, Ill., and is bringing some of the best talent available to broadcast over the air. Eddie, with his wife, Fanny, has popularized "One Hundred Years from Now," "The German Band" and many other songs over WTAS.

Freshman Opens Office in Chicago

The Charles Freshman Company, Inc., of New York, manufacturers of the Freshman Masterpiece line of radio receiving sets, has just opened a direct factory office and warehouse at 327 S. La Salle street, Chicago. Mr. S. Freshman, vice president of the company, is in charge. All sales in central and far western states will be handled from Chicago and shipments made from the Chicago warehouse.

The popularity of radio in Sweden is shown by the report from the small city of Gothenburg, where 11,000 crystal receivers and 30,000 headsets were sold in a month.

The Balaban & Katz Chicago Theater has, by arrangement with WMAQ, started changing the numbers every day for the Chicago Theater Dinner Organ Recital. This feature is on the air five nights a week and is played by Arthur Gutow of the Chicago musical staff. The announcing has also been assumed by the regular Balaban & Katz announcer, "Beeankay," and is heard from 6 to 6:30 every night but Saturday and Sunday.

HIGH-FREQUENCY HARRY'S PAGE

Station BLAH Broadcasting

NOT long ago, the pilot of this page had to spend a couple of days in bed with a bum hoof. And, by golly, I'll betcha he heard an individual market report on every grain of wheat and corn that's being raised this year. You'd think, from the hourly quotations that fill the air, that wheat and corn were in a pretty bad fix, with all the consulting Docs hanging around the bedside, issuing hourly bulletins. Farmers are planting crops by moonlight, because they're passionately listening in, all day, to get the latest info concerning the pulse and temperature of King Corn and Queen Wheat. Anyway, that's how it sounds.

* * *

Little Boy Blew

The little toy dog is covered with dust;
Toy soldier is laid away, too.
For our Little Boy Blue built a radio set,
And mixed up the wires in his new superhet—
Oh, the tubes that our Little Boy blew!

* * *

"Tuned in on some station er other, last night," said the elevator boy, "and the announcer gurgles that Sadie Rattlebang will now play 'Until the Dawn.' So I (yawn-n-n) tuned 'er out."

* * *

Radio television, or seeing by radio, is an assured fact in the near future, according to the scientific ginks. When that happens, you'll hafta tune in, with one eye in the loud speaker. And then we'll know what static looks like. If it looks like it sounds, you can expect to see glimpses of the infernal regions.

Cross-eyed sopranos will drape a derby hat over the microphone, before yodeling their stuff. And, with a radio set in your boudoir, you'll hafta cover up the loudspeaker, every night, before you peel for the pajamas.

* * *

Radiolimerick

A girl who possessed a fine "super,"
Told the fellow next door with a "blooper,"
"If you'll junk the bum set,
A kiss you will get."
Now, each guy in the block has a "blooper."

(A hand-embroidered, celluloid soldering iron will be donated to the gink who sends in a worse last line.)

* * *

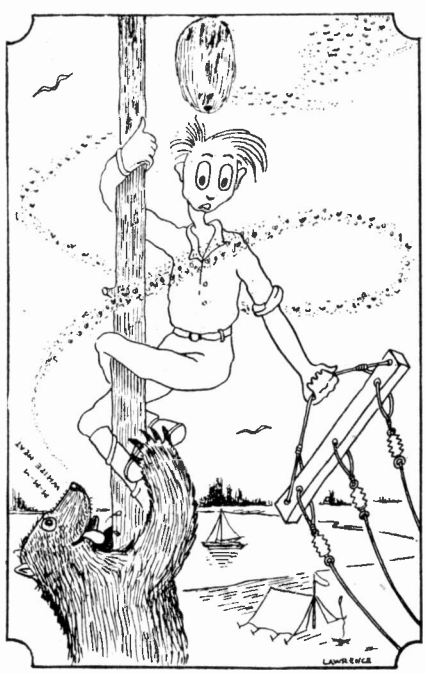
Quick, Willie, turn off the loud speaker; the announcer is going to sneeze! * * *

Don't let the cartoon on this page bluff you out of taking your set along on your vacation this summer. Such thinks seldom happen, except to comic characters in cartoons. WTAS and WCEE are planning some crackerjack summer programs. Stuff that will tickle your eardrums, and coax your ankles into rhythmic agitation, all summer long. And if you leave the old groan-box back home with the goldfish and canary, how are you going to grab all this stuff. Pack it in, along with your toothbrush and your other collar, and enjoy a REGULAR vacation.

* * *

"Mary, Mary, quite contrary,
How does your radio go?"
"With whistles and howls,
Grunts and growls,
Sensational news,
Dramatic reviews,
Weather reports,
Giggles and snorts,
Lectures emphatic,
Earfuls of static,
Yodeling bassos,
Readings with pathos,
Rattles and roars,
Baseball scores,
Songs paging Sally,
From valley to alley,
Talks about books,
Lessons, for cooks,
Forceful denouncers,
Gargling announcers,
Jazz orchestral din,
How to Grow Thin,
Bumps,
Thumps,
Groans,
Moans,
Squeaks,
Shrieks,
Yells,
Knells,
Hell's Bells!
THAT'S how my radio goes!"

* * *



THE JOYS OF SUMMER RADIO

Column conductors are not poets from choice, but from necessity. Nothing has yet been invented that will fill up large gobs of space, as effectually as a long rambling poem. Yea, verily; Laziness is the Mother of Invention.

* * *

A golf bug who had just made a hole in one, met a radio fan who had just tuned in 2LO. Both vocabularies were strained to the limit, but the radio nut won by two superlative adjectives and a split infinitive.

* * *

Lives there a man with soul so dead,
Who never to himself hath said,
When he found that his batteries all were dead,
"!————!————!————!"

* * *

A push-pull amplifier is a great addition to any set, but a push-pull imagination will bring in more DX.

* * *

No, Oswald, "Follow the Swallow," is not the bootlegger's national anthem.

* * *

If you have a radio set in camp this summer, please don't tune in Bedtime Stories on the loud speaker. It's downright cruelty to the dumb animals in the nearby woods, to make them listen to the sissified actions of Percy Rabbit, Willie Woodchuck, and other forest morons. * * *

Station BLAH, still broadcasting. Madame Hoozis will now sing the Gargle Song, from the opera, "Castoria." Stand by, one moment.

* * *

If you have corns on your ears, from tuning in, with your head in the loud speaker, try Bunko Corn Cure, on sale at all radio stores. (Adv.)

* * *

They've called "The Boss" a lot of things, but, so far, nobody has called him "The Bald Eagle of Fox River."

* * *

Station BLAH now signing off, at exactly four ninety-eight (reduced from five dollars) cuckoo clock time, until next issue. * * *

HIGH-FREQUENCY HARRY.

The Silver Lining that Covers A Multitude of Sins

Actual Data on the Characteristic Curve, Amplification Constant, Mutual Conductance and Plate Resistance of Tubes the Only Way to Determine Tube Worthiness

By A. J. Musselman

AT THE outset, I want you to understand that I am not knocking anybody's tubes, good or bad, nor am I attempting to present anything revolutionary in the profession of making radio tubes. It is my intention to give a few hard, cold facts on the tube situation, especially with regard to the protection of the consumer.

I want to make a little comparison on the methods of buying tubes—and any other commodity in general. When you enter a radio store, you specify to the clerk that you are in need of a vacuum tube. After designating the type, he reaches up on the shelf, grabs one of those he has in stock, and proceeds to test the filament for you. All well and good. If the filament lights you're supposed to believe that the tube is O. K. The same procedure applies to one, three or seven tubes. You buy them —and the silver lining on the inside of the glass may cover many things that will cause much trouble later on. You have usually twenty-four hours in which to find "duds" in the lot of tubes you take home with you—and I know from experience just how much the average fan can find out about tubes in that time with the usual equipment he has.

As the tube is the very heart of a receiving set, it is absolutely necessary to have good tubes, if one is to get the best results out of any machine.

It is almost an impossibility for anyone to purchase a tube or set of tubes and know what they are buying. Making a purchase of a tube or set of tubes at present is as ridiculous as if one went into a store to buy a pair of socks. The clerk hands out a pair in a box that doesn't show the size and insists that he cannot tell you the size, further stating he doesn't know whether they are men's socks or women's; he does not know the material, silk or may be cotton, all he knows is the price. "Oh, no; we cannot guarantee them. If they go on your feet our responsibility ceases. If you find they are no good, we will send them to the factory for the experts to pass on and see if they are what they should be. It will take from three to four months for the manufacturers to check upon them and see if you should have another pair."

The above sounds very ridiculous, but it is not one whit more so than what has happened to innumerable radio fans in the past when purchasing tubes.

What Is a Good Tube?

THE radio tube engineers have been furnishing figures for a number of years that specify what a good tube should be. These figures are arrived at by plotting a characteristic curve by means of electric test instruments, called—filament voltmeter, filament ammeter, plate voltmeter, plate milliameter, and a grid voltmeter. The relative value of a tube can definitely be determined as surely as a pound of sugar can be proved to be a pound. It is for this very good reason that tube buyers should insist on characteristic curve readings of the tubes he buys.

To simplify the matter for the amateur, this is what a 5 volt Detector and Amplifier Tube (201-A) should read: Tested at 90 volts on the plate and zero on the grid. Mutual Conductance—600 Micromhos or more. Amplification Constant 7.5 or more. Plate Flow 4.74 to 6 Milliamperes.

These figures are undisputable, as they are accepted by the leading radio engineers as the reading that will assure an unusually good tube.

By this method the public can buy a tube of a very high quality. It is the writer's opinion that whatever price you pay for a tube, it is too much unless you are furnished with the "pedigree" of that tube, which means the characteristic curve readings.

Testing Service

Some dealers make provision for testing service for their customers, by equipping themselves with tube testing devices. Others cannot do so, because a tube testing apparatus which will give the data on a tube costs too much. The dealers who have them are, as a rule, quite willing to give tests. I know of several who will match a set of tubes, provided you give them a little notice, and probably a few cents extra for their trouble. Unfortunately, however, this type of service is not universal—and the consumer of tubes has no recourse. If he wants a tube, he's got to take a chance, just as many of my readers have. The result—"duds" lying around that represent expensive experience; I wonder how many reading this are in the same boat.

The demand for tested and matched tubes for precision results brought about the demand for testing investments, and in order to comply with repeated requests, the dealer has had to equip himself with an expensive machine. From the present outlook along this line, it is easy to see that this will not be popular, since the dealer is reluctant to stand this expense, and furthermore he is not exactly enthusiastic about spending time with a product that should be tested more thoroughly by the manufacturer.

The real way out for the consumer is to buy only tubes that have been tested by the manufacturers and guaranteed to be of the standard set by the leading radio engineers as exceptionally good tube characteristic curve readings.

The writer does not wish to give the impression that all tubes are duds; he does deserve credit for originating the idea of certifying tubes.

SECRETARY HOOVER will probably call an other national radio conference this fall, in continuation of his policy to hold conferences annually. The definite plans and date have not been announced, but it is believed that invitations will go out calling the sessions in Washington in November, before Congress reassembles.

All interests will be represented, and it is probable that among the subjects discussed will be necessary legislation to bring the old 1913 radio law up to date, so that authority for assigning wave lengths and power to stations may be secured. Limitation of the number of stations in a certain class will also be brought up, as will international broadcasting and amateur regulations when such stations transmit outside the limits of the country. High power broadcasting, short-wave emissions, world-wide ship regulation and many other angles of radio development will be considered.

The question of separate wave channels for international radiophone communication, transmission of pictures by radio and the possibility of extending the broadcast band in the United States are also scheduled for investigation.

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President Coolidge's economy program has found an active ally in radio, which, army signal corps officers say, saves the government about $100,000 annually in communication charges.

The army handles the message business of many of the departments inland, just as the navy takes care of government coastwise and offshore traffic, and the signal corps has built up what its officers term "the most complete and perfected radio network in the world."

The message center of the war department, located in the munitions building, is the nerve focus of the radio system. Twelve stations link the various corps area headquarters with Washington, and within each of the corps units there are radio stations for inter-area work, comprising sixty stations in all. There are twenty-one Alaskan stations, and seventeen distributed through the insular possessions and Panama. Army transports also are equipped with radio.

Capt. E. F. French is in charge of the radio net, under Col. N. F. McClure, signal corps officer in charge of communication facilities.

@ @ @

Ten million radio sets will be in use in the United States in 1930 "Radio Retailing" predicts in a statistical survey of the industry from the time of its first real start five years ago. Estimated expenditures by the American public for radio in 1925 will total $450,000,000, as against $2,000,000 spent in 1920 and $345,000,000 spent last year.

Marked increase has been shown in the use of radio by the farmers of the country. There were 145,350 sets on farms in 1923. Last year 360,000 sets were in use in the homes of farmers. Investments by the agriculturists in radio two years ago totaled $18,459,450. In 1924 they spent $46,990,000.

"How near to the saturation point is radio?" the paper asks, and answers its own question in part by showing that on January 1 there were 11,000,000 of the 26,000,000 homes in the United States without motor cars; 16,000,000 without phonographs; 13,000,000 without electricity and 22,000,000 without radio.

@ @ @

The remarkable drawing power of the old-time songs is demonstrated every night by radio. When questions of copyright arose, the old songs were turned to in self-defense, but now it has been shown that the public really likes them. Songs that were put on as "stop gaps" are repeated over and over again, because requests come in for them. It isn't that new songs are not liked also, but the old ones seem to have an unforgettable flavor all their own.

@ @ @

A French savant has discovered, so he claims, that static is caused by a bug in the air. He does not go so far as to say what will kill the bug. If it is ever possible to get a microscopic picture of the bug, we have no doubt that it will appear as a most ferocious and appalling sort of insect. If it is as bad as it sounds, it must have a thousand legs and ten thousand voices. Any radio fan who has had static trouble doesn't care how soon the bug meets its death.

The Biltmore Hotel, New York, has made arrangements with the Standard Radio Corporation of Worcester, Mass., to install console five-tube tuned radio frequency receivers in every suite in the hotel. The aerial consists of thirty feet of wire concealed under the carpet. The ground wire connects to the radiator.

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Ordinary double bell wire makes an excellent conductor for running a loud speaker to a room removed from that in which the receiving set proper is kept. Twisted lamp cord or Christmas tree wire is also suitable.

@ @ @

The use of radio has not developed to any appreciable extent in Egypt. There are, at present, a number of Egyptian students studying radio abroad, presumably for the purpose of being entrusted with the direction and control of broadcasting upon their return. It has recently been intimated that members of the Bourse are interested in financing and erecting a broadcasting station at Cairo. If this becomes an actuality the market should react by developing to a fair extent.

@ @ @

Westinghouse station KYW has added a new feature to its family of entertainers. Si Berg has been heard from that station many times, and will now be heard in a new novelty.

Si Berg and Perc Congdon, both well known to radio, have hitched onto the same shackle-bolt and are now heard as a team from the little red studio atop the Congress Hotel, in a series of comedy skits. Perc is the pianist and baritone of the team, while Si rattles out glee by the bucketful on his uke and adds touch to their harmony singing by taking the tenor part.

The uke used by Si Berg is a genuine Koa Hawaiian instrument, having been selected out of over one thousand by one of the foremost stringed instrument critics of America. This uke has been considered as one of the best of its kind and the sweetness of its tone is well exemplified in the solos given by Si. Among the radio numbers that he has played are Miserere, Farewell To Thee and Perfect Day.

Radio GIVES Eyes and Ears To Fog-Bound MARINERS

For the First Time in Marine History Navigators Are Able to Obtain Accurate Bearings on Invisible Objects Thus Eliminating Greatest Danger of Sea

By JOHN S. CONWAY
Deputy Commissioner of Lighthouses

RADIO has given eyes and ears to vessels heretofore blinded and deafened by blankets of fog.

For the first time in marine history the navigator has a means of obtaining accurate bearings on invisible objects.

When fog blankets the sea, visibility is gone and sound is deficient in directive properties. Development of radio has overcome the perils. The directive property of the loop, or coil, antenna dates back to Hertz, who made successful experiments in 1888, based on Faraday's fundamental discovery in 1831 of electro-magnetic induction. Studies of other physicists have produced the radiogoniometer, radio direction finder, or radio compass, the term most frequently used in this country. It is not self-setting, but must be adjusted by trial.

SEVERAL types of radio compass have been perfected, differing in appearance, but depending upon the same principles. One has an outside coil mounted vertically on a spindle, rotatable in a horizontal plane, controlled by a hand wheel and fitted with a pointer.

Another consists of two large fixed loops at right angles to each other, connected to a small rotating coil on the operating panel. Each is provided with the usual radio-receiving, detecting, adjusting and tuning apparatus. The pointer may be placed over the ship's magnetic compass, thus giving at a glance the bearing of the radio signal station.

As the coil and pointer are rotated the maximum intensity of sound is heard when the plane of the coil coincides with the direction to a radio signal, and the intensity gradually diminishes, reaching a minimum when the plane of the coil is at right angles. Radio waves are accompanied by a magnetic force which is horizontal and at right angles to the direction in which the waves are traveling.

HENCE, when the coil is on edge to the wave, it is threaded by the maximal number of magnetic lines of force, and the amplified signal is heard at a maximum. Conversely, when the coil is broadside to the direction of the transmitting station, no magnetic lines of force thread the coil, and therefore no current is induced in it and no sound is heard in the receivers. At intermediate positions the current induced in the coil varies in proportion to the angle between the plane of the coil and the wave front.

In the United States Lighthouse Service important lighthouses and lightships are selected for equipment with automatic radio apparatus sending signals of definite characteristics during fog or thick weather. The mechanism has a timing switch driven by a small motor producing the signal at regular intervals. The antennas are the same as for ordinary radio communication.

The frequency is 300,000 cycles per second, the international standard for such signals, giving a wave-length of 1,000 meters. The range of usefulness is from thirty to 100 miles, depending upon atmospherics and the sensitiveness of the receiving apparatus.

TO DETERMINE the position of a vessel the navigation rotates the coil of his radio compass until the maximum signal is heard, establishing the identity of the station. He then turns the coil until the minimum intensity is reached, which is generally used for determining direction because of its more accurate definition, the coil being at right angles to the direction from which the signal comes. The pointer shows the bearing within one degree of arc. The navigator needs no knowledge of radio telegraphy.

The radio fog signal is valuable as a leading mark to enable a vessel to make a lighthouse or lightship at the approach to a harbor. When two or more sending stations are within range of audibility the intersection of the bearings may be laid down on a chart and the position of the vessel thus fixed. This system, for the first time in marine history, affords a practicable means by which a navigator may obtain accurate bearings on invisible objects. It will enable vessels to locate each other in fog when approaching or needing assistance.

Based on this combination of radio physics and engineering, this country was first to establish regular radio fog signal stations. Benefits from the fundamental researches of Faraday and Hertz continue to multiply, although at first of little more than academic interest.

* * *

CENTRAL DAYLIGHT SAVING TIME AT WTAS AND WCEE

CENTRAL Daylight Saving Time will be used for broadcasting from the Villa Olivia and Charlene Broadcasting stations in Elgin, Illinois. This is the same as Eastern Standard Time. Both stations, WTAS and WCEE studios, are located in the Kimball Building, Chicago, and operate by remote control through the operating plants at Elgin. The change to Central Daylight Saving time became effective April 26, 1925.

Much of the summer broadcasting from WTAS and WCEE will be conducted from the Elgin studios, located on the beautiful estate of Charles E. Erbstein, owner of the two stations. "The Boss's Own" orchestra will divide its time between the Elgin and Kimball Hall studios.

Short Wave KDKA Reaches Out

FEW people listening in on Station KDKA realize that in the same station is another transmitting set, the only one of its size and type in the world, which is forwarding at the same moment the program regularly to the most distant parts of the globe.

Whether these most distant parts to which the programs are being forwarded be Johannesburg, South Africa, England, Germany, Buenos Aires, South America, Sydney or Melbourne, Australia, or some other point depends on a schedule that is always arranged in advance.

This Westinghouse world-wide relay system transmission is done by making use of extremely short wavelengths, while high power is used for the transmission, it is done with the view of maintaining good, constant signals at the point of reception.

This particular transmitting set, located on the hill near East Pittsburgh, Pa., works of the Westinghouse Electric and Manufacturing Company, which operates Station KDKA, can reach every part of the world. It has successfully transmitted programs and had the programs relayed a distance of more than 12,000 miles, which, since it is half way around the world, is the maximum of distance that will be required of a transmitting set.

These transmissions handled by the Westinghouse world-wide relay system are always prearranged and fixed schedules are maintained. This is a departure from the haphazard, some times—heard long distance records made by the ordinary station. In order to make long distance relay service of practical value, the signals must go through regularly, and must not be disturbed by the ordinary conditions such as interrupt the transmission from the usual type of broadcasting station.

The station at East Pittsburgh from which the programs are sent actually is a radio power plant. There are several sets located in the building, while outside the building are many poles supporting a variety of antennae. The short wave transmitting is done on copper tubes supported by vertical poles. By proper arrangement of the poles, directional effects are obtained, thus aiding materially in reaching the desired part of the world.

The electric power company which supplies the power for this plant has a regular substation in the basement of the building. To assure reliable service and freedom from interruptions of the transmission, the company has run two feeder wires from two different power circuits, fed by two different generating stations.

The amount of power available on any of the sets is, within reasonable bounds, unlimited. For regular broadcasting from station KDKA, 10 kilowatts often are used, while for experimental purpose, the station can radiate several times that amount of power. This, of course, accounts for the remarkable range of the broadcasting station, not considering the relay operation.

As station KDKA, the pioneer radio broadcasting station of the world, and at present the most powerful station in the world, truly is the national station, so its sister station, the short wave one, is the international one.

Leviathan to Be New Broadcaster

By J. F. H. Turner
Radio Director U. S. Shipping Lines

The Leviathan is to be the world's first floating broadcast station, and by next Fall the gigantic liner will be sending out entertainment on the air as it crosses and recrosses the Atlantic. The programmes, to be made up from talent among the ship's passengers, will go out on a wave length of 280 meters and will be transmitted by apparatus of 10,000 watt strength. The Leviathan is part of a comprehensive schedule of land and sea broadcasting to be inaugurated by the United States Shipping Lines and the Shipping Board.

Music and addresses sent out from the Leviathan recently in three test programmes made in the middle of the Atlantic, brought such a flood of response from Europe and America, the United Shipping Lines took the 16,000 letters received as indication that regular entertainment broadcasting from the boat would be popular.

When the regular schedule has been inaugurated on the Leviathan, plans will be furthered to install similar broadcasting arrangements on the seven other boats of the lines to augment the land station, which will be started within a few weeks at Lakehurst.

The present radio apparatus on the Leviathan, 5,000-watt strength, is to be replaced by a new transmission plant double in strength, known as the three-way duplex system, so ordinary commercial messages will be sent out on 80-meter wave length, the entertainment on a 280-meter wave length, and the 1,200 wave length shall be reserved for emergencies. The more powerful radio equipment has already been ordered, although it is not thought the regular daily programme will be attempted during the summer months.

WUSL will be the call letters for the Lakehurst station, which will operate on a wave length around 300 meters, and which will augment the ship's radio entertainment. A remote control studio in New York will facilitate the making up of programmes with worthwhile talent, while the transmitting station will be in Lakehurst. While the land station will be operated primarily for the ships of the United lines, the executives will also offer entertainment for radio fans all over the country.

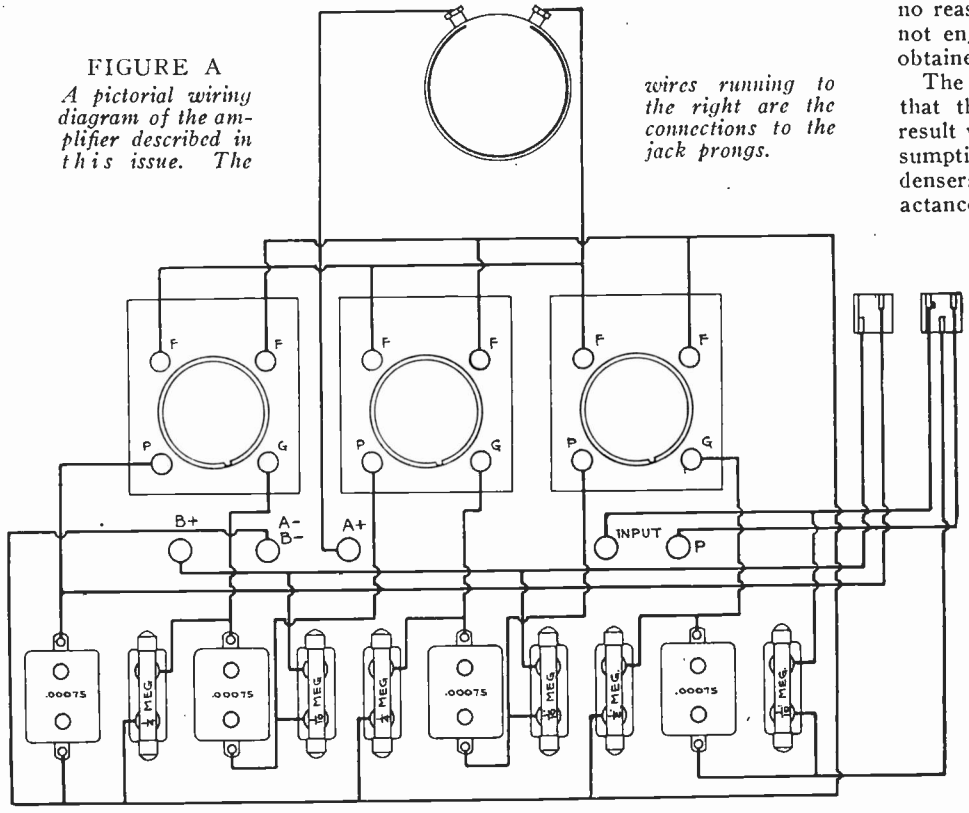

FIGURE A

A pictorial wiring diagram of the amplifier described in this issue. The wires running to the right are the connections to the jack prongs.

(Continued from page 15)

and about 13 in the second stage, or an over-all gain for the system of 18 x 13, or 234. This means a signal is 234 times stronger when it comes out of such an amplifier than it was when it went in.

In the case of a three-stage resistance amplifier the gain per stage will be about the same for each stage, since the drop encountered in the previous case does not apply to any appreciable extent. Therefore, we can allow a gain of about 6.5 per stage or about 81% of the amplification factor of an average tube. This in three stages, gives a total amplification of 275, or slightly more than that obtained with two transformer stages. There is no comparison from the quality standpoint, however, between the two systems.

Expense

FROM the standpoint of expense, the resistance system can be built more cheaply than the transformer system, due to the lower cost of the component parts.

While 135 volts is required for the resistance system, the B battery current consumption will be only about nine milliamperes, as against ten to eleven for the transformer system. Therefore, the B battery expense for both systems being about equal, with the initial battery expense higher for the resistance amplifier, and the upkeep cost of the transformer amplifier nearly balancing this, there is no reason why the average fan should not enjoy the wonderful quality to be obtained with the resistance system.

The constants are so proportioned that the maximum amplification will result with a minimum of current consumption. The .0075 coupling condensers have a comparatively low reactance to the frequencies to be handled, and are a far more practical size to work with than those of a larger capacity. Theoretically, these condensers should be on the order of one to five microfarads, but practically, .0075 is entirely large enough. The use of one of these condensers connected from plate to filament of the last stage—a point commonly overlooked — prevents poor quality often experienced with resistance amplifiers.

The coupling resistances are of 1/10 megohms or 100,000 ohms. When using 135 volts on the amplifier, the tube resistance may be considered as about 20,000 ohms, which give a total plate circuit resistance of 120,000 ohms, across which is applied 135 volts. For practical purposes, it may be considered that this voltage divides so that the actual plate voltage of the first two tubes is about 34, so that no "C" battery will be required. If a higher resistance were used, a higher plate voltage would be necessary, but if a lower resistance were used, the amplification would fall off badly. Further, the size of these coupling resistances is about five times the tube resistance, which insures practically uniform amplification at all frequencies to be handled. Actually, the variation in amplification between 60 and 6,000 cycles is only a few per cent—so slight when compared with

1 6½-ohm rheostat
1 jack, 1 spring
1 jack, 2 springs
5 insulated top binding posts
3 panel-mounting sockets
6 Muter .0075 condensers
6 Muter grid leak mounts
3 Muter 1/10 meg. leaks
1 Muter ½ meg. leak
2 Muter ¼ meg. leaks
1 7x2½x⅛" bakelite panel
1 7x10x⅛" bakelite panel
Lugs, bus-bar, No. 6/32 flat-head screws and nuts, solder and spaghetti.

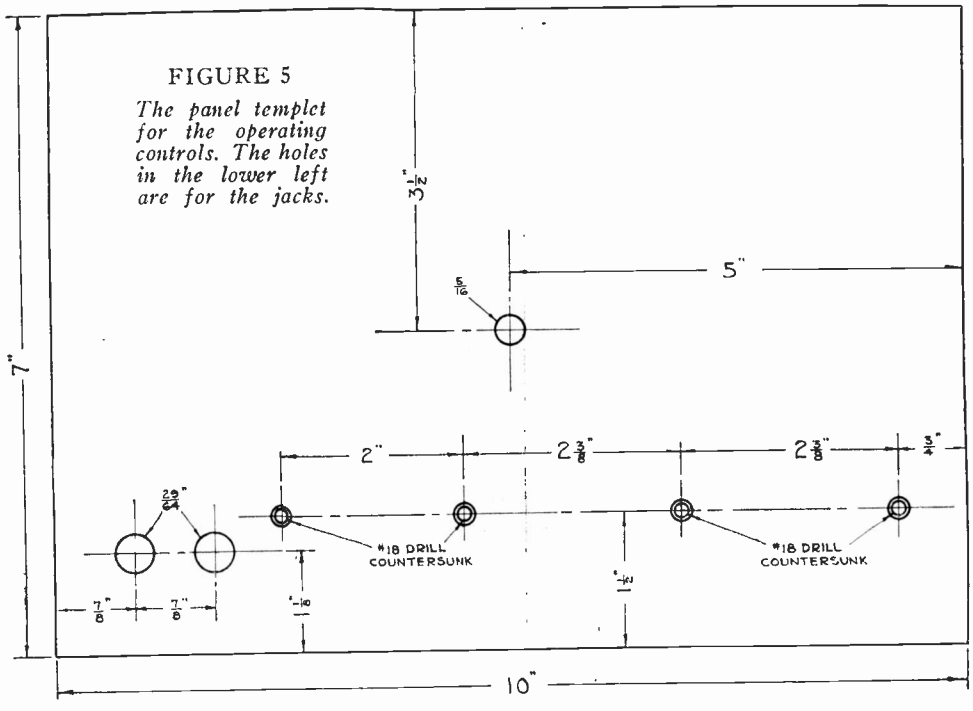

FIGURE 5

The panel templet for the operating controls. The holes in the lower left are for the jacks.

transformer amplifiers as to be entirely negligible.

The Grid Leaks

The grid leaks are of such a size that they will prevent blocking of the system, and maintain the grid potential of the various tubes at a satisfactory operating value. One-half megohm (500,000 ohms) is used on the first stage, with one-quarter megohm, or 250,000 ohms, on the second and third stages.

Because of the high resistance used for coupling the output of the receiver (or detector) to the amplifier, the plate voltage of the detector should be about 90 volts, instead of the customary 45. If the amplifier connects to a receiver using audio amplification, the plate voltage of the last tube in the receiver should be run up to 90 or 135 volts.

The resistance in the plate circuit of the last tube is only that of the loud speaker—generally 2,000 ohms—so that practically all of the plate voltage used is applied to this last tube. This being the case a C battery should theoretically be used in series with the last tube's grid leak, of about 3 to 6 volts. Actually this does not improve reproduction, and so it is not shown in the amplifier circuit. It will reduce the B battery consumption somewhat, and may be incorporated if desired.

Figure 2 is a bottom view of the unit, showing the placement of the six resistances and four condensers, these being attached to a small bakelite strip carrying the five binding posts, which is in turn fastened to three panel-mounting sockets.

Parts Required

THE material necessary to build the unit costs about $18.00, and is listed below. All parts should be of first class manufacture, particularly the resistances and condensers. Standard panel sockets should be used, which will accommodate either UV201A or WD12 tubes. UV199's should be used with adapters, but this will not impair the efficiency of the set, though it does not make an excellent mechanical arrangement. DeForest DV3 dry cell tubes will fit standard sockets. The new UV199, soon to be out with standard bases, will fit the sockets recommended.

The panel should be prepared by drilling it in accordance with the drawing, using the drill sizes shown, and countersinking holes where this operation is indicated.

The assembly is started by putting through the sub-panel the six screws used to hold the sockets, but not fastening the sockets to them with nuts. Then, with these six screws hanging loose in their holes, the four condensers and six leak clips are screwed on to the sub-panel by putting flat-head screws through it from the other side. After this has been done, the three sockets may be placed in position, and nuts tightened up on the six screws used for holding them. A reference to Figure 1 will show how the parts are put in place on the sub-panel, and just how lugs are put on the leak clips and condensers. Lugs are shown on some condensers, and if soldering paste is to be used, the wiring should be run to these lugs, and not to the condensers. If no paste is used in soldering to the condensers, the wires may be soldered direct to the small rivets used for holding the brass plates of the condensers together.

The five binding posts are put on the sub-panel as shown in Fig. 1, with lugs under the screw heads as indicated.

Operation

BEFORE connecting it for operation there are one or two tests to make. First, the A battery should be connected to its posts, the tubes inserted, and the rheostat turned on. The tubes will light if all connections are correct. If they do, disconnect the A plus wire, and connect it to the b plus post. The tubes should not light, and if they do, there is an error in the wiring which must be corrected. Assuming they light only when the A battery is connected to its proper posts, a 90- or 135-volt B battery should be connected to the posts marked for it in the diagram.

"ON THE AIR" List of

PRINCIPAL BROADCASTING STATIONS

Dial Positions of Stations Received

Call Letters	Location	Wave Length	Dial Positions 1	2	3	4
WTAS	Elgin, Ill.	302.8				
WCEE	Elgin, Ill.	275				
KDKA	Pittsburgh, Pa.	309				
KDPM	Cleveland, Ohio	250				
KFAE	Pullman, Wash.	330				
KFGH	Stanford Univ., Cal.	273				
KFI	Los Angeles, Cal.	467				
KFKB	Milford, Kans.	273				
KFKX	Hastings, Neb.	288				
KFMZ	Roswell, N. M.	250				
KFOA	Seattle, Wash.	450				
KFSG	Los Angeles, Cal.	278				
KFUO	St. Louis, Mo.	549				
KGO	Oakland, Cal.	300				
KHJ	Los Angeles, Cal.	404				
KJS	Los Angeles, Cal.	294				
KLX	Oakland, Cal.	509				
KLZ	Denver, Colo.	283				
KOA	Denver, Colo.	322.4				
KOB	State College, N. M.	349				
KOP	Detroit, Mich.	278				
KPO	San Francisco, Cal.	430				
KQV	Pittsburgh, Pa.	275				
KSD	St. Louis, Mo.	549.1				
KYW	Chicago, Ill.	535.5				
WAAW	Omaha, Neb.	278				
WBAP	Fort Worth, Tex.	480				
WBAV	Columbus, Ohio	294				
WBBR	Rossville, N. Y.	273				
WBZ	Springfield, Mass.	333				
WCAE	Pittsburgh, Pa.	461				
WCAP	Washington, D. C.	469				
WCBD	Zion, Ill.	344.6				
WBCN	Chicago, Ill.	266				
WCCO	Minneapolis, Minn.	416				
WCM	Austin, Tex.	360				
WCX	Detroit, Mich.	517				
WDAF	Kansas City, Mo.	366				
WDAP	Chicago, Ill.	360				
WDAR	Philadelphia, Pa.	395				
WEAF	New York City	492				
WEAI	Ithaca, N. Y.	286				
WEAO	Columbus, Ohio	360				
WEAY	Houston, Tex.	360				
WEB	St. Louis, Mo.	273				
WEBH	Chicago, Ill.	370				
WFAA	Dallas, Tex.	476				
WFI	Philadelphia, Pa.	395				
WGBS	New York City	316				
WGN	Chicago, Ill.	370				
WGR	Buffalo, N. Y.	319				
WGY	Schenectady, N. Y.	380				
WHA	Madison, Wis.	535				
WHAS	Louisville, Ky.	400				
WHAZ	Troy, N. Y.	380				
WHB	Kansas City, Mo.	366				
WHN	New York City	361				
WHO	Des Moines, Ia.	526				
WIP	Philadelphia, Pa.	508				
WJAR	Providence, R. I.	306				
WJAS	Pittsburgh, Pa.	275				
WJJD	Mooseheart	302.8				
WJY	New York City	405				
WJZ	New York City	454				
WLS	Chicago, Ill.	345				
WLW	Cincinnati, Ohio	422				
WMAQ	Chicago, Ill.	448				
WMC	Memphis, Tenn.	500				
WNYC	New York City	526				
WOAI	San Antonio, Tex.	395				
WOAW	Omaha, Neb.	526				
WOC	Davenport, Ia.	484				
WOO	Philadelphia, Pa.	508				
WOQ	Kansas City, Mo.	278				
WOR	Newark, N. J.	405				
WOS	Jefferson City, Mo.	441				
WPG	Atlantic City	300				
WQJ	Chicago, Ill.	448				
WRC	Washington, D. C.	469				
WRM	Urbana, Ill.	273				
WSAI	Cincinnati, O.	326				
WSB	Atlanta, Ga.	428				
WSY	Birmingham, Ala.	250				
WTAM	Cleveland, O.	389				
WTAY	Oak Park, Ill.	250				
WWJ	Detroit, Mich.	353				

CANADIAN AND CUBAN STATIONS

Call Letters	Location	Wave Length	Dial Positions 1	2	3	4
CNRC	Calgary, Alta., Can.	430				
CNRT	Toronto, Ont.	400				
CNRM	Montreal, Que.	430				
CFUC	Montreal, Que.	400				
CHYC	Montreal, Que.	341				
CKAC	Montreal, Que.	411				
CKCD	Vancouver, B. C.	410				
CKCE	Toronto, Ont.	450				
CNRO	Ottawa, Ont.	435				
CNRR	Regina, Sask.	420				
CKY	Winnipeg, Man.	384.4				
PWX	Havana, Cuba	420				

OTHER STATIONS

Good Coils

(Continued from page 6)

order that spaced turns be effected, a piece of cotton string is wound alongside of each turn, making sure that both string and wire are wound firmly in place. When the last turn has been secured into place firmly, the string is removed, giving a coil of spaced turns lying on three celluloid strips between the turns and the cardboard tube.

The celluloid strips are then painted with a small quantity of collodion, you can obtain a small bottle of this fluid in any drug store, and the entire unit is then allowed to dry. Collodion contains a solvent for celluloid, and the wire will sink into the strips a trifle, making the coil very rigid and firm. When dry, the coil will stand much handling and rough usage as far as keeping the turns in place. As in the case of string, turns cannot slip out of place, making the coil lopsided, and so long as the wire itself is not bent, the finished coil is an inductance that represents the utmost in efficiency.

The cardboard tubing is removed by cutting the paper pasted over the longitudinal cuts, leaving only the wire adhering to the celluloid strips.

The sizes of the coils must be proportioned in the manner described for the Westman-Mandley inductance, viz., the coil is wound too large, and turns cut down until the highest wavelength you wish to reach comes in around 90 to 95 degrees on the dial of a .0005 mfd 23 plate condenser. This cut and try method is possibly more efficient than actual calculation, because it gives the practical value from operating test, calculations often disregarding influences present in the set that cannot be accounted for. Then too, variable condensers vary considerably from their ratings; from experience we know that no two of them will give precisely the same readings for definite mechanical settings with a given inductance.

The materials for the coil are not hard to acquire—you can buy the collodion at any drug store, and the celluloid strips may be obtained from many sources. An auto curtain repair shop is invariably the surest place to get the celluloid. Cardboard tubes are available at any radio store.

Some Good Ready Made Coils

There are several manufactured types of inductances available to those experimenters who dislike to bother themselves with coil winding, that conform very closely to the requirements of electrical efficiency. In an unbiased manner, we seek to educate our readers into acquaintance with these coils. We are not inferring that one is better than the other, all of them are excellent examples of good design, some manufacturers expressing in their construction a regard for mechanical strength with less electrical efficiency, others giving high effectiveness from an electrical standpoint with a slight sacrifice in constructional features.

The Henninger Coil

The Henninger inductance is a good example of all around general efficiency, since it conforms with the policy of good coil design in many respects. It has little insulation within the field of the coil, and what it does have is good material. Semi-space winding of the input-coil gives low distributed capacity, and its small size keeps the field of the coil within exceptional limits. This inductance is an excellent example of electrical efficiency, at a slight sacrifice of mechanical strength. The coils are not fragile, but must be handled intelligently if they are to give the best results. (See Figure 1.)

The Bell Space Wound Tuner

The Bell Space Wound Tuner is another example of high efficiency in inductance design. While it has considerably higher radio freequency losses due to the presence of more insulative material within the field of the coil, it does have the advantage of greater mechanical strength than any of the others shown herewith. For all around purposes, this coil is an exceptionally wise choice. While we are not acquainted with its actual performance, we can readily see from its mechanical features that it cannot but help be efficient from an electrical standpoint. It represents a very delicate balance of radio frequency losses and physical construction.

The Bremer-Tully Coils

The Bremer-Tully type of inductance is another fine example of real engineering. The space windings make for low distributed capacity, the cutaway frame lowers the radio frequency losses to a point where for a given mechanical strength they are highly efficient. Another coil of this type is the Ambassador "Uncle Sam" tuner, a three-circuit tuning device that is giving exceptional results just as are the others described on these pages.

Other Good Tuners

This is but a partial list of good tuning devices that are on the market. The Carco three-circuit tuner, the Lopez, the Hendrick Low-Loss Tuner, the Globe Low-Loss Tuner, the Freshman radio frequency inductances—countless others. They are all good generally speaking, some superseding others in efficiency when used in various circuits. We couldn't name all the good ones, but we feel that it is fortunate for the uneducated broadcast listener that there are so many good ones that there is really no necessity for his being "rooked."

General Pointers

Hand in hand with good coils go good variable condensers. There are a number of these on the market, and common horse sense and a little research into the factors comprising good condenser design will tell which is the best one to use. Remember always, the performance of a good coil can be entirely spoiled by a rotten condenser.

When you make or buy a good coil, give it a chance—keep it free from losses by keeping its field clear at least by two inches. Losses incurred in long leads, properly placed are much smaller than losses due to "coupled resistance," caused by placing objects of absorptive nature too close to your tuning apparatus.

A Summer Cottage Super-Het

(Continued from page 8)

nected on top of the sub-panel assembly. Next, the wiring on the underside of the sub-panel should be completed, and then the wires which run through the sub-panel, between terminals located on opposite sides of it. The front panel is then attached and the remaining wires connected.

At one end of the sub-panel are the eight-battery terminals. The A battery may be either six dry cells connected three in series, or preferably a four-volt storage battery. Binding post 40 should be connected to the 45-volt B battery terminal for the first and second detector tubes, and binding post 41 to the 90-volt end of the B battery for the amplifier tubes. Binding post 34 carries a 4½-volt negative C battery voltage to the grids of the two audio tubes, while post 35 carries a 3-volt grid bias to the intermediate frequency tubes.

At the other end of the binding post panel are the three posts for loop connections. Post 32 should connect to a tap on the loop such that one-fourth of the total turns on the loop are included between posts 31 and 32.

As in all Super-Heterodynes, a great deal depends on the tubes; all eight tubes are of the UV-199 or C-299 type, and it is especially important that those used as oscillator and both detectors should be good oscillating tubes.

To operate the set, turn on the battery switch and turn the rheostats about three-fourths of the way on. Set the small condenser, No. 6, at its minimum capacity and begin tuning with the two large variable condensers. When the set is working, gradually increase the capacity of condenser No. 6 to sharpen up the tuning, but not enough to throw the detector into oscillation. Rheostat 3 should be turned on as far as possible without causing loss of clearness of tone, and rheostat 4 should be turned down as low as possible without losing volume.

Lay the parts out on the baseboard in such a manner that all leads are short and direct.

Vernier dials are better than extra plate verniers on condensers, as the latter cause losses by not making good contact.

How to Freshen Up Tired out Crystal

THE sensitivity of any set using crystal rectification is limited by the sensitiveness of the particular crystal used.

If after three or four months of service you find the strength of signals from certain semi-distant stations dropping off and your batteries and tubes check up O. K., look to the crystal for trouble. If it is of the fixed type it may need a rest.

Peculiar as this might sound, it has been found that crystals get tired out, so to speak, and will again give good service if laid away and not used for a few weeks.

Adjustable crystals, for the most part, are liable to go bad earlier in service than those of the fixed types. Their sensitive spots are usually exposed to dampness and dust, and the occasional imprint of a finger does much to hasten the end of its useful service.

In such cases the laying aside of the crystal will not help matters. An entirely new surface must be had, presenting new sensitive points.

Galena is by far the most popular crystal today. If it is used in its natural form you will find it difficult to break it up to obtain a new surface without ruining the mineral entirely, as it has a tendency to break up in small cubes. The best method is to keep it in its wood or metal mounting and with a fine toothed file scratch the surface lightly.

Synthetic crystals will not break up in cubes, but the same process can be used for getting a new surface. Some radio enthusiasts recommend washing a crystal with soap and water, using a toothbrush for getting into the crevices.

It has been our experience this method is not as good as filing, our deductions being that oils present in any soap have a tendency to adhere to shiny surfaces, which is next to impossible to thoroughly clean off. Alcohol also is a good cleaner.

Brilliant Tubes Sign of Wasteful Voltage

Brilliancy of the tubes is a poor index of their operating point. Its use as a guide is apt to result in the tubes being burned too high. Either use a volt meter across the terminals of the tube or turn down the rheoestat to the point where it begins to cut the signal strength. Nothing is gained be given to the listeners.

Danish Broadcasting Under State Control

The Danish government has decided that broadcasting in Denmark shall be under state control. A committee will decide what is to be broadcast and it has been decided that the operas performed at the Royal State Theater will be given to the listeners.

Some Good Facts to Remember

Home-made grid leaks composed of carbon lines drawn on a piece of cardboard are unstable, as their resistance will vary with changes in temperature.

The value of low-loss condensers will not be realized if they are used with tube-wound coils, treated with shellac, as the losses of the latter offset the gain made by the condenser.

The audio amplifier of a set will not work unless the connections to the jacks are properly made. The inner prongs of a double-circuit jack are wired to the primary of the transformer; the outer prongs go to the plate and battery, respectively. Try reversing the wires to the inner prongs for better results.

It is not advisable to employ more than two stages of reflexed amplification, as the set will generally be too critical to operate.

Placing a crystal detector across the aerial and ground posts of a receiver may be helpful in eliminating static.

A milliammeter placed in series with the positive "B" battery lead of the audio amplifier will show the amount of current in milliamperes that the tubes are using. If the meter is of good make it will use practically no current.

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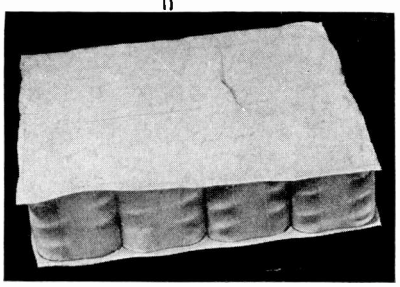
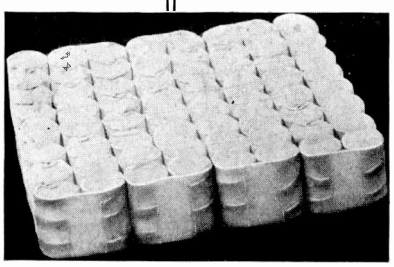


THE FEATHERWEIGHT



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