RADIO

WITH WHICH IS INCORPORATED "RADIO JOURNAL"

VOLUME VIII — JUNE, 1926 — No. 6

Radiotorial Comment

THE GOVERNMENT'S defeat in its lawsuit against WJAZ seems to have awakened Congress to the pressing need for some form of new radio legislation. The Chicago judge decided that the present law, as passed in 1912, gives the Secretary of Commerce "no express grant of power to regulate the stations" which he is required to license; that Congress has withheld from him the authority to prescribe any regulations beyond the limited ones defined in that law. Another judge in New York has declared that the Secretary of Commerce has no right to refuse a license.

On the other hand, a strict interpretation of one section of the law might prohibit any form of commercial radio communication between states. The entire act is so full of defects and ambiguities that only the most generous interpretation and acceptance of its provisions has allowed radio to develop to its present position.

Such supervision as has been exercised over broadcasting has been with the consent and co-operation of those regulated. This virtual self-regulation has been in accordance with the recommendations of the four radio conferences called by Secretary Hoover. He has invited widespread public participation in these conferences so that every side of every question could be heard. He has repeatedly requested that the responsibility for final decisions be taken from him. And yet he is accused of seeking an arbitrary one-man control of the situation!

The Department of Commerce has merely administered the recommendations of the majority. In the absence of an adequate law it has exercised the duties of traffic policemen of the air until such time as a new law may be enacted.

Any one of the half dozen bills now pending in Congress would suffice. Several others have been proposed during the past five years, which would have legalized the Secretary's actions.

The White bill recently passed the House. This embodies most of the recommendations of the Fourth Radio Conference, including the vesting of control in the Secretary of Commerce. So his political opponents in the Senate are opposing it.

The new Dill bill is almost identical with the White bill except in substituting a national commission for the Secretary of Commerce and in providing for a three-year instead of a five-year tenure for station licenses. It also legalizes the transmission of commercial messages by Navy stations to localities not served by private stations. This is primarily intended to increase trans-Pacific communication and thus improve trade relations with the Orient and Alaska.

There is still hope that one of these bills may be passed before Congress adjourns. Nor do we share the feeling that utter chaos would result if it does not. We are confident that most of the present and prospective broadcasters have the good sense to know that they cannot afford to arouse public resentment. But we do recognize the need for some law that will prevent the possibility of such resentment being aroused and exerting a detrimental effect on all branches of the radio industry.

A new law will stabilize the industry. The old one leaves it in a precarious condition. Why not pass the law?

ONE of the greatest sources of confusion in the nontechnical radio mind is the complex combination of numbers and initials used to designate various types of vacuum tubes. These were originally catalogue codes for ordering shipments from the manufacturer, as are common in almost all businesses. That the man-in-the-street has adopted them indicates a lack of foresight on the part of the manufacturers.

One manufacturer's code number of 201A has come into such common use that other manufacturers have adopted it to signify any tube of somewhat similar characteristics. Although this may have first been done with intent to deceive, the custom has become so current that the general counsel of the San Francisco Better Business Bureau is about to rule that such numeral and initial designations are not violative of the advertising law so that any manufacturer's tubes may be sold under this name. It has become representative of a type rather than an individual. Even if this has been registered with the Patent Office it is an open question whether it would be practical to prosecute firms that have adopted it.

The evil in this situation arises from the fact that those who buy inferior tubes branded with this type designation are likely to lose confidence in the type and possibly also in the manufacturer with whom they have learned to associate the type. Nothing herein stated is intended to imply any comparison as to the relative merits of the so-called standard and so-called independent tubes. Some of the latter give as good results as some of the former, and conversely. But undoubtedly many inferior tubes do impersonate their betters, wolves in sheeps' clothing as it were.

The remedy is obvious: the manufacturer should place his advertising emphasis upon his trade name and not upon his catalogue number. No one would think of buying an xyz-711-RSVP automobile or a pqrl-999 collar or pair of shoes. So why try to remember the difference between a 171 and 112 tube when it would be so much easier to think of them as a current amplifier or as a voltage amplifier? But above all else the emphasis should be placed upon the manufacturer's name or trade mark.

This suggestion is made not for the protection of any manufacturer but for the protection of the average buyer who has enough difficulty in remembering his telephone numbers without solving a problem in mental arithmetic every time he buys a new tube. The men who perpetrated and perpetuated this numerical monstrosity were poor psychologists. The man who has the courage to break away from its established tradition will be a public benefactor.

Bending of Radio Waves by Storms

Some Interesting Experiments on the Influence of Weather Conditions on Fading and Other Reception Phenomena

By John J. O'Neill

RADIO compass operation is based on the fact that a loop antenna will give a minimum signal when the loop is perpendicular to the direction in which the received wave is traveling. The conclusion that is naturally drawn from this fact is that the angle in which the loop is pointing when the maximum signal is received indicates the true direction of the transmitting station from which the received wave is sent. This does not necessarily follow and the acceptance of such a conclusion permits a dangerous gap in our reasoning because recent observations by the author indicate that setting of the loop does not always correspond to the directions of the transmitting station, but under certain conditions may vary 30 degrees or more from the straight line connecting sending and receiving stations.

These variations take place when the received wave has travelled a route that carried it through atmospheric structures such as cyclonic or anti-cyclonic disturbances, popularly known as storms, cold waves, etc. The atmosphere is never free from these disturbances.

Storms act as refractors of radio waves in the same way that a lens or prism bends or refracts light rays. The most common type of storm, technically called a cyclone, is a giant atmospheric structure that may spread over the major portion of the country. It is an immense whirling vortex from 500 to 2,000 miles in diameter. It is composed of atmospheric gases in various degrees of ionization, which in their widespread sweep over vast stretches of territory produce in the air and in the ground electrical stresses, charges and discharges on a gigantic scale.

With the most spectacular of the electrical effects of the storm processes—lightning, we are quite familiar. Our radio sets, especially during the summer months, make us quite familiar with invisible electrical effects that manifest themselves as the sizzling, frying and pebble shower types of static. These are distinct from the crashes produced by lightning discharges. There are many other types of electrical phenomena that take place as the result of the many and varied transformations and movements of the atmosphere and the substances which it carries in enormous amounts. When the air takes up moisture, when vapor is condensed, and when moisture is precipitated, changes in the electrical conditions of the atmosphere and the adjacent portions of the ground take place. These changes take place within the magnetic field which surrounds the earth.

Cloud masses carrying charges, sometimes not intense enough to cause a lightning discharge, will move swiftly through the air, producing by induction, corresponding effects in the ground. Other portions of the storm area will carry in suspension ionized particles, such masses of air sweeping over wide stretches of ground, and contributing their type of electrical effect.

The storm as a whole—perhaps 1,000 miles in diameter and a few miles thick, with its air masses whirling toward the center, is not unlike a pancake coil, with its convolutions running spirally from the rim of the fibre form to its center, and which produces its peculiar lens-shaped field of force.

In considering the effect of electrostatic and magnetic fields of force on radio waves we must keep in mind that radio waves are identical in nature with light rays and light rays are influenced in many ways by such forces. For example we know that a magnetic field produces the peculiar splitting up of spectrum lines, known as the Zeeman effect, and that light rays reflected from the face of a magnet are circularly polarized. This is interesting in connection with the current speculations on "cork screw" polarization of radio waves, and in view of the fact that the surface of the earth to which radio waves adhere is the face of a huge magnet.

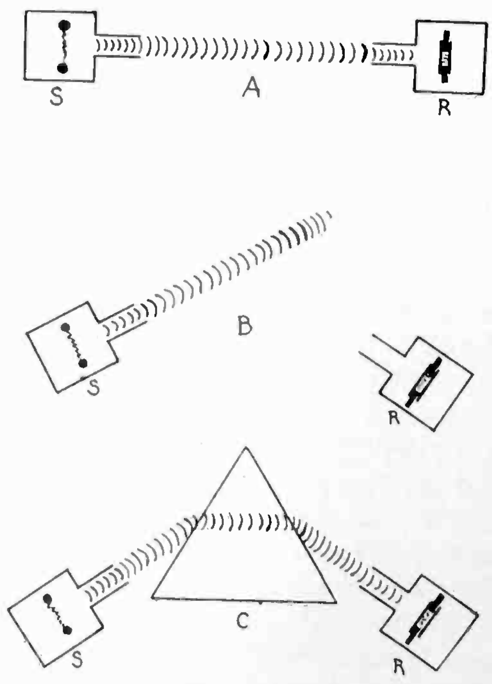


Fig. 1. Refraction of Radio Waves.

It might be well to refer here to a classical experiment in the refraction of radio waves. It is illustrated in Fig. 1. *S* is a sending set consisting of a small spark coil, *R* is a receiving set of the now obsolete coherer type. For the purpose of shielding them, both sets were placed in metal cases having an extended tubular opening in front. When the sets were placed facing each other, as in Fig 1A, the signal transmitted from *S* was received and indicated at *R*. When the sets were placed at an angle to each other as in Fig. 1B, a signal transmitted from *S* was not received at *R*. When, however, the large paraffine prism *P* was placed between *S* and *R*, the signal sent from *S* was received at *R*, the wave having been refracted by the paraffine prism. The prism used had faces about 24 in. square. This experiment closely parallels the one in which a prism is used to bend a ray of white light and break it up into a spectrum.

Atmospheric structures have been observed by the writer, to bend radio waves in the same way that a prism bends light rays. Before giving the data on the refraction of radio rays it would be well to state in a little more detail the conditions that are found in these atmospheric structures.

A cyclone centers around a central low pressure area toward which flows spirally the surrounding air masses which are under higher pressure as the distance from the center increases. An anti-cyclone is a central high pressure area from which the air flows spirally outward, the pressure growing less as the distance from the center increases. A diagram of an idealized contiguous low and high pressure area (cyclone and anti-cyclone) together with the distribution in them of air currents, or winds, is given in the upper portion of Fig. 2. The distribution of barometric pressure along a line passing through the center of both areas is given in the lower portion. The shape of, and pressure in, these areas varies widely in different storms.

Those who have not studied meteorology may have the idea that a storm is a disorderly panic of the weather elements. Quite contrary is the case. While an individual storm may be as fickle as a soft detector tube, storms as a general proposition are staged by Nature with clock-like precision. This may be gleaned from Fig. 3, which gives an idea of the internal structure of a storm (cyclone or low pressure area).

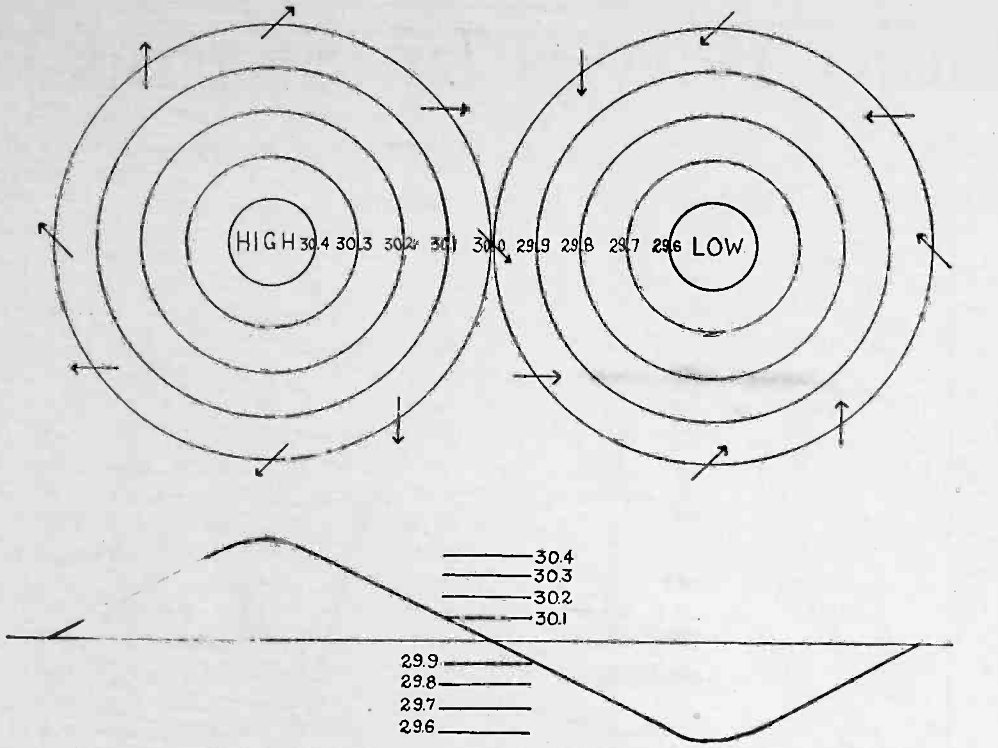


Fig. 2. Contiguous High and Low Pressure Areas with Corresponding Barometric Pressures.

In the southeast quadrant we have rain or snow, and warm winds from the south. The warm moisture laden air from the south cools as it moves toward the center of the cyclone. Its ability to carry water vapor is reduced and the moisture condenses to rain, or snow. Experiments have demonstrated that free ions are utilized as condensation points for the formation of drops when the saturation point of a gas has been reached. In this way each of the untold myriads of rain drops carries an individual charge from the air to the ground.

In the northeast quadrant we have an entirely different set of conditions. Here we have the cooler air of the cold north area moving toward the center of the storm. As the air carries comparitively little moisture there is practically no precipitation in this area. In the remaining quadrants we have intermediate conditions—cloudy with warmer temperatures in the northeast and clearing and cooler in the southwest quadrant.

A high pressure area, or anti-cyclone, is produced by the downpouring to the lower levels of the atmosphere in contact with the surface of the earth, of cold air masses from the upper reaches of the atmosphere. These air masses may come from a height of five miles. It was these upper air strata that Nikola Tesla proposed as a conducting medium for the currents of high potential and high frequency in his suggested project for world-wide distribution of wireless power. He thought that the highly ionized condition of the air in the upper levels of the atmosphere made it a universal conducting medium for the broadcasting of power.

Changes in the electrical conditions of the atmosphere naturally follow the shifting of such enormous masses of air as are involved in cyclones and anti-cyclones. They do not involve the building up of the enormous potentials which result in lightning discharges, but their aggregate produces more subtle effects of enormous magnitude.

If an iron cored and iron covered electro-magnet a few miles thick and 500 miles in diameter should rotate with a peripheral speed of 25 miles per hour, or more, on the surface of the earth we would expect electrical effects of earth-wide extent. In a cyclonic structure we have air masses of this extent, and while they are not fabricated of iron, the most paramagnetic of the elements, they have as one of their components, comprising one fifth of the whole, a substance, oxygen, that is magnetic to the extent of about 3% of iron.

The earth is a conductor and has a magnetic field of its own. That there are "stray" electric currents of natural origin flowing almost everywhere in the earth is well-known and expeditions are now busy in many parts of the earth studying them. In the giant swirling vortices of the atmosphere carrying ionized gases, magnetic gases, and charged bodies such as clouds, dust, etc., we have a condition which is potent with all the factors necessary for the generation of ground currents flowing toward the point under the center of the vortices. These in turn will produce electro-static and electro-magnetic fluxes, or fields, co-existent in space with the storms, or cyclones, which brought about their existance.

What effect the ionization of the outer layers of the atmosphere by forces emanating from the sun has in the production of the sub-permanent low pressure area over the Aleutian Islands from which most of our storms, or cyclones, come, is now a subject of investigation.

With complex electrical and atmospheric structures existing in the space through which radio waves pass, it would

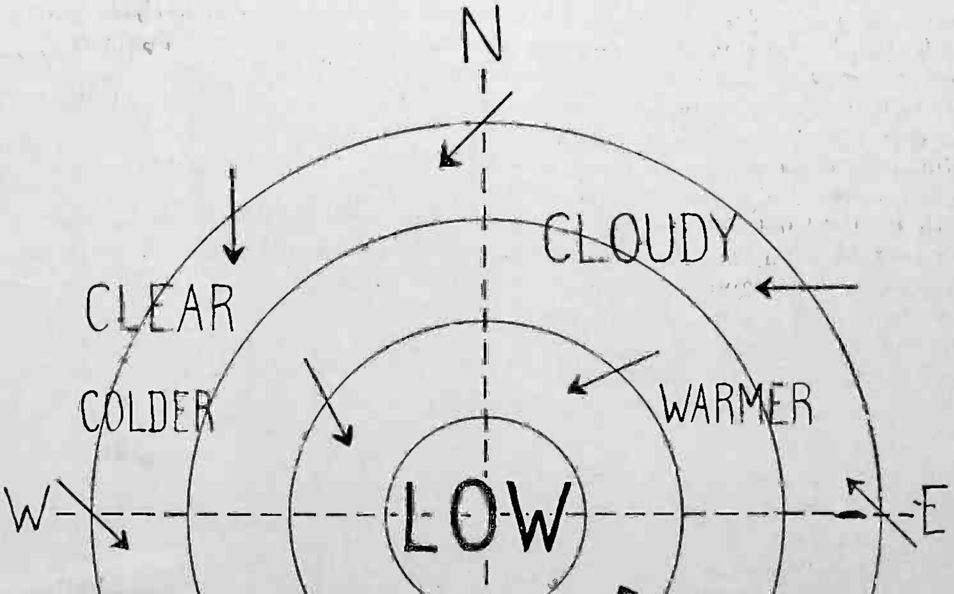


Fig. 3. Internal Structure of a Storm Area.

be reasonable to expect that the radio waves would suffer refraction and reflection in the same manner in which the electro-magnetic light rays are bent and reflected when passing through mediums of varying density. With these conditions in mind the author made numerous observations on radio reception over a period of several months, using a loop antenna receiving set.

General observations of a qualitative nature were made on the reception from various stations such as strength of signal from stations north, south and west, when the weather was clear, when rainy, when cool and warm. Clear cool weather was found best for strong signals from most stations. Rainy weather brought varying results. For instance, when there was a steady rain without lightning, stations to the north (Canada) were received with more than average strength of signal, while stations to the south (Florida) were much weaker.

Most interesting however, were the loop observations. Station WEAR in Cleveland, O., operating on a wavelength of 389 meters, was the station on which regular directional readings were taken from New York. A five tube set having two radio frequency stages was used. The loop was of the pancake type. The setting of the loop, on various nights, for maximum signal, and the setting at right angles to this for zero signal, were taken and checked against each other. These readings were then checked against the weather conditions as shown by the U. S. Weather Bureau map, available the following day.

Most of the observations did not show a variation from the calculated direction that could not be ascribed to slight errors in judgement as to the exact setting of the loop for maximum and zero signals, for the ear is not adapted to the production of precise data. But when variations of more than 10 degrees were found, these could not be attributed to errors of observation, for the receiving set was capable of giving more exact readings.

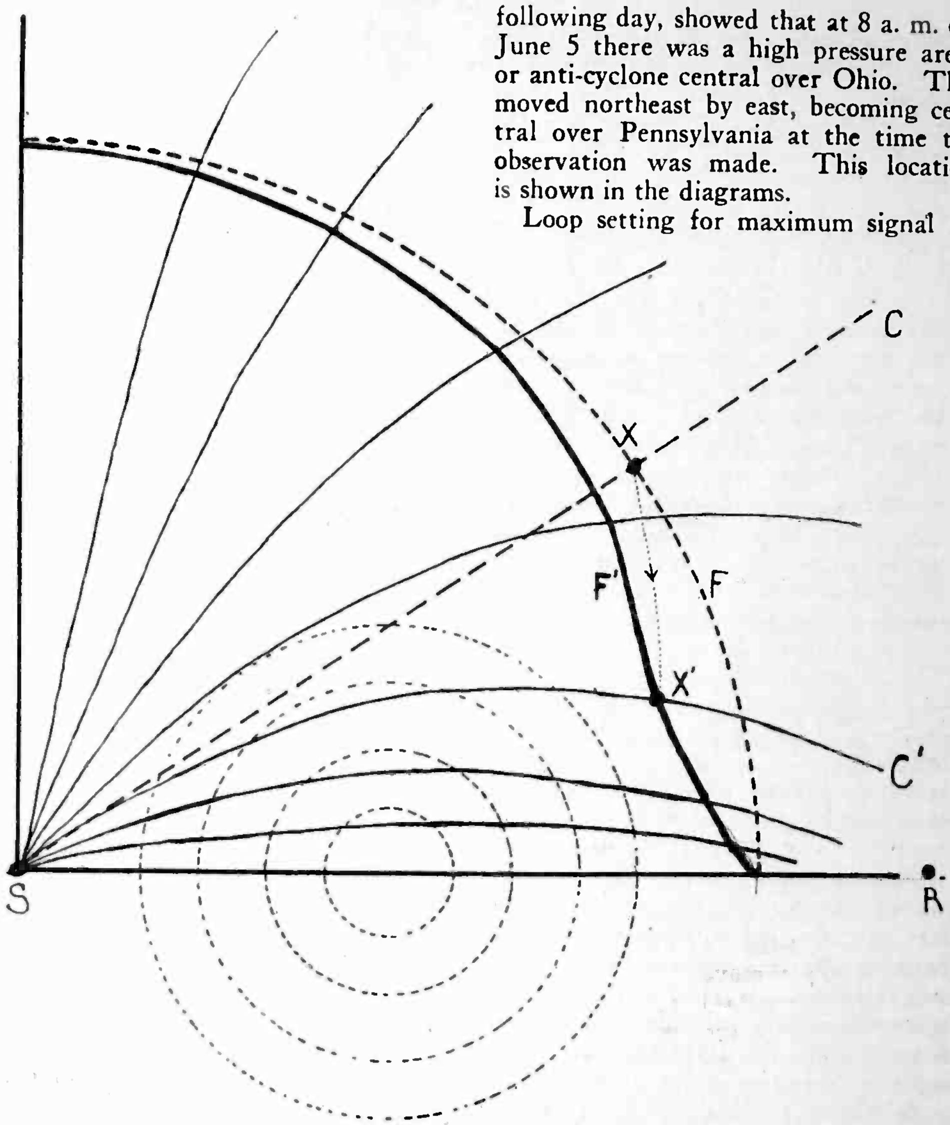


Fig. 5. Effect of Refracting Atmospheric Structure.

Typical observations in which variations from the plotted direction of the stations were observed on June 5, 1925, are shown in Fig. 4. The observations were made between 10:30 and 11:00 p. m. The weather map, available the following day, showed that at 8 a. m. on June 5 there was a high pressure area, or anti-cyclone central over Ohio. This moved northeast by east, becoming central over Pennsylvania at the time the observation was made. This location is shown in the diagrams.

Loop setting for maximum signal on station WEAR (Cleveland) gave a reading of 330 degrees. This was checked by the zero signal at 240 degrees. The normal setting for maximum signal over the extended series of observations was slightly less than 350 degrees, and the normal path between Cleveland and the receiving station at Freeport, L. I., is shown by the dotted line. The course actually traversed on June 5, as indicated by the dial setting, is shown by the heavy line.

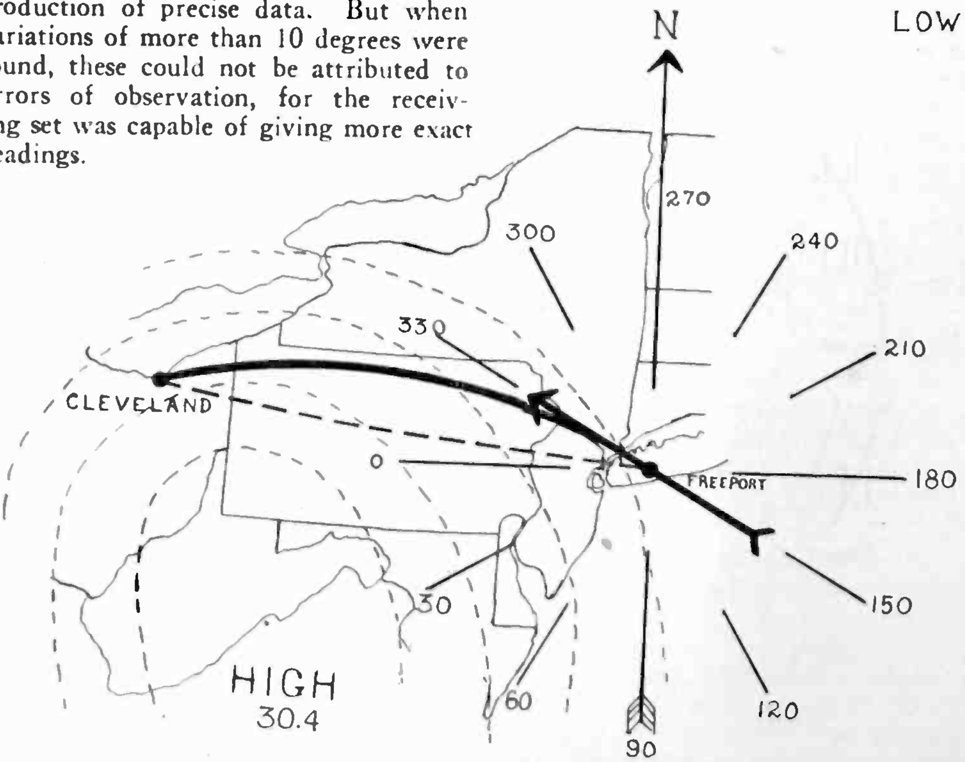


Fig. 4. Observed Deviation Due to High Pressure Area.

A deviation of still greater extent was indicated by observation on the same evening on a station to the southward, WLIT of Philadelphia. The dial settings for maximum signal was 120 degrees, while the direct air course called for a maximum signal setting of 50 degrees.

It will be noted that the indicated wave course varied to a great extent from the normal path and that the course of the refracted wave of each station tended to describe an arc of a circle concentric with the center of the high pressure area, or parallel to the isobars (*i*) in the anti-cyclone

This refraction of radio waves by atmospheric structures gives us a clue to a possible explanation of the fading that is noticed on the reception on other than local stations, and one that does not require us to resort to use of Heaviside layer reflection as an explanation of change in signal strength. With a varying refraction of the radio wave by different portions of a cyclonic structure we have a condition that will produce a distortion of the wave front and have a marked effect on the strength of the signal received.

In Fig. 5 we have a quadrant of the area between the transmitting station S and the receiving station R, in which is shown the undistorted radial courses of the emitted wave and the advancing wave fronts C is shown by the heavy dotted line. If a refracting atmospheric structure indicated by the light dotted lines, exists between S and R, the radial courses C will be bent and the wave front F will be distorted. The normal radial course is indicated by C and the course resulting from refraction by C^1. The point which the wave front F would have reached on a straight radial course C is indicated by X. The point which the distorted wave front F would reach in traveling along a bent, and therefore longer course C^1 is indicated by X^1.

Such a distortion of the wave front would not in itself produce a varying strength of signal, but a non-uniform refraction affecting the whole wave front would cause a greater intensity of signal strength in some portions of its circumference and a considerable reduction of signal strength in others.

In the radio courses C representing each area and equal signal strength distribution, are bent or refracted in a non-uniform manner, portions of the wave front in some of the radial areas will be compressed into smaller areas (A, Fig. 6) producing greater signal strength in such areas, while in other sections (B, Fig. 6) will be stretched or extended, causing a diminished signal strength. To what extent the signal strength will vary at different points but at equal distances from the transmitting station, and in various directions from it, is shown by the broad black area in Fig. 6, the greater width indicating greater signal strength. It will be evident that even slight changes in the refracting conditions at C, can cause comparatively great variations in signal strength at more distant points, or in other words, produce marked fading.

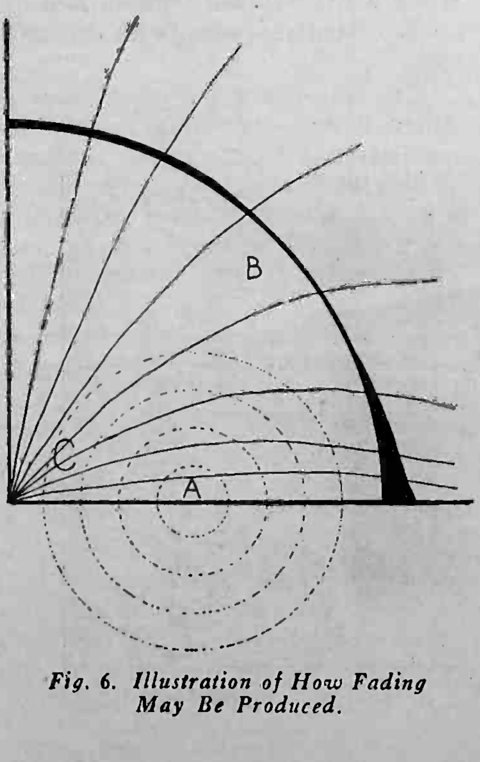


Fig. 6. Illustration of How Fading May Be Produced.

There is a vertical as well as a horizontal structure to storms. A cyclone extends a considerable distance upward into the atmosphere. The storm strata is normally about five miles thick. Electrical conditions accompanying a cyclonic structure will extend their influence still higher in the same manner that a magnetic flux will extend far beyond the confines of the solenoid creating it. A cross-section of a cyclone and an anti-cyclone is shown in Fig. 7. In a

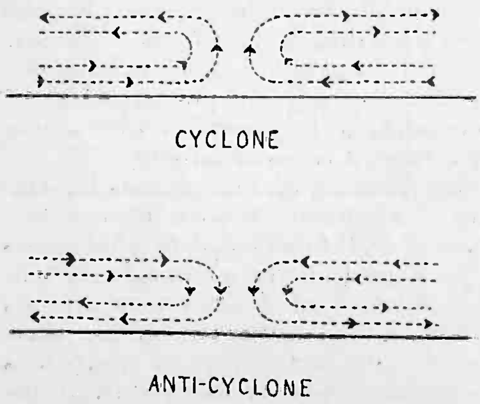


Fig. 7. Cross-Section of Cyclone and Anti-Cyclone.

cyclone the air masses that travel toward the center of the disturbance rise vertically through the core of the storm and then spread themselves out on a higher level. In an anti-cyclone the cold air masses in the upper strata of the atmosphere flow toward the center of the area and then drop vertically, producing a surface high pressure area and spread out producing a clockwise vortex of winds.

Radio waves have a circular vertical section as well as a circular horizontal section and the vertical component of the wave will be subjected to the same conditions, in passing through the vertical section of a cyclonic structure, as the horizontal component of the wave in passing through the horizontal section of the storm area.

In the refraction of radio waves with consequent intensification and diminution of signal strength we have a more satisfactory basis for ascertaining the cause and mechanics of fading than is offered by the Heaviside layer theory.

The Heaviside layer theory of fading accounts for the change in signal intensity by interference between the ground portion of the radio wave and the sky portion reflected back from the underside of a highly ionized strata of the atmosphere. The shifting in height and contour of the Heaviside layer is supposed to cause a shifting in the areas on the surface of the earth in which the reflected sky wave will be in phase with and therefore intensify the ground wave or out of phase and thereby obliterate or diminish it.

The Heaviside layer is that strata of the atmosphere in which the displays of the Aurora Borealis are staged. The Aurora Borealis is caused, according to theory, by polar magnetic deflection of streams of electrons of solar origin. In displays of the Aurora Borealis there will be observed no such easy swings of the brilliant streamers or glowing cloudlike masses that would correspond in period with the fading swings observed in radio reception. Instead there is observed extremely rapid changes—glowing cloudlike masses sweep from below the horizon to the topmost heavens in the twinkling of an eye; streamers shoot across the sky at almost incredible speeds—all in the most erratic fashion. Another fact that militates against the Heaviside layer fading theory is that observers are in agreement that displays of the Aurora Borealis have no noticeable effect on radio reception.

It is quite evident, however, that an area of electrical intensity accompanying atmospheric structures will have a pronounced effect in altering the contour of a highly ionized strata of air, and phenomena ascribed to the Heaviside layer would have its point of origin much nearer the surface of the earth.

Extensive series of observations made in many parts of the country and over an extended period of time will be necessary to secure the data necessary for the firm establishment of the theory of electrical-atmospheric refraction of radio waves. A group of amateurs, whose stations are strategically located, would gather much data as observers of broadcast stations, or better still, amateurs having transmitting stations could organize for the purpose of making observations and assembling the data at a central source, where the directional observations could be checked against the government weather map.

In controlling the current supply from the house-lighting circuits for some of the modern sets a wall-switch, with a "bull's eye" indicator, such as are used for some types of heating appliance outlets, will be handy in reminding you to turn off the set when you are through with it.

Although not required by the Underwriter's Laboratories, it is a good plan if building a new house to have a special service led from the panel at the meter to the radio set, as this will eliminate much unsightly wiring, and will also permit the right fusing of the radio circuit exclusively, which is an added safety feature. This may also eliminate interference, in some cases, from household devices, etc.

Why Do Radio Tubes Peter Out

A Simple Explanation of the How and Why of Electron Emission

By Volney G. Mathison

"I DON'T understand it," grumbled Mr. Trifflebagger to the clerk in the radio store. "These six tubes here from my super-punkadyne receiver all light up all right, but they don't work good any more. I now hear only local places; whereas I used to get . . ." (Here the clerk in the radio store sat down and took a nap, while Mr. Triffiebagger called out the names of about seven times more cities and towns than does the man in gray in the Chicago union station, when he sends off a transcontinental train.)

"The trouble with your tubes," said the clerk, waking up about an hour later, when Mr. Trifflbagger had finished, "is that they have lost their emission. They will have to be rejuvenated."

"But I have had them rejuvenated," complained Mr. Trifflbagger, irritatedly.

"Then they must have lost their emission for good, and you will have to get some new ones," replied the clerk. "Now, we have a special bargain today on Honkatrons——"

"But what is this emulsion you people are always speaking of, and how do the tubes lose it?" demanded Mr. Trifflebagger. "Why can't it be replaced, and why do the tubes still light when it is gone?"

"The emission is a kind of vapor that goes from the filament to the plate in the tube; it comes from the stuff in the filament, and when the stuff in the filament is gone, the emission stops."

"Oh, I see," said Mr. Trifflebagger. "Only a little of this emulsion stuff is put in the filament, and that little is soon gone. It's clearly a scheme of the trusts to keep people everlastingly buying new tubes. Well, give me six tubes —the cheapest ones you have."

"The cheapest ones we have are Squawking Ducks at fifty-nine cents, but they aren't very good. Now, we have a special bargain on Honkatrons——"

"Give me five of the Squawking Ducks. I've tried all grades, and I've found them all the same. No matter how much you pay for them, they lose their emulsion."

LIKE Mr. Trifflebagger, most of us have found out that all radio tubes, no matter how much we pay for them, are rather short-lived—they all have a tendency to lose their "emulsion." But it is not very clearly understood by the radio public just why it is that a radio tube does this, why it tends to become inactive long before it burns out, and, incidentally, why the process called rejuvenating will sometimes restore a tube to a state of renewed activity.

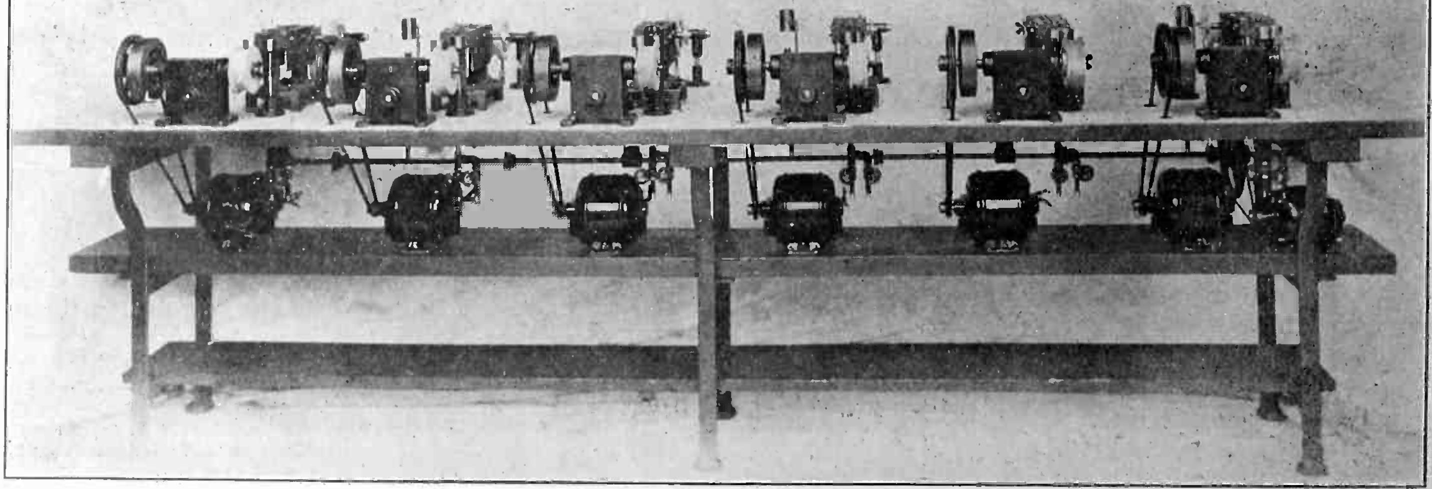
Before going into the reasons for failure of electronic emission from a filament, I shall briefly explain what causes a tube suddenly to go completely out. The filament of a radio tube becomes brittle and crystallized from the alternate heating and cooling to which it is subjected because of the *A*-battery current being turned on and off; also, the sudden turning on of the current impresses on it weakening strains, until the filament becomes so fragile that it finally breaks in two from its own weight, or snaps under a slight jar.

But how about the new tube that suddenly goes out after only a few hours of use? In this case, the filament is usually pinched so tightly in the nickel sleeves that support it that it is almost sheared off, and after only a little use it does break at this point of junction. Again, when the filament wire is welded to supporting nickel lugs, instead of being pinched in sleeves, it is sometimes almost burnt in two, in the process of welding, and so is left in a fragile state. Then, too, the filament may have been in bad shape in the first place; it may have been partly crushed or broken in the process of drawing the wire through the dies and so left in a weak condition. But the subsequent process of annealing and cleaning the wire usually discovers such flaws. Finally, careless workers in the tube factories sometimes mount straight filaments in such a way that they are under too much tension, with the result that the wire is injured. In short, when a tube goes completely out after only a little use, without having been mishandled by the purchaser in any way, it usually indicates that either the filament was defectively weak in the first place or it was damaged in the process of being cut to length and mounted into position. This is seldom found in the case of standard tubes that are subjected to rigid inspection before being marketed.

Returning now to the question of emission, it is first requisite to review very briefly the conventionally accepted fundamental action of the vacuum tube, and to tell something of the late scientific discoveries about the action of electrons.

The standard type of radio tube, as we know, is provided with three elements, filament, grid, and plate: clouds of electrons are "emitted" from the filament to the plate, and the intensity of this emission is varied by impressed voltages on the grid. The grid acts as a sort of delicate gate-valve in the plate circuit, whereby, under proper operating conditions, the plate-circuit current is an accurate, but magnified reproduction of the feeble control currents in the grid circuit.

The stream of free electrons shooting from the filament to the plate is an es-



A Battery of Tungsten Filament Wire-Drawing Machines.

sential phenomenon of tube action. These multitudes of flying electrons do not, as was once thought, carry over electricity or provide a path for electricity; they *are* electricity, in a pure, disembodied state. At this point, it is well to remark that the older idea of electric current flowing from positive to negative poles is found to be wrong; the deceiving stuff flows the other way, and our conventional positive and negative poles are, therefore, misnamed.

The fundamental requirement of a vacuum tube, obviously, is the continuous production of a liberal stream of freed electrons across a gap between two elements, in which gap is interposed a controlling gate-valve in the form of a grid. The fulfillment of this easily-stated requirement—the production of a profuse stream of freed electrons—is no simple business.

All matter, as rocks, metals, gases, and so forth, is composed of atoms, of which there are so far known to be 92 fundamental kinds, called elements. These atomic elements, in their turn, are composed of small symmetrical groups of nothing but negative and positive electrons; so, incidentally, the entire physical world, everything we see, feel, hear, touch, and smell, is made up of this one seemingly almost spiritual thing—the electron. The structure of the atom is generally conceived to be that of a rigid nucleus composed of positive electrons, or of positive and negative electrons tightly bound together, around which rapidly swirl the negative electrons, each atom therefore being similar to an exceedingly minute solar system. Some scientists, among whom is Langmuir, doubt the swirling motion of the planetary electrons, but there is a general conviction that the structure of the atom is such as has been outlined herein.

Thus the lightest atom, that of hydrogen, consists of one central positive electron and one rotating negative electron. If a hydrogen atom could be magnified so many billions of times that the central positive electron were about the size of a football, the rotating negative electron would be over a mile away and would be approximately the size of a golf-ball. All the intervening space seems to be a perfect vacuum. In a uranium atom, similarly magnified, there would be 92 swirling electrons flying at various radii up to a couple of miles around a central nucleus consisting of more than 200 positive and negative electrons rather loosely bound together.

It is well to remember that the actual diameter of the negative electrons is such that a million millions of them placed in a row would occupy about 1/6 in., and some scientists now consider the positive electrons to be about 2,000 times smaller than that; but the measuring of these things is a tough job, and there is still a little uncertainty about the size of the positive electrons.

The electrons of some of the elements, as of silicon and helium, are very persistent in remaining in their orbits about their central nucleii; they strongly refuse to budge out of the atomic systems they make up. In some of the metals, however, as in copper and silver, there appear to be a good many free or extra electrons, generally about one to each atom; and it is the lightning-like drift of these electrons that is taken to comprise an electric current. But even these semi-free electrons object to passing from the surface of a metal entirely into space—which is the action we seek in the radio vacuum tube.

The only elements from which electrons are easily hurled off into space are those which are called radioactive, as barium, strontium, thorium, and so forth. These elements are, in the first place, heavily laden with electrons, thorium containing over two hundred times as many to the atom as hydrogen does. Thorium atoms contain what is called α and β particles; the α particles being helium atoms, which in turn consist of two planetary and six central electrons; and the β particles are pure negative electrons. Thorium atoms are inclined to burst apart, like exploding flywheels, and when they do, they hurl their electrons off into space at speeds of 50,000 miles a second and more.

This disintegration of the thorium atom, with a consequent hurling forth of electrons, is sometimes conceived as representing the operating emission of a thoriated radio tube filament; but such is not the case, except to an absolutely negligible extent. Even without exploding at all, the radioactive elements are considerably inclined to hurl electrons off into space, the necessary conditions for their doing so being these: that the atoms be heated to a certain temperature and that there be plenty of other free electrons immediately available in the vicinity of the element to replace those being hurled away into space. This phenomenon may be expressed in a somewhat different way by saying that the surface-tension of the radioactive atoms is comparatively low, making it easier for the electrons to burst out of them than from some of the other elements.

It will now be clear that these radioactive elements, being comparatively good throwers-off of electrons, are the ones which must be used in the construction of the filament of a radio vacuum tube. However, we also see that merely to make the electronic emitter of a tube of radioactive material is not alone sufficient to produce a large stream of electrons through the vacuum to the plate, upon the application of the plate current. Before the emitter will throw off liberal showers of free electrons, it must be heated to a certain extent. Just why heating is necessary does not seem to be any too clear as yet. It is thought that the heat increases the velocity of the rotating electrons in the element comprising the emitter part of the filament, thereby causing them to be more easily hurled off into space against the surface tension. If this is the case,

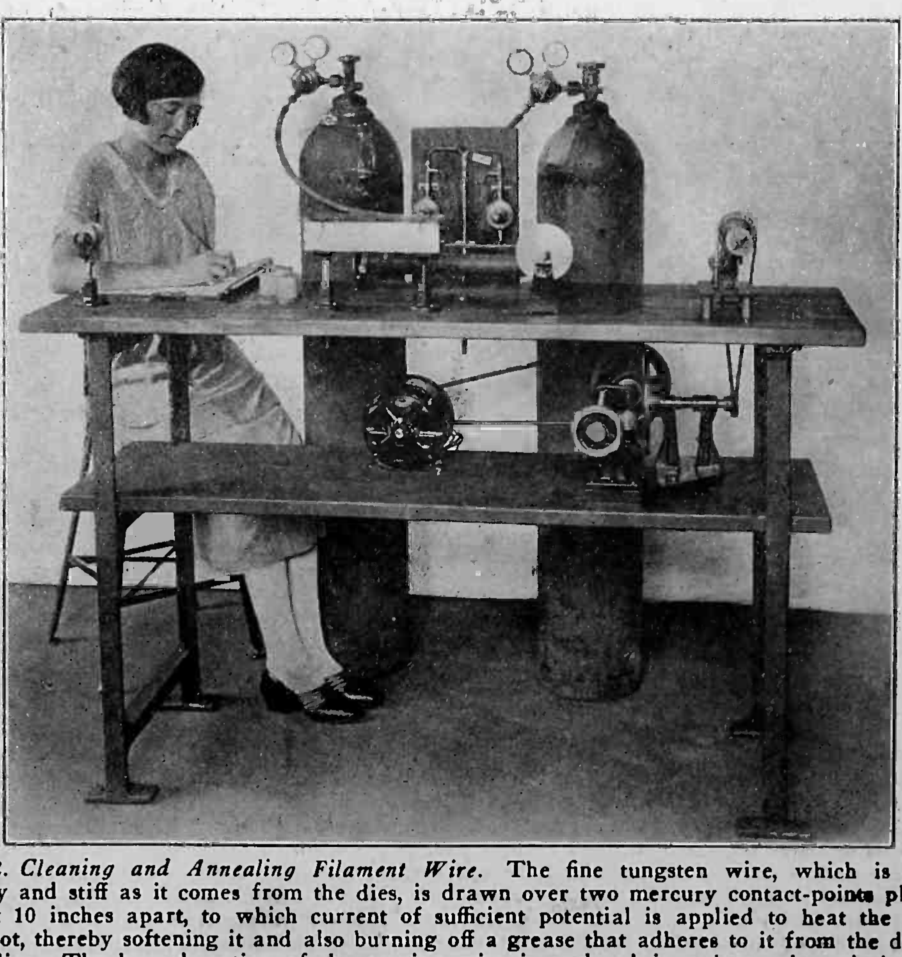


Fig. 2. Cleaning and Annealing Filament Wire. **The fine tungsten wire, which is very snarly and stiff as it comes from the dies, is drawn over two mercury contact-points placed about 10 inches apart, to which current of sufficient potential is applied to heat the wire red-hot, thereby softening it and also burning off a grease that adheres to it from the drawing dies. The heated section of the moving wire is enclosed in a box, where it is continuously bathed in purifying gases fed from the steel cylinders.**

it is still not very clear why the application of heat increases the swirling motion of the electrons to such an extent as it is thought to do.

But we do know that heated radioactive materials are profuse emitters of electrons. Therefore, radio tubes are made with filaments of radioactive material, such as thorium, barium, and strontium; and, for the purpose of heating, these elements are blended into or cemented upon wires of tungsten, platinum, or certain cheaper alloys. The hot tungsten filament of a 201-A or 199 type tube serves to heat the radioactive thorium compound incorporated in the wire, and, at the same time, provides a conducting path to carry in electrons to replace those thrown off from the thorium into the adjacent vacuum. The electrons may be said to be fed into the filament from the negative end of the *B*-battery. From the filament they shoot across the vacuum to the plate; and thence most of them return to the positive side of the *B*-battery.

It is, as I have already indicated, a popular idea that the prolific emission of electrons by the thorium or strontium of a tube filament is the result of a chemical decomposition of the radioactive material. It has been conceived that the thorium or strontium is converted or broken up into electrons, and that when the thorium or strontium has been all thus used up, the emission of electrons ceases.

But some reflection will show that this idea is absurd. A vacuum tube in operation emits millions of electrons per second; and if these immense quantities of electrons were all the decomposed parts of the minute amount of thorium oxide in the filament, why then that thorium would be completely exhausted in five minutes, and the tube would be stone dead before you had time to hear the announcer saying, "The selection to which you have just listened is *Tomatoes y Spaghetti* by Madame Tony de la Patooty."

The electrons that shower across the vacuum in the radio tube are furnished by the *B*-battery; and the thorium, barium, or strontium in or on the hot filament merely provides a fairly efficient release surface from which the electrons can be shot away into space. Nothing in the thorium or other radioactive material is used up or changed directly because of the operating emission. Nothing in the tungsten filament, either.

The filament of a 201-A type tube, in the course of six months of operation, casts out enough electrons to equal those contained in perhaps a pound of tungsten or thorium. These electrons practically all come from the *B*-battery. The thoriated or strontium-coated filament is merely an objecting place for them—somewhat as the nozzle is the escaping point of a high-pressure line of fire-hose. If the emitted electrons were all released merely through the disintegration of the filament, we should hardly need any plate-circuit battery—any *B*-battery.

Then, we ask, what does become of the thorium or strontium in the radio tube filament? Mainly this: the heat ruins and destroys it. In the hot filament, there is a lot of boiling, seething, and crackling going on. Despite its minute diameter, the filament is much hotter in the middle than it is at the surface, owing to the dissipation of heat from the surface in the form of infra-red rays. As a result of this difference in temperature between the middle and the surface of the filament, the thorium oxide of a 201-A or 199 type tube, after being converted by the heat into a metallic compound, moves out to the cooler surface and there forms a scale or coating of a kind that is not a good emitter of electrons. In the case of the UX-12 type of tube, in which the radioactive strontium is cemented onto the surface of the filament, and not impregnated through it, the heat gradually cracks up and burns away the active coating on the wire. So the electronic emission of the tube falls off; in other words, the amount of current allowed to flow in the plate circuit grows less and less, with a resultant reduction in the volume of music obtainable from the receiver.

But how is it that a tube with a thoriated filament may be sometimes brought to a state of renewed activity by rejuvenating it? To "rejuvenate" a radio tube means simply to apply a current of comparatively high voltage to the filament (about 16 volts in the case of a 201-A type and from 8 to 9 volts in the case of a 199 type), which heats it almost to the melting point and burns off the coating on the surface of the thoriated wire which obstructs the emission of electrons. When this has been done, the tube will again act, provided there is still some thorium oxide left under the burnt-off coating. Tubes that have filaments coated with strontium, as the WD-11 and UX-12 type, cannot be rejuvenated; because these tubes have their active materials cemented to the wire instead of impregnated through it, and the heat applied at the normal operating temperature gradually cracks up and burns away the active coating, thereby permanently destroying it.

It is of course true that the natural radioactive action of the thorium and strontium would eventually disintegrate it; but this action is independent of the operating emission, and it probably would take more than a hundred years for a tube to peter out solely from this cause. The principal reason, in fine, that a tube becomes inoperative, though still lighting, is that the active material in the filament is damaged and finally destroyed by the heat necessary to make it function.

It seems too bad that an entire tube must be discarded intact, when the only thing that has worn out is the filament. In some large power tubes, the filaments are renewable. The shell of the tube is in two parts, which are separable, and a mercury-vapor pump is attached for re-establishing a vacuum after a new filament has been put into place. But in the case of the common varieties of receiving tubes, it has not been found commercially profitable to replace the destroyed filaments. The cost of collecting burnt-out tubes, of opening and cleaning them, of replacing the filament and re-exhausting the bulb is greater

(*Continued on Page 50*)

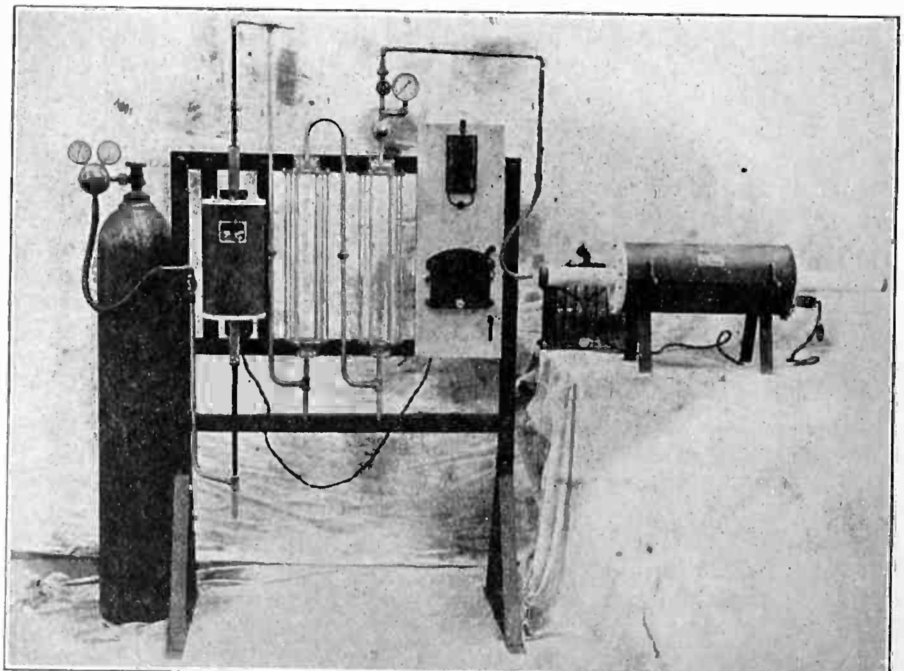


Fig. 3. Hydrogen-Purifier and Electro-Hydrogen Cleaning Furnace. Hydrogen gas from the steel cylinder is passed through several purifying chemicals, and thence is introduced in a 100% pure state into an electrically-heated furnace, wherein are quantities of radio tube parts heated white hot. The hot hydrogen bath removes all gases and foreign impurities from radio tube plates, and other parts, leaving absolutely pure metals that will not afterwards throw off gases when sealed into the bulbs of vacuum tubes. This furnace will turn thick flakes of iron rust back into pure silvery iron.

The ABC of "A," "B" and "C" Circuits

An Exceedingly Simple Explanation of the Amplifying, Detecting and Generating Action of a Vacuum Tube

By Arthur Hobart

A VACUUM tube has three circuits, corresponding respectively to its filament, its plate, and its grid. The function of the filament or *A* circuit is to heat the filament so that it will emit negative electric charges, as fully explained elsewhere in this issue by Volney G. Mathison. That of the plate or *B* circuit is to attract these negative charges from the filament to the plate. The *C* or grid circuit controls the movement of the negative charges.

The mechanical action of these three circuits can be well illustrated by a kettle of boiling water, a vacuum cleaner and a tire pump, arranged as in Fig. 1.

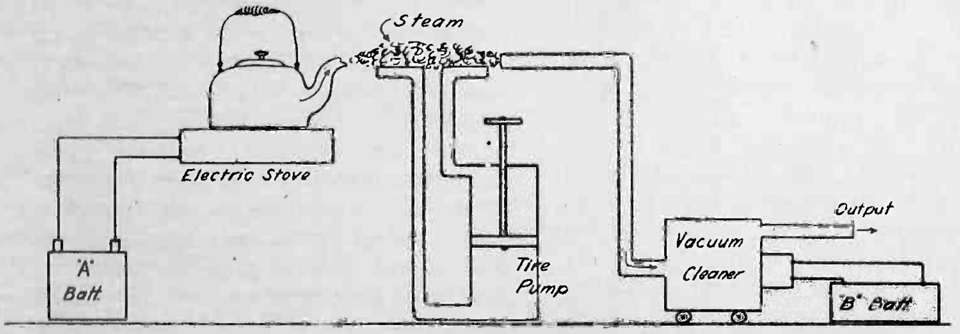


Fig. 1. Mechanical Illustration of Vacuum Tube Action.

The kettle is heated by an electric stove connected to an *A* battery, thereby causing steam to be emitted from the spout. The vacuum cleaner, which is run by a high voltage *B* battery, attracts the steam from the spout. The two outlets of the tire pump are placed between the spout and the suction intake so that one tends to blow the steam back into the spout during the down-stroke and the other helps to blow the steam into the suction during the up-stroke.

When the tire pump is not working the steam flows continuously from the spout to the suction intake. The more heat applied to the water, the greater the steam flow. Furthermore the stronger the suction, the greater also is the steam flow through the cleaner.

When the pump piston is pushed down some of the steam is blown back. When it is pulled up more of the steam is blown into the suction. Thus the piston movement changes or regulates the steam flow. Furthermore any small change in the piston movement is reproduced and magnified as a corresponding large change in the steam flow.

The steam from the spout obviously represents the negative electric charges emitted by the filament when it is heated with current from the *A* battery. The suction of the vacuum cleaner likewise illustrates the action of the positive plate as it attracts the negative charges due to the fact that the positive potential of the plate is maintained by connecting it to the positive terminal of a high voltage *B* battery while the negative condition of the filament is assured by connecting it to the negative terminal of the same battery.

This flow of negative electric charges constitutes an electric current which is conventionally represented as flowing from the positive terminal of the battery to the plate, across the vacuum, to the filament and thence to the negative terminal of the battery. This *B* circuit is closed only when electrons are flowing from the filament to the plate. Consequently when the *A* battery is disconnected there is no drain on the *B* battery.

The tire pump simulates the action of the grid placed between the filament and the plate so as to control the flow of the negative electric charges. As the grid alternately becomes positive or negative, in accordance with alternations of the oscillating voltage which may be impressed upon it from an aerial or from the plate of another tube, it tends either to repell or attract the electrons just as the piston movement repelled or attracted the steam. These small alternations in grid voltage are faithfully reproduced and magnified in the current flow between the plate and filament much as the small motion of the pump is reproduced in the large steam flow from spout to suction.

This thus illustrates the action of a vacuum tube as an amplifier. A small current in the grid or input circuit becomes exaggerated as a large current in the plate or output circuit. All variations in the small grid voltage are reproduced in the much greater plate voltage. The energy coming to the grid releases the energy in the plate circuit. Strictly speaking, a vacuum tube is not an amplifier but a controller. A relatively large amount of energy in the plate circuit is controlled by a relatively small amount of received energy in the grid circuit.

To function as a detector the tube must rectify or change a high frequency alternating current, to which a telephone diaphragm will not audibly respond, into a pulsating direct current which the telephone can convert into sound. This requires that some kind of a one-way valve be placed in the *C* or grid circuit. Two methods are in use for this purpose, an understanding of whose action may again be aided by our mechanical analogy.

Suppose that the upper outlet of the tire pump is closed so that the pump works only during the down stroke of the piston, when the steam tends to be repelled back toward the spout. In this way one-half of the effect of the piston motion is suppressed. The other half of the variations in piston motion, let us say the negative half, is reproduced as corresponding, but much larger, variations in the steam flow from the spout to the cleaner intake. Thus the former pulsating alternations of piston movement are changed into pulsating one-way movements which control the steam flow.

In the usual detector tube circuit the one-way valve is the grid condenser and grid leak, a fixed condenser shunted by a high resistance in the grid circuit. The condenser is alternately charged positively and negatively by the incoming alternating oscillations. As the grid is made negative with respect to the filament the flow of negative charges from filament to plate naturally becomes less. When it is made positive some of the negative charges are attracted to and stored in it, more and more of these being stored up as the oscillations continue. If this storage process were not checked the grid condenser would finally become negative enough to entirely block the flow of negative charges to the plate. But by allowing its excess negative charges to gradually leak off through the high resistance or grid leak, the grid may be kept just negative enough to suppress the positive component of the incoming oscillations and pass the variations in the negative component. Thus the grid condenser and leak act as a one-way valve which releases the *B* battery energy during one-half the period and has the effect of rectifying the current.

Another less frequently used method of maintaining the grid at a slightly

(*Continued on Page 56*)

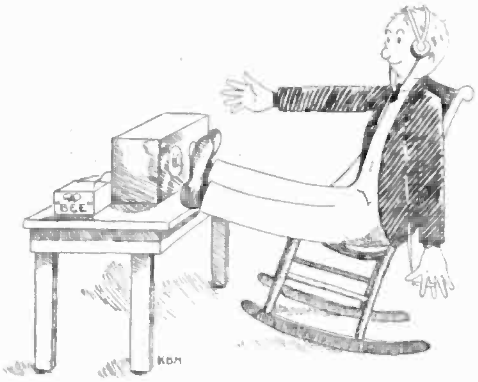
What's What in Radio Inconsistencies

Some Truths Spoken in Jest and Some Jests Spoken in Truth

By Kirk B. Morcross

On an average evening the average B C L with an average receiving set adjusts himself and chair to a position of comfort and waits to see what's coming. I am an average broadcast listener. One average evening I adjusted my average receiving set to—let us say—station ABCD. I heard the voice of the announcer in the headphones.

"Station ABCD will resume its program in one minute," it said. The tone of his voice was quite charming and I was lulled into a condition of child-like trust. I waited five minutes instead of one, adjusted the phones upon my head, waited one minute and thirty seconds more, and at the end of this period station ABCD "resumed its program." You think it strange that I did not tune for another station during the interim? Grapenuts![1] My feet were in the way and I could not reach the dials of the set.



"Could not reach the dials."

Albeit this experience was not without its benefits. After listening half an hour longer I became aware that the headphones—the kind that don't smart nor hurt the ears—were doing so, so I removed them and rubbed one ear meditatively. It seemed to me that it was unfair of radio announcers to misrepresent the time interval between numbers and it seemed equally unfair that manufacturers should underrate the pinching qualities of phones. In thinking of these inconsistencies of radio I got to speculating about others. My thoughts began, quite naturally, with things relating to broadcasting stations and after following a devious path, including inconsistencies relating to both amateur and broadcast activities, they ended with a "plop" into the realm of early broadcast receiving sets. That my brain was not seriously damaged may seem miraculous.

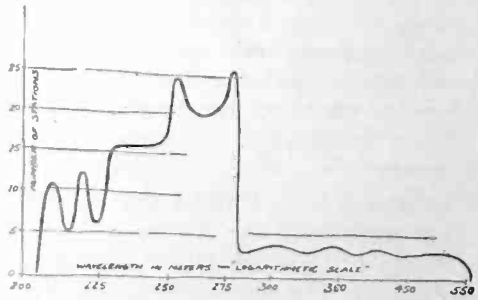
"First," thought I, "what about the inconsistencies of call letters assigned to broadcasting stations?" They *are* inconsistent because most of them have no special meaning. Not only this, but some of them are decidedly unwieldy and contain letters that are difficult to recognize. F and S, for example, should be entirely eliminated. You can't tell one from the other over a phone wire and although Simon pure radio is an improvement in this respect, extraneous noise often offsets this advantage. On the basis of this argument about half the alphabet could be eliminated. This would not leave enough letters for the 500 or more broadcasting stations and so we would have to eliminate about 300 stations as well. This, of course, is impractical."

Having satisfied myself as to this point I got out a high power reading glass and a brand new list of broadcasting stations arranged "alphabetically by states and cities" and began making more discoveries. I had always known that broadcasting stations situated inside the boundaries of the Volstead Act used either W or K as the first letter. I now discovered that "W" stations were almost always in the East while "K" stations were situated in the West. They dovetail together in some of the Mississippi Valley states but on the whole the designations are quite distinct. There is one famous exception of course, KDKA in Pittsburg.

Having made this "first letter" discovery I tried to dig out a translation from the complete call letters. In this I often struck a snag. There were, to be sure, a good many letters having definite meanings—KOP, the police station in Detroit; WLS, "World's largest store," near Chicago; KHJ, "Kindness, happiness, joy," Los Angeles; KVOO, "Voice of Oklahoma"—and some others. On the other hand I found that prying loose a meaning from many station letters required the nerve of a life insurance agent and a mind as flexible as the decrement of a spark transmitter. Try this game yourself sometime. It is as fascinating as crossword puzzles and more difficult.

Another inconsistency about broadcasting stations (and this is important) is the comparatively greater number of stations which are assigned frequencies above 1070 kilocycles or below 280 meters. An interpretation of this is given in the accompanying sketch. The curve is an "envelope" including the important peaks and valleys caused by different numbers of stations at different points in the frequency band. This curve is not a sure-fire copper-riveted method of illustrating the comparative congestion in the two sections of the broadcast band because on the average the high frequencies use less power and do not have as continuous a transmitting schedule as the low frequency stations. But even making allowances for these two factors the high frequency stations have the short end of the argument as far as space in the ether is concerned. As every cloud has a silver casing the owners of such stations may be consoled by the fact that the congestion of their frequencies has contributed its bit toward the sale of straight line frequency condensers. The set builder seeks something to spread these stations further apart on the dials, which is what the straight line frequency condenser does. If in addition, it could stop several stations from broadcasting simultaneously on the same wave, it would be a true world beater.

One of the most conspicuously inconsistent things in radio is this insidious



Approximate Distribution of Broadcast Stations.

"high-wave low-wave" vernacular. The growth of these expressions was not less rapid nor miraculous than Jack's beanstalk. Some thoughtless person planted the "hi-lo" seed and up sprang the beanstalk reaching its tendrils alike into the pages of radio advertising, the mouths of amateurs and broadcast listeners and even the craniums of professional radio engineers. In olden times if anybody had started anything like this he would have been thrown into a dungeon. But in this present age of radio we can get by with most anything.

The first time I heard the expressions "high wave" and "low wave" it gave me a feeling of joyful ecstacy. Like any innocent radio phan I assumed that some one had discovered just how waves travel. I pictured them moving in orderly batallions in ether strata, the little low waves close to the ground, the less little waves a little higher, still others a little higher and so on up to the Heaviside layer. Later I learned something to the effect that waves don't travel that

[1] "There's a reason."

way. Instead they don't observe any definite form of etiquette but move through space as best suits their own particular convenience. Some are horizontally polarized, some are vertically polarized; some even get tired of being polarized and "depolarize" themselves, twisting and turning about while sliding through space. Also they frequently get discontented and start investigating the upper regions and upon encountering the Heaviside layer they walk along it heads downward by way of diversion, then once more getting reckless they bounce back to earth again. Quite frequently they bump into a part of themselves left below, causing fading and even distortion.

Had I known all this before hearing the hi-lo vernacular it would have saved me much useless rejoicing. On the whole, speaking of high and low waves is just about as sensible as speaking of "short" and "long" frequencies. The only way I can remember which are "high" and which are "low" is by looking at the dials on the receiving set. Truly this is an example of a radio inconsistency having an appeal which is appalling in its magnitude but fortunately it's of the harmless variety.

A very peculiar inconsistency relating to well-known vagaries of radio transmission is found in the ability of some radio manufacturers to make sets which will receive through any kind of interference short of the receiving antenna being hung directly under that of the broadcasting station and from any distance under 12,500 miles. At least so one might almost infer from the reading of certain advertisements. Such claims are frequently punctuated with less violent ones by way of variety. Fortunately there are many manufacturers of A-1 sets who (praise them!) avoid making definite statements as to the receiving range of their equipment. This is as it should be, since the great variation in intensity of received signals can not be smoothed out in the receiving circuit no matter how sensitive it may be. Radio engineers have spent much time and effort in getting bona fide data showing the variations in received power from distant stations but it seems as though some manufacturers have got the best of these vagaries and have surreptitiously developed sets which are unperturbed by changing conditions in space.

An odd inconsistency concerning antenna construction was recently noted in a radio advertisement. This pictured a remarkable achievement that at first sight appeared to be a cross between a baby cage and an over-size lampshade. However, since the device was used on a pole out of doors, which was not only inaccessible for babies but unnecessary for a reading lamp, one concluded that it was intended to be a "cage" antenna. The advantages claimed, while easy enough to swallow by one uninformed in radio matters, did not always check with the scientific principles underlying the operation of antennas, many of which can be verified experimentally by any second-rate radio engineer.

Discussions of frequency and wavelengths are getting rather stale; nevertheless we can probably get by with it here on the grounds of inconsistency. We speak of the length of received waves then without even putting a period at the end of the sentence and without batting an eye, we finish up with a reference to the intermediate frequencies in our superheterodyne set! A prominent radio engineer dictates a letter in which appears a sentence like this: "The *wavelengths* from our station have excellent carrying power and the *frequency* of the received signals is non-variable." If this isn't inconsistent what is it?

Some persons think wavelengths ought to go where bustles and pug-dogs went and that frequencies should be adopted exclusively. Personally I am not arguing for the abolition of waves; what I *am* advocating is consistency in the use of the two terms. (I believe you can trip me up on this statement by noting some of my expressions elsewhere in this article).

For amateurs, the use of frequencies has at least two objections. One is that the allocation of their stations in frequencies takes a good many figures. For instance it's much easier to write "40 meters" than "7,500 kilocycles." A way to eliminate this difficulty is to write it "7.5 megacycles." This shifting of the decimal point three places to the left gets rid of two useless ciphers. The second objection is more serious. Consider the wave band of 18.7 to 21.4 meters—only 2.7 meters wide. Now reduce this to kilocycles and it becomes 16,000 to 14,000 kilocycles—a width of 2,000 kilocycles! If the amateur wishes to secure wider wavelength bands, specifying the band in kilocycles seems to be a serious "fox pass" since in that case he would appear to be getting a much wider space in the ether. Consequently his chances of getting it might be lessened.

But after all, the radio fraternity—scientists, engineers, "would be's," "has beens" and everybody else who has connected a *B* battery to the *A* battery posts—is getting pretty well informed about frequencies. Hence they are not so likely to be fooled by the space occupied by so many meters or kilocycles. Further, the convenience of allocating broadcasting stations by frequencies is not to be denied.

Radiation or "reradiation" is one of the inconsistent things of radio. Why should a receiving set be allowed to transmit? When an amateur assembles a transmitting circuit he must secure a license to operate even over a limited portion of the wave band and must also give proof of his sanity, general intelligence and similar attributes. On the other hand, a person who never saw a radio set before has a perfect right to pick out one that incorporates oscillation in its circuit, connect it up to a life-size antenna and broadcast disturbances over the whole ether band from A to Z, subject to frequency limits of his set. It may be suggested that such disturbances do not carry very far. Probably a good many of them don't; furthermore a good many oscillating receiving sets are so constructed that they do not radiate. However this still leaves some DX possibilities for radiating sets and it is a pretty safe statement that there is no fixed limit to their transmitting range. The writer has frequently heard whistles of good intensity—the kind that come

Photo by Underwood and Underwood

American Committee in Charge of Program for International Radio Telegraph Conference to be Held at Washington Next Spring. Members of the Committee are, from left to right: Frank McIntyre (State Department), Major J. O. Mauborgne (War Department), W. D. Terrell (Commerce Department), Chairman; L. A. Corridon (Commerce Department), W. M. Greene (State Department), E. M. Webster (Treasury), H. C. Moore (U. S. Shipping Board), and Lieut. Commander A. H. Tawresey (Navy).

from receiving sets—on a set of only average sensitivity and when it was definitely known that the nearest other receiving antenna was a quarter of a mile away. Amateurs transmit thousands of miles on ridiculously low power so why shouldn't a radiating set cover thousands of feet quite comfortably?

Sometimes a radiating set serves a really charitable purpose. One example is of interest. I had a crystal set hooked up to an inside antenna and with this layout I anticipated nothing save the local station. My neighbor had a radiating set and very accommodatingly tuned it to a distant station. I tuned my simple crystal set to the same wave and received the whole program—a distance of three hundred miles or more—as well as he did, minus some noise in the more sensitive receiver.

Organized effort to reduce interference from radiating sets has done much to reduce this trouble. It has been found that many owners of such sets were unaware that they were causing any interference and as soon as they are informed of the fact they observed precaution in the operation of their sets. No doubt the majority of BCLs are thus inclined.

A bill now pending in Congress will, if passed, have an effect on the manufacture, sale and operation of radiating sets. This bill was introduced in the House of Representatives Dec. 15, 1925, by Representative Wallace White of Maine and provides for "The regulations of radio communications and for other purposes." Provision is made for the establishment of a National Radio Commission of five members appointed by the President. The use of apparatus by "person, firm, company or corporation" for radio transmission purposes within any state when the effects extend outside the state or when such use causes interference with communication outside the state or vice versa, is prohibited. Violators are to be punished by heavy fines or imprisonment.

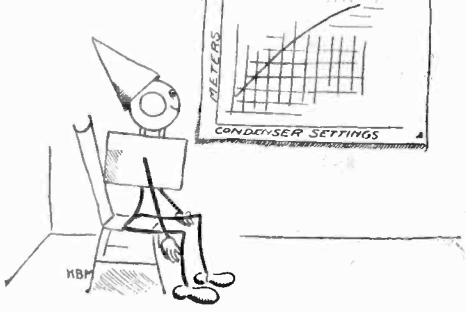
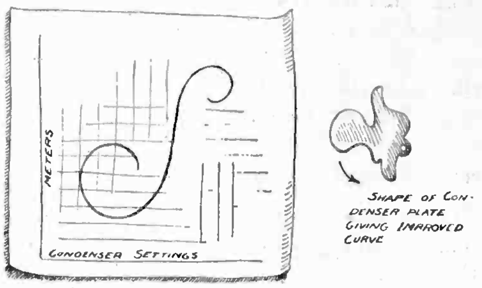


Fig. 1. Portrait of Simple Wavemeter and Curve.

Another inconsistent thing in radio is found in wavemeters. These instruments are entirely too simple. Whoever heard of a device for measuring anything as complicated and mysterious as radio waves that consists of nothing more than a little coil of wire, a simple variable condenser and something to indicate resonance such as a common electric light bulb? To make matters worse, this ridiculously simple piece of equipment is supplied with a very unornamental calibration curve commonly designated as "smooth" and it is painful to note that most engineers actually take pride in having a smooth unattractive curve. I have pictured this undecorative achievement in Fig. 1. Note the absence of



Improved Wavemeter Curve Giving More Pleasing Appearance.

relief from drab monotony of the thing. This objection can be readily overcome by the simple expedient of making the curves of graceful contour. In this, one may use an almost unlimited number of designs. I have pictured one of these in Fig. 2; it strikes the happy medium between severe simplicity and that condition best described as "blasé." Fortunately in securing attractive curves, the wavemeter condenser plates must be redesigned and cut to an intricate shape. Thus we are adding to the complexity of the wavemeter and kill two birds with one stone. In Fig. 2 also I have sketched the shape of condenser plate giving the calibration curve in question. It is unfortunate that this plate can not readily be made of a shape equally pleasing to that of the curve. Apparently the only way of securing this result would be to have the plates of varying thickness at different points over their surfaces. Thus to avoid an ugly projection on the contour of the plate or to remove an unsightly notch, it would only be necessary to vary the thickness at these points by predetermined amounts. Condensers are actually available on the market which *do* have such varying thicknesses but the manufacturers have apparently decided to confine their efforts to securing simple effects such as the attaining of a straight line calibration curve with a semi-circular plate condenser.

Of all inconsistencies in the radio field none are more interesting than those exemplified by the design of some of the early broadcast receiving sets. The manufacturers evidently thought the broadcast listener was a highly trained radio specialist and put plenty of controls on the panel to keep him amused. It is doubtful if the person uninformed in radio matters ever remembered the use of all those knobs, dials, switches and what not from one day to the next, and it is quite certain that no self respecting radio engineer would consent to use such a set without operating on its insides and amputating some of its appendages. Hence why such a layout in the first place? The manufacturers themselves were probably never able to answer that question for it was not long before such sets disappeared from the field of public view.

Instead of making complicated panels some designers amused themselves by adopting trick arrangements of binding posts and tube sockets. A certain set had the *A* and *B* battery posts marked with very small letters and to further aid in the difficulty of identification, the binding posts were mounted at the rear of the set in the most inaccessible position. The idea was, of course, to encourage the burning out of tubes by getting the *B* battery on the *A* battery posts and in all probability the tube manufacturer paid the set maker a certain percentage of his profit on tube sales over a specified amount.

The writer recalls quite distinctly another set provided with a horizontal panel of generous size (what filled all the space below it was a mystery). Holes were provided near the center of this panel through which the tubes were inserted in sockets mounted below the panel. The tubes were left exposed so that they would shine brightly in the eyes of the radio listener. The tubes were mounted very close together. This made it more difficult to remove them from the sockets and increased the probability of the hand slipping and getting punctured on the sharp tips.

The other interesting feature of this set was found in the *A* and *B* battery binding posts. In spite of the available panel space these posts were mounted very close together, thus rendering the making of connections as difficult as possible. This close spacing of the binding posts materially contributed to leakage losses, assisted in frequent "shorts" between *A* and *B* batteries, and since the thumb nuts had sharply knurled edges, they were very effective in removing skin from fingers in making connections.

It's a far cry from the early sets of this type to the majority of sets produced at the present time. What with single dial controls, pleasing design and beautiful cabinets one must admit that this progress, made all in a few short years, is of great significance. Certainly we may say that it is an indication that at least one kind of radio inconsistency had been given the gate. May we not conclude likewise that a good many of the rest of 'em are on the toboggan?

A Tuned R.F. Amplifier

A Simple Means for Increasing Sensitivity and Selectivity and for Preventing Radiation From Any Receiver

By G. M. Best

MOST of the superheterodyne receivers described during the past two years have consisted of the conventional oscillator, two detectors, two or more stages of intermediate frequency amplification and the usual number of audio stages. Occasionally a receiver incorporating a stage of tuned r.f. amplification ahead of the first detector has appeared, but was frequently not very successful due to lack of shielding, with consequent coupling into other pieces of apparatus in the set, and troubles such as oscillation at very high frequencies, and lack of selectivity.

The advantages of the r.f. stage ahead of the first detector are obvious. If properly constructed, the amplifier will make it possible to hear stations not otherwise audible, will prevent energy being radiated from the heterodyne oscillator tube, and will improve the selectivity by reducing the number of harmonics picked up on the oscillator condenser dial. To obtain all these advantages, however, it is advisable that the r.f. amplifier be shielded, as an unshielded amplifier may be worse than none at all. By shielding the back of the panel and the inside of the cabinet, the shields being connected to ground, most of the difficulties due to picking up energy in the wiring of the amplifier is eliminated, and feedback from the superheterodyne itself is obviated.

Such an amplifier as here described can also be used ahead of any radio receiver, where added selectivity and sensitivity are required. Its theory can best be understood by reference to the schematic wiring diagram in Fig. 1. The amplifier consists of an input transformer with secondary tuning condenser, a vacuum tube, output transformer and a regenerative control, as well as miscellaneous associated apparatus.

Panel View of R. F. Unit.

For convenience in tuning, the two r.f. transformers are of the plug-in variety, so that by the use of coils having different turns ratio, the amplifier may be made to cover all waves from 50 to 600 meters, and higher if desired. The antenna circuit is aperiodic, the antenna coil being untuned, and arranged so that it can be coupled loosely to the secondary. The secondary is designed to work with a variable condenser having a capacity of .00035 mfd., and is of the split winding type. The tuning condenser is shunted across the entire secondary, and the center tap is connected to the filament through the filament rheostat, thereby providing the grid of the tube with sufficient negative potential for proper operation.

The plate circuit is connected to the secondary coil through a small variable air condenser having a maximum capacity of not over .000025 mfd., so that a reasonable amount of regeneration may be employed, when it is needed. The output of the amplifier tube is fed into the primary of the second transformer, which is identical with the antenna tuner, and is shunted back to the filament circuit through the 1 mfd. by-pass condenser.

High frequency is kept out of the *B* battery circuit by means of a radio frequency choke, as shown in the diagram, and at the same time, any disturbances in the *B* battery circuit emanating from the superheterodyne are kept out of the amplifier, a most desirable characteristic. As the impedance of the primary winding is quite low, it is desirable to insert a small r.f. choke in the plate circuit, between the tube and the primary winding, in order that some of the energy can be fed back into the grid circuit. This choke will limit the tendency of the amplifier to oscillate at some ultra high frequency, and at the same time will not cut down on the amplification in any detrimental quantity.

The filament rheostat provided is not absolutely necessary. It is advisable to use an automatic filament resistance cartridge to limit the current to the rated value without the necessity of installing

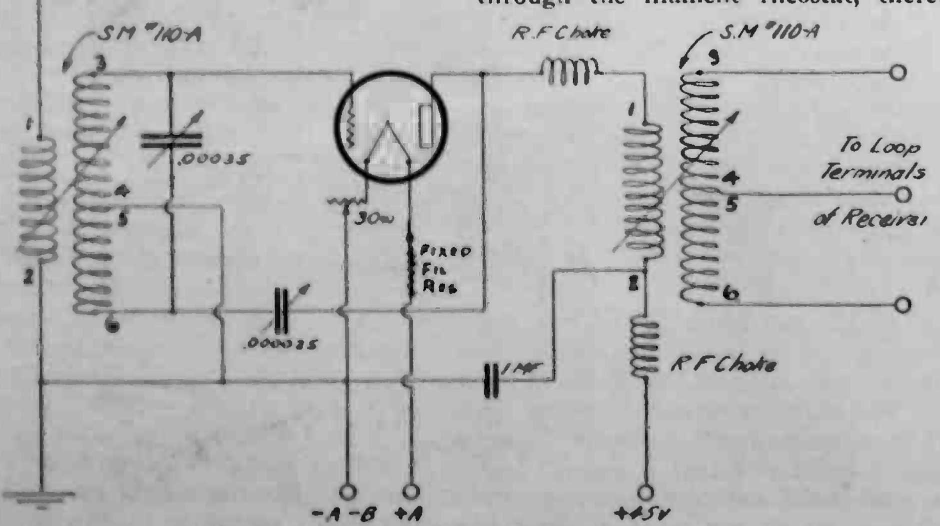


Fig. 1. Schematic Wiring Diagram of R. F. Unit.

a voltmeter, but at the same time, if the amplifier is to be used for controlling the volume, the rheostat makes an excellent control, and the 30 ohm size will serve either for dry cell or storage battery tubes.

The lists of parts given herewith contain those parts used in the experimental model. Data are given for winding the coils, blank coil forms being easily obtained, where it is necessary to use other turns ratios than those furnished in the manufactured article. The main thing to remember is to use good parts, as the total cost of the amplifier with the most expensive apparatus available is not over $15, and little is gained by economy in selection of material.

The panel is of 3/16 in. stock, as the shield is 1/16 in. thick, and the two together make a ¼ in. panel, so that the recess edges in the sides of the cabinet should be ¼ in. deep, to allow the panel to rest flush with the sides of the cabinet and for the shields to make good contact. On the panel are mounted the antenna tuned circuit consisting of the antenna inductances and condenser, the filament rheostat and the feedback condenser. A bakelite shelf supported by a pair of metal brackets is fastened to the back-panel shield, and contains the r.f. transformer, r.f. chokes, by-pass condenser, tube socket and battery terminals. The antenna tuner is shielded from the r.f. transformer by means of a brass partition, 4x6x1/16 in., which also serves as additional support for the shelf. This partition is important, for even though the two inductance coils are at right angles to each other, it is advisable to limit the field of the antenna coil as much as possible. One end of the partition should be provided with a flange so that it may be fastened to the back-panel shield with two 6-32 machine screws.

In order to conserve space, relatively small sized apparatus was used, so that it is well to note the type and size of the filament rheostat, straight line frequency condenser and the feedback condenser, as the use of larger equipment may cause crowding of the shelf, and will necessitate a re-arrangement of parts.

If a very small filament rheostat is used, the positions of the feedback condenser and rheostat, as shown in the picture, may be reversed, and the leads to the condenser thereby shortened somewhat. The data for the inductance coils, which are identical, are given in the following table:

Wavelength Range	Coil 1-2 1½ in Tube No. 26 D.S.C.	Coil 3-4 2½ in. Tube No. 24 Bare	Coil 5-6 2½ in. Tube No. 24 Bare
190-555 meters	25 T	45 T	45 T
90-210 meters	16 T	17 T	17 T
50-110 meters	6 T	8 T	8 T

The secondary coils used in the experimental set are space wound, with lacquered copper wire, without silk or cotton insulation. This greatly reduces the

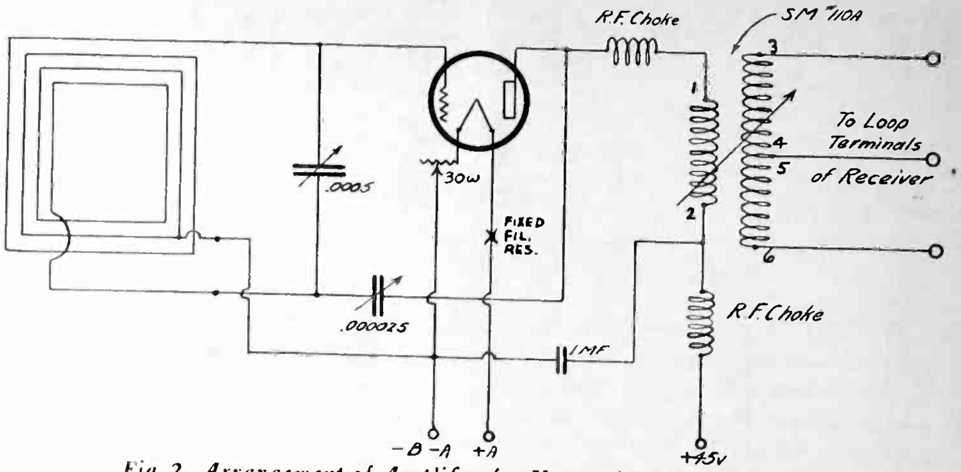


Fig. 2. Arrangement of Amplifier for Use With Loop Antenna.

LIST OF PARTS

- 2 Silver Marshall Type 110-A inductances, with mountings.
- 1 Cardwell .00035 mfd. variable condenser.
- 1 General Radio Type 301, 30 ohm rheostat.
- 1 Silver Marshall Type 340 condenser, .000025 mfd.
- 1 Vacuum tube socket for UX-CX base tubes.
- 1 Filament resistance cartridge.
- 1 1 mfd. by-pass condenser.
- 2 Silver Marshall Type 275 chokes.
- 3 Binding posts.
- 1 Vernier dial.
- 1 Panel, 8½x12x3/16 in.
- 1 Brass shield, 8½x12x1/16 in.
- 1 Bakelite shelf, 6x7x3/16 in.
- 1 Brass partition, 4x6x1/16 in.

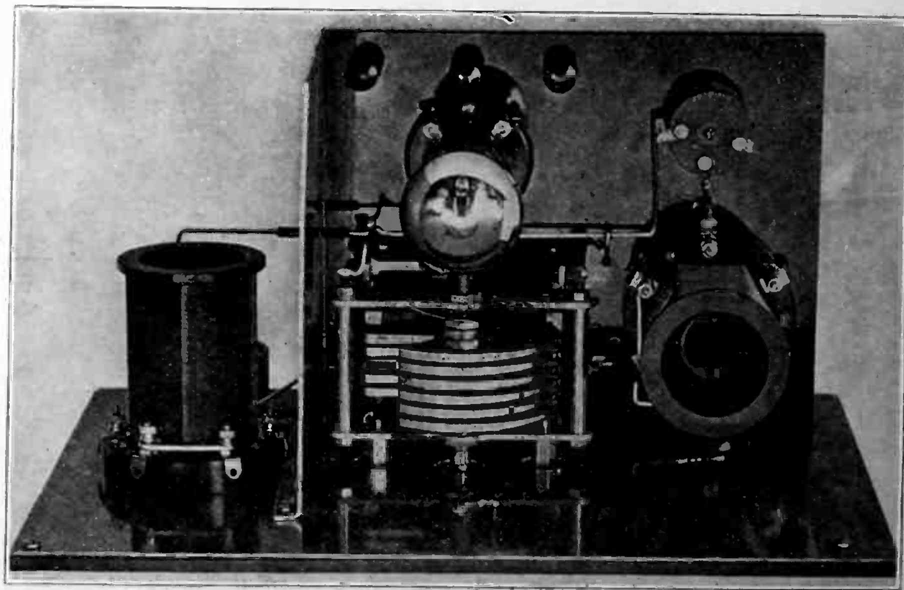
distributed capacity of the coil and gives low effective resistance. The rotor is wound with No. 26 d.s.c. wire, and need not be space wound. It should be mounted inside the secondary coil, and arranged so that it may be easily adjusted for any degree of coupling desired.

The r.f. chokes each consist of 800 turns of No. 26 d.c.c. wire, wound on a spool having a ½ in. hub. A tap is taken out at the 250th turn in order to make the coil as flexible as possible, as the coil in the plate circuit, between the tube and the r.f. transformer, will probably require only 250 turns. The chokes should both be mounted on the shelf, at a reasonable distance apart, and in a manner so that the connecting leads will be short.

Since the plug-in coil mountings have binding posts and soldering lugs for each connection, no binding post strip is needed, the only binding posts required being the three which are mounted on the rear of the shelf, for the *A* and *B* battery connections. The negative *A*, *B* and ground terminals are all at the same binding post, with the positive *A* and 45 volt *B* connections to the other two binding posts. The output terminals from the secondary of the r.f transformer should preferably be brought out through holes in the side of the cabinet, the binding posts on the coil mounting being good terminal connections.

All wiring with the exception of the filament circuit is in bare bus bar. There are so few connections that there will be no necessity for using spaghetti covering, and where the wire must pass through the shelf, holes may be drilled with a No. 27 drill.

The installation of the amplifier is not difficult, and should take but a few minutes. Assuming that the amplifier is to be used ahead of the conventional 8 tube superheterodyne, the panel should be placed to the left of the receiver, and the loop antenna disconnected. Connect the output terminals of the amplifier to the loop binding posts inside the set. The antenna and ground connections go to terminals *1* and *2* of the input trans-



Amplifier Assembly, With Shield in Place.

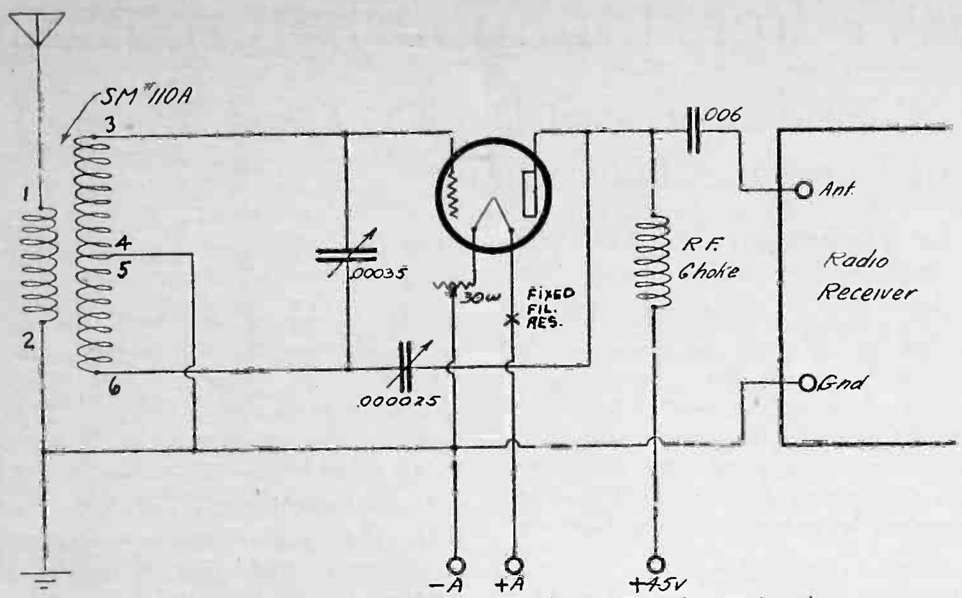


Fig. 3. Circuit for Connection Ahead of Any Tuned R. F. Receiver

this control should be set at zero. For local stations, no regeneration should be employed, and should be used only when receiving distance, and even then it will be found that the amplification of the r.f. tube, without regeneration, will be very great. A small antenna will be sufficient for all purposes, for a long antenna will broaden the tuning of the amplifier dial, and in spite of the shielding, may reduce the selectivity materially at the longer waves.

If a loop antenna is to be used, the antenna coil may be omitted, and tuned directly by the variable condenser, as shown in Fig. 2. In this case, the loop may require a condenser of .0005 mfd. maximum, which can be determined by the size of the condenser already mounted inside the superheterodyne. Although the r.f transformer secondary is wound for use with .00035 mfd. con-

former in the amplifier, and the *A* and *B* battery connections may be brought directly from the battery terminal strip in the receiving set. If the set is of the dry cell tube variety, a type CX-299, UX-199 tube should be used, and for storage battery sets, the tube should be of the conventional type A.

Turn on the filament of the r.f. tube, and adjust the superheterodyne in the usual manner, for some local station. Turn the amplifier condenser dial until this station is heard at maximum, and adjust the volume control on the super until the volume is brought down to the right amount. Adjust the primary of the r.f. transformer until the tuning of the loop dial on the super appears to be sufficiently selective.

The same procedure should be followed with the antenna tuner, and the coupling should be arranged so as to be as loose as possible, consistent with sensitivity. If the amplifier oscillates, the regeneration control may be set at too high a capacity, and when first testing,

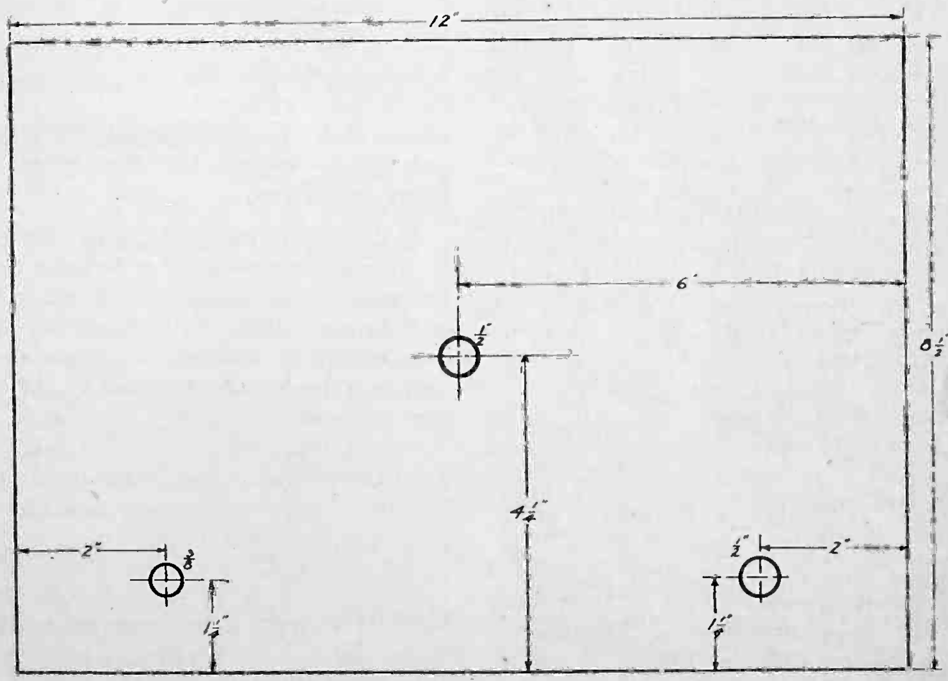
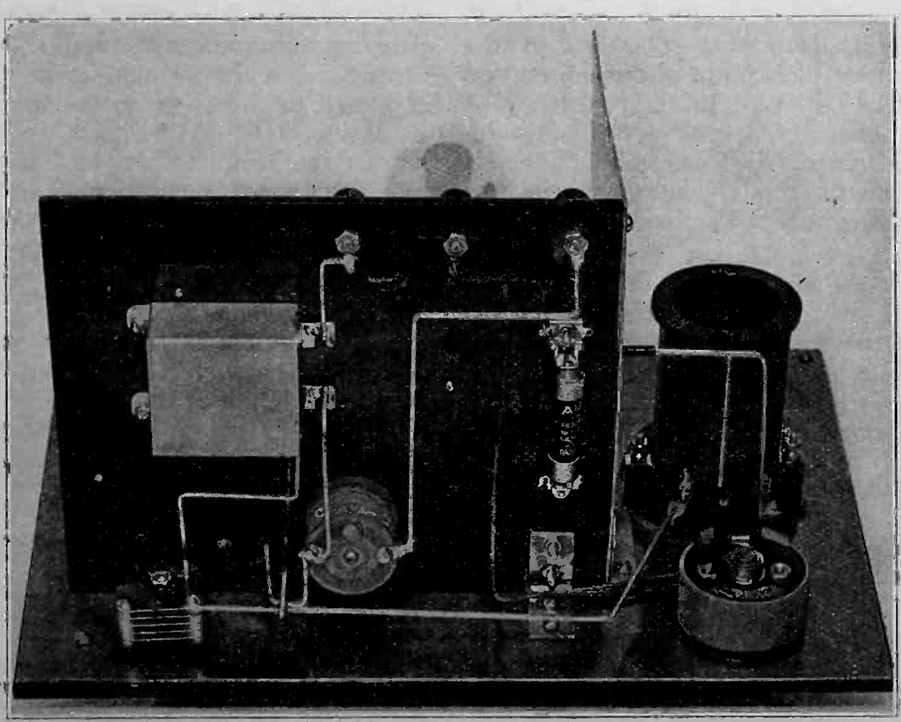


Fig. 4. Drilling Template for Panel and Shield.

densers, and the loop condenser in the super may be .0005 mfd., the additional capacity will not be bothersome except at the very short waves. It is simple to remove a few turns from each secondary winding, to reduce the inductance to the right value for the particular capacity of condenser used, so that it is advisable to try the amplifier out first, and make the adjustment of secondary turns afterwards. A center tap loop should always be used, as otherwise it is impossible to obtain regeneration, and the directional balance of the loop will not be as good.

To use this amplifier ahead of a set which is not a superheterodyne, two methods are available. The circuit shown in Fig. 3 is similar to that described by A. J. Haynes in a recent issue of RADIO, in which the amplifier tube is impedance coupled to the first tube in the receiving set, the antenna coil in the receiver being used as an output transformer for the extra r.f. amplifier. One of the r.f. chokes specified for use in the

(Continued on Page 61)



Lower Shelf View.

Design of Band Pass Filters for Superheterodynes

With Practical Values of Constants on Improving Selectivity Without Impairing Tone Quality

By Raymond B. Thorpe

THE great interest with which readers of May RADIO greeted the article on band pass filters for superheterodynes indicates that further information on this subject would be welcomed. This article, therefore, constitutes a study of some of the design factors which decide what will give good and what will give poor results. A table of filter constants is also given which contains values for the more commonly desired filters.

There is no simple formula for the calculation of these filter constants which can be put into curve form for easy solution. We are concerned, in every case, with three constants, an inductance and two capacities which serve to determine an impedance and two cutoff frequencies. The only possibility of plotting curves for these quantities would be by means of three dimensional graphs. Such an arrangement, of course, is not feasible. We will, therefore, have to introduce a few equations from which the reader can compute his own filter constants for any bands or impedance he may choose. These equations may be found in the original patent paper granted to George A. Campbell, inventor of the electric wave filter in 1917. Anyone who wishes to secure a copy of this patent paper may do so by writing to the Superintendent of Documents, Government Printing Office, Washington, D. C., requesting Patent No. 1227113 and enclosing ten cents.

In this paper, after discussing the general equations for cutoff frequencies and impedances, Campbell derives the design formulas for each of the special cases resulting from the omission of one of the four circuit elements as described last month. For the filter in which we are interested; that is, the one in which the series inductance has been omitted, the equations are:

$$L_2 C_2 = \left(\frac{1}{2\pi f_2}\right)^2 \qquad (1)$$

and

$$\frac{C_1}{C_2} = \frac{1}{4}\left[\left(\frac{f_2}{f_1}\right)^2 - 1\right] \qquad (2)$$

where f_2 is the upper and f_1 the lower cutoff frequency and L_2, C_2 and C_1 are as shown in Fig. 3 below.

These equations do not determine exactly any one of the circuit elements; that is, each element is given in terms of one or more of the others so that there is always one circuit element whose value is a matter of choice. In some cases this element may be chosen for convenience of design, but we will show later that for our purpose it must be so chosen that the impedance will approximately match that to which it is connected in the circuit. Campbell does not indicate directly any solution for filter impedance. It is possible to deduce the desired relationship from the following formulas:

$$L_2 = \frac{(f_2 - f_1)\,Z}{4\pi f_1 f_2} \qquad (3)$$

$$C_2 = \frac{f_1}{\pi f_2 (f_2 - f_1)\,Z} \qquad (4)$$

$$C_1 = \frac{f_1 + f_2}{4\pi f_1 f_2 Z} \qquad (5)$$

where Z is the filter impedance and f_2 and f_1 are respectively the upper and lower cutoff frequencies.

Not only are these equations very easy to solve, but they give a definite value for each circuit element without reference to any other circuit element. For convenience in making our calculations they may be better expressed in the following form:

$$L_2 = .0796\,\frac{DZ}{P} \qquad (6)$$

$$C_2 = .318\,\frac{R}{DZ} \qquad (7)$$

$$C_1 = .0796\,\frac{S}{PZ} \qquad (8)$$

In these equations S is the sum of the cutoff frequencies, D their difference, P their product and R the ratio of the lower to the higher cutoff frequency. Z is the characteristic impedance of the filter near the middle of the transmitted band. If these quantities are determined by expressing the frequencies in kilocycles and the impedances in thousands of ohms the result will be given in henries and microfarads directly.

Before considering the manner in which the circuit elements are affected by the choice of cutoff frequencies in the filters we may well consider the importance of proper impedances for the filter. In Fig. 1, as indicated schematically, the arrangement of the filter is in a vacuum tube circuit. Essentially we are concerned in having the largest amount of energy pass from the input of the filter on through to the input of the next vacuum tube in the freely transmitted range of frequencies and to have as little energy as possible so transmitted at any other frequency.

It has been shown in previous articles that the audio-frequency interstage transformer should have as high an impedance as possible, consistent with other design factors, in order to obtain the best result. It is usually pointed out, however, that this would not be true of an output transformer where we are concerned in delivering power to a loud speaker or other device. Upon further inspection we find that we have essentially the same problem in this case of filters as in the case of output transformers; that is, we must deliver through an artificial line the maximum of energy rather than of voltage.

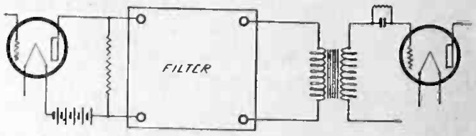


Fig. 1. Schematic Arrangement of Filter in Vacuum Tube Circuits.

Essentially the circuits of Fig. 1 may be shown as in Fig. 2 where the branches a and b represent the equivalent impedances of the filter sections. Suppose for a moment that the vacuum tube has an impedance of about 16,000 ohms and that the input resistance to the filter, whose function is to supply B battery to the vacuum tube plate, is also 16,000 ohms. Since the vacuum tube impedances and the input resistances are effectually in parallel as they face the filter, the net impedance facing the filter will be 8000 ohms.

If the impedance a and b in the filter were on the order of, say 10 ohms it is obvious that most of the energy would be absorbed in the vacuum tube impedances and in the filter elements before reaching the output transformer at its terminus. Likewise if these impedances were very large, say on the order of 100,000 ohms, most of the available energy would appear in the resistance R_i

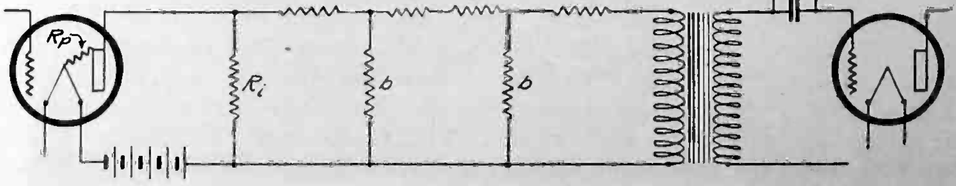


Fig. 2. Equivalent Impedances of Filter Sections.

and very little of it would get through to the transformer.

It may be shown that the best possible transfer of energy from the first vacuum tube to the second will be accomplished if the characteristic impedance of the filter, or whatever other line is placed between the two, is made equal to the impedance facing it at each end. This requires, of course, that the two terminal impedances be equal in the case of trans-

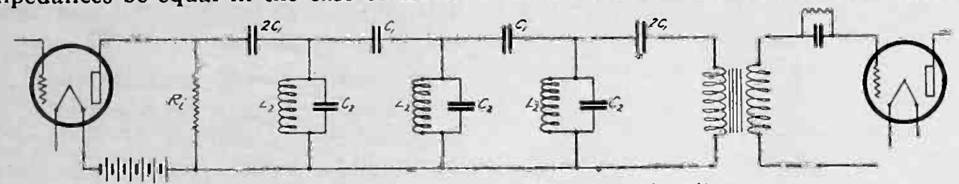


Fig. 3. Actual Arrangemen t of Elements in Filter.

mission lines and of filters having not very many sections. In case they are not equal or nearly so, it might be necessary to introduce a transformer of the proper impedance ratio to reduce the so-called reflection loss which would otherwise occur. Fortunately, however, we are not concerned with the delivery of power beyond the primary of the output transformer. What we desire in the secondary of the transformer is merely a variation of potential without an accompanying flow of current so no power is involved. Consequently if the transformer has a reasonably high primary impedance when the secondary is open we will not need to concern ourselves about its effect on the filter.

The selection of a resistance as an input element to the filter is open to some debate. It is necessary, of course, that some impedance element be provided for this purpose which offers a suitable path to direct current, yet not too low an impedance to high frequency currents. A retard or choke coil of some type would seem to be the obvious answer. However, as pointed out last month, an ordinary air core choke would couple magnetically with the three inductances of the filter, thereby destroying the filter effect. It would be possible, however, to substitute an iron core choke coil for the input resistance R_1 if this choke is completely shielded. For this purpose one of the regular iron core interstage transformers might be employed, using either the secondary or the secondary and primary in series.

This arrangement has a very definite advantage over that of using an input resistance since it does not introduce such a large loss in plate potential due to the direct current feeding through it and at the same time may eliminate much of the loss due to alternating current passing through the input impedance. Assuming that a good iron core choke has been used the impedance for which the filter should be designed is approximately that of the vacuum tube itself, e.g. 16,000 as assumed above. For some constructors the advantage offered by such a plan may not justify the expense of an additional interstage transformer to be used

sistance termination. When this method is used the resistance should be about equal to that of the vacuum tube and for best results the characteristic impedance of the filter should be made half that of the vacuum tube.

Table I gives the inductances and capacities required for filters having various cutoff frequencies and various impedances, including some adapted especially to the resistance method of termination

as a choke and they will prefer the re- and others adapted to the choke coil method.

A study of equations 6, 7, and 8 makes it rather easy to determine what conditions to avoid in designing filters. by increasing the difference D between the two cutoff frequencies. Likewise it is decreased by raising the transmitted band in the frequency scale since the product P of the cutoff frequency appears in the denominator.

By multiplying equations 6 and 7 we find that the product L_2 and C_2 depends solely upon the upper cutoff frequency F_2. This agrees with Campbell's first equation and means, of course, that for a given cutoff frequency the behavior of C_2, when the other quantities are varied, is just the opposite of that for L_2. The series capacity C_1 varies directly as the sum of the two cutoff frequencies and inversely with their product so that if the middle frequency of the band is held constant a changed width of band does not greatly affect C_1.

Since decreasing the width of the band requires that L_2 must become

TABLE I

Inductances and Capacities Required for Various Cut-off Frequencies and Inductances. Inductances are given in millihenries and capacities in microfarads.

Cut-off Frequencies—Kilocycles f_1	f_2		IMPEDANCE—OHMS 6000	8000	10000	12000	16000
20	30	L_2	7.97	10.63	13.27	15.93	21.25
		C_2	.00353	.00265	.00212	.00177	.00132
		C_1	.001022	.000767	.000613	.000512	.000384
25	35	L_2	5.47	7.28	9.10	10.92	14.55
		C_2	.00378	.00284	.00227	.00189	.00142
		C_1	.000910	.000682	.000546	.000455	000341
30	40	L_2	4.02	5.34	6.68	8.03	10.70
		C_2	.00396	.00298	.00238	.00198	.00149
		C_1	.000775	.000581	.000465	.000387	.000291
35	45	L_2	3.03	4.04	5.05	6.06	8.08
		C_2	.00412	.00309	.00247	.00206	.00154
		C_1	.000672	.000505	.000403	.000336	.000252
40	50	L_2	2.49	3.19	3.98	4.77	6.37
		C_2	.00423	.00317	.00254	.00212	.00159
		C_1	.000596	.000447	.000358	.000298	.000224
45	55	L_2	1.93	2.57	3.21	3.85	5.14
		C_2	.00433	.00325	.00260	.00217	.00162
		C_1	.000535	.000402	.000321	.000267	.000201
50	60	L_2	1.59	2.22	2.65	3.18	4.24
		C_2	.00442	.00331	.00265	.00221	.00166
		C_1	.000485	.000364	.000291	.000243	.000182

Probably the most striking thing which is at first apparent is the fact that an electrical wave filter is not a generalized form of the ordinary tuned circuit; that is, if we reduce an electrical wave filter to some special case the result is not a simple tuned circuit, but an absurdity. For example, if we so narrow the transmitted band that the two frequencies become identical their difference is zero and we find $L_2=0$ and $C_2=\infty$, while C_1 takes on such a value that its reactance is just equal to the required impedance of the filter. Such an arrangement is equivalent to a group series condensers with bridged short circuits. Obviously this circuit would not produce the desired result.

Considering each one of the elements separately, we find that if the impedance increases, the inductance L_2 increases proportionately, while the capacities C_1 and C_2 decrease reciprocally. The inductance L_2 is also increased by widening the freely transmitted band, that is,

smaller and C_2 must become larger it will be apparent that too narrow a band should be avoided since it is hard to construct a very small inductance and a very large capacity having a sufficiently high impedance when connected in parallel resonance to meet the impedance requirements of the filter. It should be remembered too that the attenuation at the edge of the transmitted band follows hyperbolic curves whose steepness is not materially affected by the width of the transmitted band. Consequently little is gained by reducing the band while much will be lost in quality.

Probably the least width for which a filter of this type should be constructed is about 6000 cycles. This statement should be qualified of course by a consideration of equations 6, 7, and 8 which make it evident that all of these relations are relative so that we should say that the narrowest practicable band is about 6000 cycles when located in the neighborhood of 40,000 but that if we were to desire a band in the neighborhood of 80,000 cycles it should not be less than 12,000 cycles wide. Fortunately most commercial transformers for intermediate frequencies give their greatest amplification at frequencies lower than 80,000 cycles and for this reason Table I gives filter constants only for the region from 20,000 to 60,000 cycles.

Last month it was stated that in any case it would not be necessary to use the exact value of inductances and capacities indicated by the formulae. We need to know, however, how far to trust such a statement. If the capacity of C_1 for a desired filter should be computed as .00054 mfds we will need some means of determining whether or not .00050 mfds. might be satisfactory and similarly for the other circuit elements. This may be readily accomplished by solving equations 3, 4, and 5 for F_1, F_2 and Z. The result is given in equations 9, 10 and 11.

$$f_2 = \frac{1}{2\pi\sqrt{L_2 C_2}} \qquad (9)$$

$$f_1 = f_2\sqrt{\frac{C_2}{4C_1 + C_2}} \qquad (10)$$

$$Z = \sqrt{\frac{f_2 + f_1}{f_2 - f_1}}\,\frac{L_2}{C_1} \qquad (11)$$

From these equations the cutoff frequency and impedances of the filters involving any values of L_2, C_2 and C_1 may be determined. If, therefore, we desire a band pass filter having cutoff frequencies of 35 and 45 kilocycles and an impedance of 11,000 ohms we will find from equations 6, 7, and 8 that the constants should have the exact values $L_2 = 5.50$ millihenries, $C_2 = .00266$ mfds, $C_1 = .000372$ mfds., which might be difficult to obtain except for the inductance, which of course, may be wound to any value desired by choosing the proper dimensions and number of turns.

We will wish to determine in this case whether the condensers might be changed to the nearest standard values .0025 and .00035 without seriously disturbing the cutoff frequencies and impedances of the filter. We can make sure that the upper cutoff frequency is not disturbed, if that seems important, by readjusting L_2 so that the product of L_2 and C_2 is the same as before; that is, L_2 will become 4.98 MH. Using then the proposed values C_2, C_1 and L_2 we find that the filter constants are $f_1 = 36.0$ KC, $f_2 = 45.0$ KC, $Z = 11{,}650$ ohms.

There are now available on the market small fixed capacities of intermediate values so that most any desired capacity may be built up from a set of fixed units. In some cases, however, the result would not only be expensive, but the apparatus would be very bulky. It would seem desirable, therefore, to find some other way of adjusting the capacities to the desired values. A simple and inexpensive method which affords very good results in some cases and requires only a little patience is illustrated in Fig. 4-A and B. It consists of a semi-variable condenser comprising a single moving plate mounted on one lug of the fixed condenser and a double moving plate with suitable mica insulation mounted on the other lug. In order to successfully apply the variable condenser the fixed condenser should have a capacity slightly smaller than that which is required.

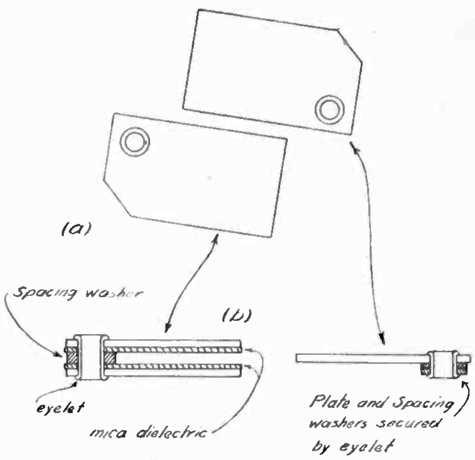


Fig. 4. Method of Adjusting Capacities.

When the condenser has been mounted these moving plates may be pushed together just far enough to give the desired increase in capacity and the screws may then be tightened up to make the adjustment permanent.

The method of mounting each condenser unit is indicated in Fig. 5-A for the ordinary type of condensers. In the Sangamo condenser a slightly different arrangement may be necessary as suggested in Fig. 5-B.

Since the success or failure of a filter of this type depends largely upon the electrical efficiency of the circuit elements it will not only be necessary to have the circuit elements exactly matched, but also well designed from a resistance standpoint. Mica condensers meet this requirement very nicely, and the type of inductance coil illustrated last month will be quite satisfactory, particularly for the larger values of inductances. However, some of the filters shown in the table call for quite small inductances and these may be made to have much better electrical efficiencies if wire of a larger diameter, say 22 or 24 gauge plain enamel, is employed in the same form.

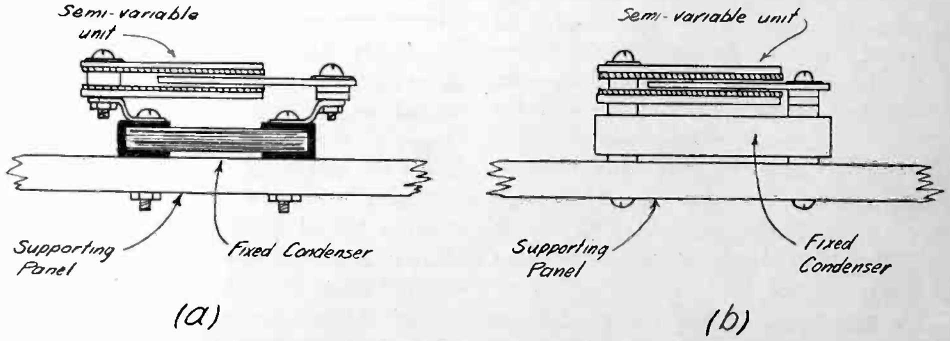


Fig. 5. Method of Mounting Condenser Units.

HANDY HINTS

By D. B. McGOWN

Sealing wax may be used with a hot iron to "solder" paper, bakelite, wire terminals, and the like where it is desired to make these fast, and where good insulation and fair strength also is needed.

"Bookbinder's paper" may be used to cover up home-made coil windings; this will give a neat finish that is also cheap and durable.

Fragments of old fountain pens are very handy around the radio table or shop, as they are made of high-grade hard rubber, and are first-class insulator tubes.

A piece of leather screwed to a small block of wood, and rubbed with tripoli or rouge makes a handy burnisher for polishing small objects, or restoring the finish to tarnished surfaces which are too delicate to buff.

Don't forget that in most modern receivers the "noise level" usually determines the actual reception of distant stations. If there is a great deal of noise present due to static, it may be impossible to receive stations that are moderately strong, which would come in quite comfortably if there were no noise present. In the radio art as it exists today nothing seems possible to eliminate this noise other than to increase selectivity, etc., through the proper shielding and design of circuits.

If you have a set that is very "microphonic" this trouble can quite often be reduced by changing the tubes around, as tubes show this effect more strongly in some places than in others.

In placing a "cone" type loud-speaker, more natural results will usually be had if the device is not placed too close to a wall or flat surface. If such a cone could be suspended several feet from all other objects more ideal conditions would usually result, but if this is not possible, the speaker should be as far from reflecting surfaces as it is possible to get it.

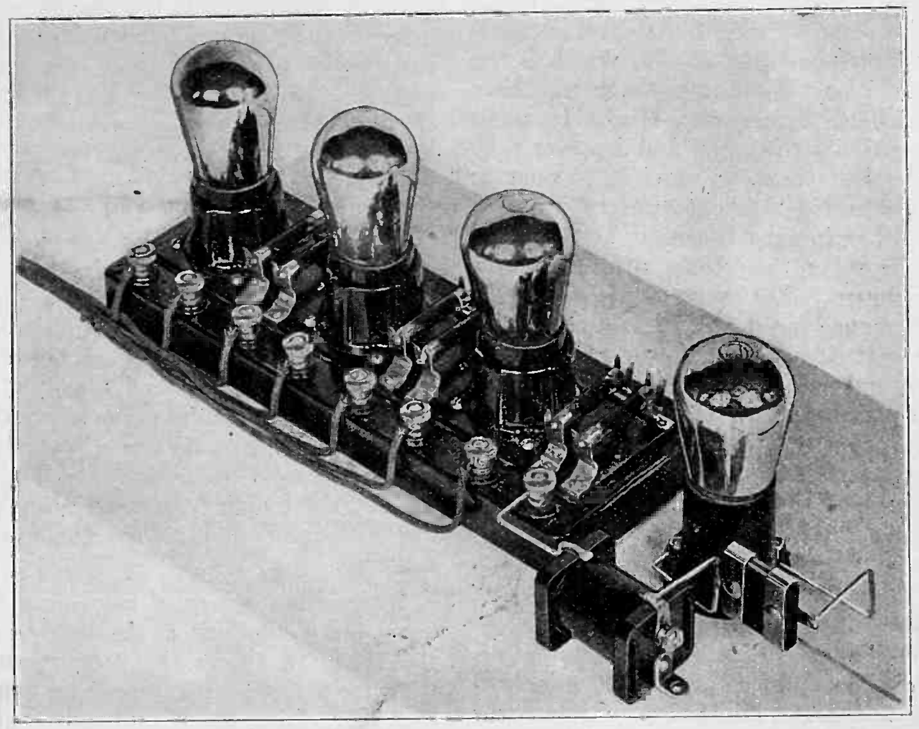
In wiring a set, if it is not possible to use colored wire for the circuits, small dabs of dye of appropriate colors may be placed on the terminals, where they are soldered, and quite satisfactory color scheme wiring obtained.

Improving the Resistance or Impedance Coupled Amplifier

By Clinton Osborne

THE popularity of resistance and impedance coupled audio amplifiers is well established. Many of the latest commercially built receivers have installed such amplifiers, and rapid progress has been made in the manufacture of parts for the home set constructor. With the proper resistances or impedances in the plate circuits of the tubes, the right size coupling condensers, and the use of *C* batteries in the grid circuits, an amplifier capable of giving wonderful tone quality and large power output can easily be constructed, and attached to any radio set having a detector tube and one or more stages of r.f. amplification.

Such amplifiers, however, are not always free from annoying troubles, when used in connection with a receiving set having a considerable amount of r.f. amplification, and the trouble usually manifests itself by a state of continuous oscillation in the r.f. amplifier, or a series of weird audio frequency howls in the phones or loudspeaker. This is particularly true in the superheterodyne. The cause and cure of the difficulties usually experienced will be discussed briefly.



Method of Installing R.F. Choke Ahead of Resistance Coupled Amplifier.

It is well known that in the plate circuit of the detector tube, (the 2nd detector in the case of the superheterodyne), there are two a.c. components, one of audio frequency, being the detected or demodulated carrier wave, and the other of radio frequency, the carrier wave itself, which is amplified to a certain degree. We wish to amplify the audio frequency component and reject the r.f. currents, as they are no longer of use, and in transformer coupled audio amplifiers, a by-pass condenser of .001 mfd. is generally connected between the detector plate and filament, providing a short, low resistance path for the high frequency currents, while the audio frequencies and the plate current of the tube follow another low resistance path through the primary of the audio transformer. Some of the r.f. currents pass through the transformer primary, to be sure, but the larger part goes through the by-pass condenser, and returns directly to the filament. A small amount of the r.f. gets through the 1st audio transformer, and is amplified by the 1st audio tube, but is usually reduced to a negligible factor in passing through the 2nd audio transformer, and does not reach the 2nd or power tube.

In resistance coupled amplifiers, and to a certain extent in impedance coupled stages, a different problem is presented. With the proper resistances, and coupling condensers, a resistance coupled amplifier is almost as good at radio frequencies as it is at audio frequencies. Hence, the r.f. component in the detector plate circuit is readily amplified by the successive resistance coupled stages, and the power tube receives a considerable amount of r.f. currents along with the audio frequencies amplified. This is very undesirable, as the presence of r.f. currents of high amplitude in the last audio stage is conducive to feedback to the r.f. stages, and trouble may be had from oscillation, particularly if in the design of the set, the builder is unfortunate enough to mount the output terminals adjacent to wiring in the r.f. amplifier circuit. Quite often these oscillations are of an ultra high frequency, of 10,000 kilocycles or more, depending upon the length of the exposed wiring and the parasitic capacities in the circuit. In the superheterodyne circuit, where the intermediate frequency may be as low as 30 kilocycles, this trouble is very severe unless a large by-pass condenser is used in the detector plate circuit, and this is undesirable.

The reactance presented by a fixed mica condenser of .002 mfd., to a frequency of 1,000 kilocycles, which is in the center of the radiocast band, is approximately 72 ohms. At 30 kilocycles it is 2650 ohms. With these values must be included the effective resistance of the condenser, which in some cases is quite high. This condenser is actually in shunt with the conventional 100,000 ohm resistance in the plate circuit of the detector tube, and should by-pass 95 per cent of the frequencies in the radiocast band, and a large part of any frequency

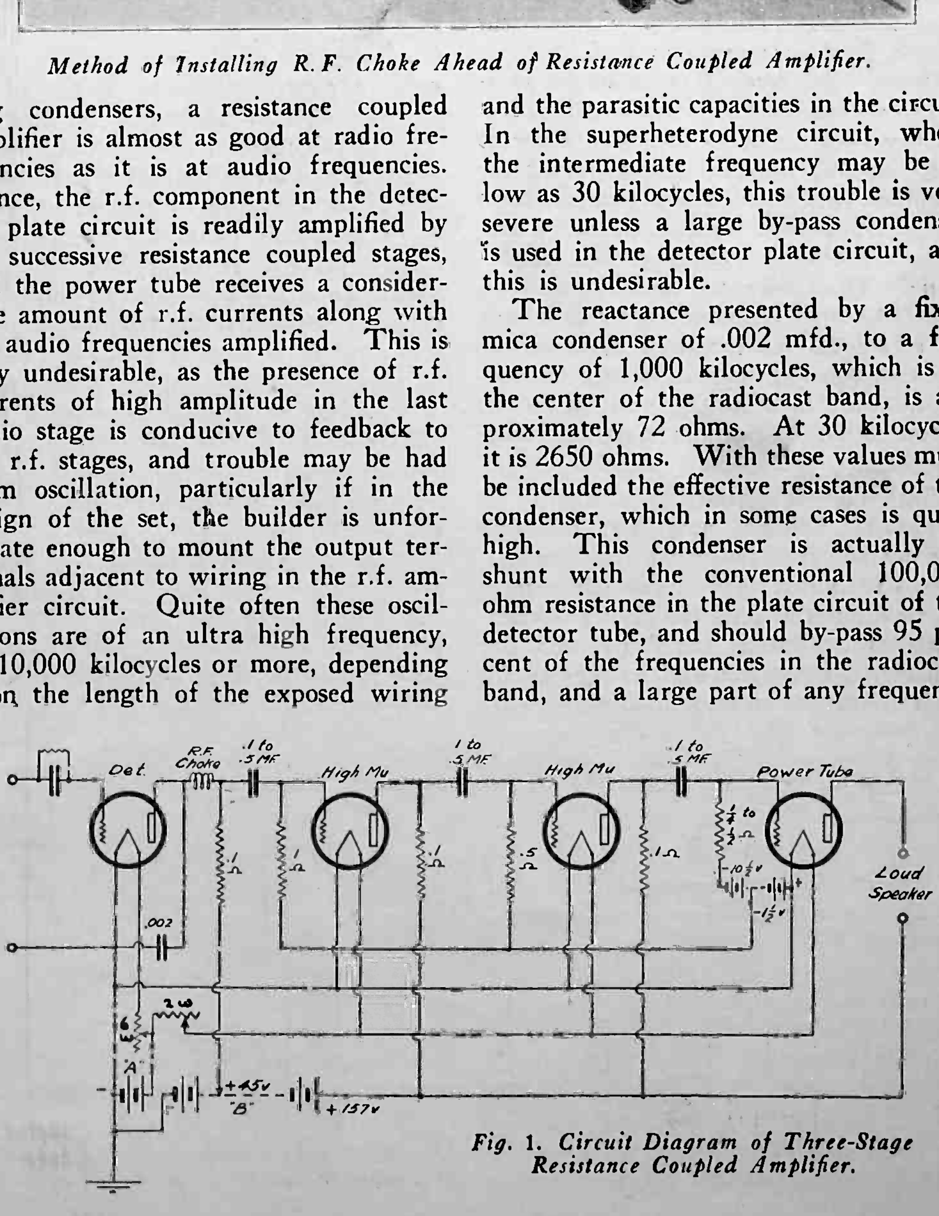


Fig. 1. Circuit Diagram of Three-Stage Resistance Coupled Amplifier.

employed in the intermediate amplifier, if the set be a superheterodyne. If the condenser were made larger, it would present a fairly low resistance to the higher of the audio frequencies being amplified, and distortion would be introduced at an undesirable point in the circuit.

Fortunately, there is an easy remedy, in the shape of a radio frequency choke in the plate circuit of the detector, connected as shown in Fig. 1, which is the circuit of a typical three-stage resistance coupled amplifier, with High-Mu tubes in the first two stages, and a power tube in the last stage. For circuits such as the Browning-Drake, Counterphase, S-C and other tuned r.f. sets, the choke need not be more than three millihenries in inductance. 500 turns of No. 26 d.c.c. wire wound on a spool having a ¾ in. hub will be adequate for tuned r.f. circuits, and when used in conjunction with a by-pass condenser having at least .001 mfd. capacity, will prevent any large quantity of r.f. currents from reaching the grid of the 1st audio tube, and the circuit should be perfectly stable. Choke coils can now be obtained ready made, the one appearing in the picture being made by the Samson Co.

In the case of the superheterodyne, the choke should be at least 10 millihenries, and preferably more. 2500 turns of No. 26 d.s.c. wound on a ¾ in. spool will for all practical purposes be sufficient to choke out any intermediate frequency component in the 2nd detector plate circuit, and is a sure cure for the peculiar variety of squeal which is so often noted when resistance coupled amplifiers are used with the superheterodyne. The choke coil and by-pass condenser or high frequency filter as it may be called can be mounted close to the detector tube, at the point where the connections are made to the input of the resistance coupled unit, as is shown in the picture.

This filter is a valuable adjunct in an impedance coupled amplifier, although the average impedance coil has considerable distributed capacity which acts as an additional by-pass for high frequency currents, and with tuned r.f. sets this capacity is usually enough to prevent the high frequency singing condition. In a superheterodyne, however, it is essential, and should always be installed.

Now that tubes having amplification constants of 20 or more are available, a three-stage amplifier can be constructed so as to have great voltage amplification. Fig. 1 shows the best arrangement of the filament circuit and plate voltages for use with these tubes. The power stage, not having a high resistance in the plate circuit, should have the proper *C* battery, as specified by the tube manufacturer. For the CX-UX-112, or the Daven MU-6, the plate voltage should be 157 and the *C* voltage 10½. The new CX-371, UX-171 power tube will stand a maximum of 180 volts plate, and should have 40 volts negative grid at that plate voltage. With 157 volts plate the *C* voltage should be approximately 32. It is not absolutely essential that the High-Mu stages have a *C* battery, but the use of a 1½ volt *C* battery, where 157 volts plate is available, will help stabilize the circuit, and conserve the life of the tube by reducing the plate current slightly, as well as preventing distortion due to overloading the tube.

In impedance coupled amplifiers, however, this *C* battery is absolutely essential. Fig. 2 shows the proper connections for a three-stage impedance coupled amplifier, using all 6 volt tubes. If 5 volt tubes are employed, it will be necessary to control them by means of the filament rheostat shown in the diagram. The metal cases of the coupling impedances should all be connected to the negative *A* battery, and to ground. Failure to do this may cause a high frequency sing, especially if High-Mu tubes are used. In either resistance or impedance coupled amplifiers, the coupling condensers must be at least .1 mfd., and can be as high as .5 mfd. in the power stage. The values of grid leaks depend upon the tubes used. It has been the custom in the past to use a grid leak of only 250,000 ohms in the power stage, but as this materially cuts down on the total gain of the amplifier, it is a good idea to try a ½ megohm leak in this part of the circuit. If the power tube then blocks or overloads easily, the smaller leak should be used, but ordinarily this will not occur.

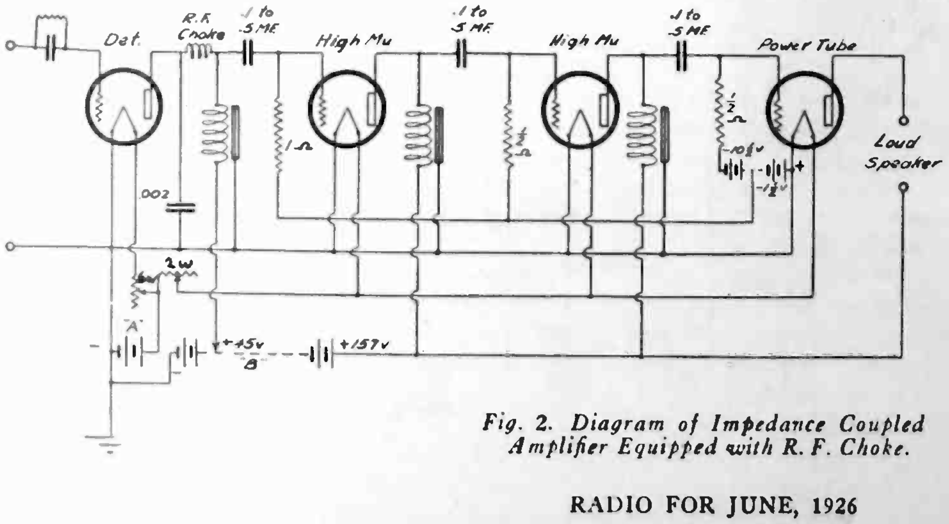


Fig. 2. Diagram of Impedance Coupled Amplifier Equipped with R. F. Choke.

In assembling a receiver incorporating resistance or impedance coupled stages, never mount the audio amplifier in a position such that coupling between the grid and plate leads of the r.f. amplifier can take place with the grid and plate leads of the audio stages. The writer has seen several sets recently in which, for the sake of convenience and appearance, the r.f. tubes were mounted in a row along the back of the sub-panel and the a. f. tubes were placed towards the front of the sub-panel, the last audio tube being adjacent to the 1st r.f. tube. Even with chokes in the plate of the detector tube, high frequency oscillations resulted whenever the r.f. amplifier was set at even fair amplification, and was cured only by elaborate shielding and the liberal use of chokes in all the audio stages.

CARNEGIE INSTITUTE OF TECHNOLOGY

As a result of the demand that has been developing during the past few years, a course of six weeks in radio communication, it is announced, will be given this year at the Carnegie Institute of Technology in Pittsburgh, from June 28 to August 6 under the direction of the Department of Electric Equipment and Construction. Although the course is offered primarily for the benefit of teachers of industrial education, anyone, the announcement points out, is eligible to take the work. No special restrictions have been placed on a prospective student's educational training in order to enroll. Included in the course will be the study of elementary electricity covering magnetism, resistance, inductance, and capacity; methods of transmitting energy; properties of wave motion; theory of production and reception of electromagnetic waves; antennas, wavelength and measurements; transmission and reception of damped and undamped waves; vacuum tubes, operating characteristics, uses as detectors, amplifiers, and oscillators; radio telephony, method of transmission and reception; practice in continental Morse code.

If properly connected, a simple double-pole double throw switch can be made out of a "double circuit" telephone jack, by either inserting a plug that is disconnected, or else making a wooden or rubber "dummy" plug, which will spread the springs.

In testing out a new current supply set, or similar device using the house-lighting current, a good plan is to connect the electric iron, or toaster in *series* before turning the current on for the first time, as this will limit the current to a reasonable value, if everything is not all right in the circuits, and prevent damage.

Red Dawn!

By Earle Ennis

THE CHIEF tilted back in his chair and regarded the nine men before him with a close and somewhat satisfied attention. He had been careful in their selection—superlatively so. He was reasonably sure—as sure as one can ever be in dealing with human equations—that they could be depended upon. When he spoke, it was with crisp decision, behind which were long hours of deliberation.

"I presume we all understand the situation," he said. "You will be known only by numbers—one for each of the nine federal districts to which you have been assigned. My own designation will, be merely 'Q' for purposes of identification only. No names or other indices must be used. All reports will be in cipher, copies of which have been already given you. Memorize these tonight. Then destroy the books. Burn them. Do not under any circumstances carry them in your pockets. Street accidents happen and one copy in the hands of the authorities and everything is ruined. I cannot too clearly emphasize this particular point."

There was a general nodding of heads. The nine men assembled there were in no sense of the word—ordinary. All bore the indefinable mark of authority which comes to men accustomed to exacting obedience from others, leaders, men of affairs. As they sat there, quiet, calm, self-contained, they might easily have been the board of directors of any large institution in session. One of them now stirred in his seat.

"In reference to filing reports . . ?" he questioned, and left the sentence suspended.

"You will use nothing but broadcasting stations," the chief replied quickly. "There are, as you know, from five to eight stations of major classification in each federal district, handling standardized programs furnished by the National Society of Musical Copyrights—an organization under my control. Needless to explain, we can change or alter any of the programs on any night as we see fit. In filing your reports you will use only coded orchestral and vocal music, following lines laid down carefully in your code books. Transmissions of coded music must be made from at least two stations in the same district at the same hour. My listening posts will check every district every night for this purpose.

"The double transmission will indicate to the listening posts that such transmission is coded. The decodations will reach me within a few minutes by special channels which I have carefully arranged. In this, I have taken every precaution to insure secrecy. I am depending upon each one of you to be equally circumspect."

He paused for a moment, but there were no questions. After a moment he continued:

"Well, gentlemen," he said, "that appears to be all. When you pass through that door in a few minutes, it may be the last time that any of us will meet. In a sense, this is war—with all of war's penalties for failure. In much that remains to be done, your own intelligence will have to dictate your actions. I have done all that I can . . ."

He paused and held out his hand. One by one the nine men circled the table to grip his fingers. There were no words spoken, yet there was a wave of common sentiment which swept them all . . .

When they had gone, the chief sat for a time lost in thought. After a bit, he ran his eyes around the room, and touched a button. A man appeared from an inner room.

"Ames," said the chief slowly, "The work here is finished. You will sell everything — desks, furniture — everything. If, by any chance there are inquiries from the corporation commissioner or the postoffice inspectors, say simply that the firm has gone out of business, and that you are merely an employe. If, by any chance, you are arrested, your bail will be arranged and the technical charge against you dismissed. Within reasonable time you will report to Mr. James Lorrimer in the Keller building where you will be employed as a private secretary. Mr. Lorrimer will be found willing to take a chance on your—er—your record." He smiled sardonically. Ames bowed.

"Dan Byrne stood up."

"Yes, sir. Is that all, sir?"

"Quite, Ames, except that I'd go through my pockets, if I were you, and see that my mail was—well, of the right sort. You understand?"

"Perfectly, sir!"

The chief arose, picked up his hat and stick and gave a final glance about the room. He had been quite comfortable there—more comfortable in fact than he would probably be again, for some time. Without a further word, he turned on his heel and went out and with his passing the International Securities company came to a simple and effective close.

This was in October . . .

IT was in the middle of April of the following year that a telephone jingled in the hotel room of Jeffrey Maylon, Washington correspondent for a chain of nationally known newspapers, with headquarters in New York. Ryerly, an under-secretary to a departmental head, was on the wire. His information was startling . . . There was to be a special night meeting of the Cabinet.

" . . . a national crisis . . ."

Maylon was all attention instantly.

"But good lord . . . there's nothing impending . . ."

The under-secretary cut him off abruptly.

"Not only impending but it's on top of us . . . I've just got a smell . . ."

"Can you shoot over the fone?"

"Don't dare."

"All right—the Gold Dragon . . . in half an hour."

Ryerly considered.

"Yes . . . all right. Barely time. I've got to be in attendance in an hour . . ."

"Good. I'll be waiting."

Maylon banged up the telephone, frowning. A national crisis. What could it be? Diplomatic circles were quiet . . . The Balkans had simmered down. The Orient was quiescent . . . At home, the federal reserve mess was before the Supreme Court. He gave it up after a brief resume in his own mind and began to dress rapidly.

The Gold Dragon is a tea-house conducted by a woman known far and wide as Madame Laroux. It was a decorative, exotic rendezvous for Washington's social and diplomatic elements—a queer rambling structure, with niches and alcoves where gossip and intrigue flourished under candelabra of softening glow, and where the freedom of a royal favorite's salon prevailed during the height of the diplomatic season. One could find persons of vast importance at the Gold Dragon, chatting casually over matters that statesmen would have given empires to have overheard.

In Washington affairs, the Gold Dragon had a definite function—one that was known only to certain officials of the State Department. Madame Laroux was a paid operative of the government—one of its most trusted. In a tiny room, above her office, a miniature switchboard connected to dictaphones located at various strategic points about the main floor. There, on more than one occasion, secret service agents had taken stenographic reports of conversations which had occurred in different alcoves that had changed the whole trend of the government's action.

Only an intimate few knew of the existence of the little room or suspected Madame Laroux's connection with the government. One such was Maylon who frequently used the little cubby-hole above the office for important meetings with Ryerly, the under-secretary who was one of his main pipe-lines on affairs political. It was there that Ryerly found him following his telephone conversation and without delay plunged into the dramatic narrative, whose elements he had declared constituted a national crisis.

Maylon listened intently as Ryerly talked. The faces of both men were white and tense under the little drop light that shone on the table between them.

"We haven't got the full scope of the thing yet," Ryerly said. "We know a dictator was assigned to each of the nine federal districts of the radio division, with a complete organization under him. The membership includes switchboard operators of telephone companies, telegraph linemen and operators, railroad men, trusted employes of power companies and a million others. Every arsenal and ammunition station has been mapped and tabulated. Every resource has been outlined and estimated. It would take but the raise of a finger to fillip the entire structure of the government from order to complete chaos."

Maylon smashed his hand down on the table.

"By God, Ryerly," he said, "they've done what my paper has been trying to tell America for months was going to be done. And our readers have called us propagandists, alarmists. The great, easy-going, dumbbell public has laughed at us and said we were crazy. With hell standing on their doorsteps, ready to enter, they've—laughed!"

Ryerly leaned across the table.

"The Cabinet tonight intends to map out a counter-plan. They've damnably little time. May 1—Red May is the date set. We've got less than a month—twenty-two days to be exact, in which to do the impossible. In a case of war—America can strike back, because she has something concrete to work against. But this—this is different. It is intangible. We know it's there, but we can't put our fingers on it. We can't find the center of the web. It may be Soviet. It may be capitalistic . . . it may be controlled from the Orient."

Maylon's fingers locked together.

"And niggardly, treasonable politics have tied us nationally into a knot," he gritted. "Reformers and pacifists have worked Congress into protective stinginess. Prohibition has broken down national faith. Crooked politicians have destroyed public confidence. We are faced with Revolution—sheer insurrection and loyal Americans have less than a month in which to save the country from what Russia experienced. Well—I ask you—what for? Why should we save the country—you and I and those of us that know what is ready to start? To be kicked about by another generation of milk-fed reformers?"

Ryerly nodded slowly.

"And yet," he said, "across the water, Jeff, there's that acreage of headstones . . . the boys, your brother and mine . . . They believed in us and they gave all they had . . ."

Maylon threw up his head.

"Yes, by God, Ryerly, they did . . . and it's up to us. We'll have to trim out this fungus that is creeping in from the outside. We'll have to stamp out our own dry-rot. I've got the most powerful newspaper organization in the world behind me. What can we do? . . . This is enlistment, boy—enlistment, with war twenty-two days off . . . twenty-two days to the firing of the first shell . . . !"

Ryerly stood up suddenly.

"It isn't shells this time, Jeff," he said slowly. "It's the creeping, deadly gas of internal corrosion. And Uncle Sam hasn't a gas mask to his name . . . not one that will keep out the deadly radical fumes . . ." He broke off and grew more quiet. "That's all I know. The secret service has turned certain data over to the President which he intends to spring tonight. After that . . ." He spread his hands.

They walked down the stairs and out into the cold, crisp air, still fragrant with a lingering Spring. Men and women hurried along intent upon their own affairs. In the street two children and a dog were playing with a ball. Maylon stared at the peaceful scene and the magnitude of the task ahead was borne in upon him—the job of awakening a complacent nation to its danger.

"The Lord have mercy on them!" he said. "It's a cinch the enemy won't!"

The Cabinet meeting had been called for 8:30 o'clock that evening, to give time for one member, who was outside of Washington to reach the White House. At 8 o'clock Washington's biggest broadcasting station began its regular broadcast program—a selection of pieces to be played by the Philharmonic orchestra. As a special opening number, the announcer informed listeners the orchestra would play "The Pilgrim's Chorus" from Tannhauser.

At the same hour, one of the bigger broadcasting units in New York city, also began its regular evening program. By a strange co-incidence the announcer

(Continued on Page 52)

Improvements in the Best Superheterodyne

Suggestions for Bringing Several Previously Published Circuits up to Date

By G. M. Best

THE original Best superheterodyne article was published in May 1924 RADIO, and judging from the letters which have been received from many who have built sets from this article, uniform success has been had with this model. Shortly after the story was first published, a contest was held among our readers, with prizes given for the best suggested improvements to the original circuit. These improvements were incorporated in another set which was described in January 1925 RADIO. Subsequent articles in August and September 1925 RADIO described shielded and unshielded models for all-wave reception.

As no more copies of these articles are available, and it is somewhat difficult to supply those who write in for information with the complete details of these circuits, a set of schematic wiring diagrams are being given herewith, for the four sets which were described, and the latest improvements have been incorporated so that the owner of any one of these models can bring his set up to date by making the changes noted.

The May 1924 model consisted of eight type 99 tubes, and was the first dry cell tube superheterodyne to be adequately described in any radio magazine, as well as the first to employ regeneration in the loop circuit. The number of times this circuit has been copied in other publications at subsequent dates indicates how well it worked.

With the advent of the dry cell power tube, a change in the last audio stage is recommended, and the method of installing the type UX-120, CX-220 power tube is shown in Fig. 1. A separate 22½ volt *C* battery for this tube is installed, and the *C* battery already in the set is used for the r.f. and 1st audio tubes only. The volume control is in the positive filament circuit of the first two r.f. tubes, and should be a 30 ohm filament rheostat. The shunt resistance method, consisting of a 50,000 ohm variable resistance bridged across the primary of the second i.f. transformer may also be used, but as the original model was equipped with a rheostat, no change need be made at this point. The filter tuning condenser is shown in dotted lines, as some filters have the primary circuit tuned, and others the secondary circuit, so in order to make the circuit apply to any filter transformer, the connections are shown in dotted lines and two condensers are shown. Only one should be used in any event.

Fig. 2 shows the circuit published in January 1925 RADIO, and differs from Fig. 1 in that a storage battery type power tube is used in the last audio stage, and the shunt resistance volume control is employed. The panel arrangement of the set is different, but the circuits in Fig. 1 or 2 will apply to any good panel arrangement.

In order to avoid the use of a storage battery, the power tube is operated from alternating current through a step-down transformer. A 10 watt bell ringing transformer with a 6 volt secondary is adequate, and should be shunted with a 200 ohm potentiometer in order that the grid circuit of the tube may be properly balanced, and the a. c. hum eliminated. It is necessary to use a double circuit fila-

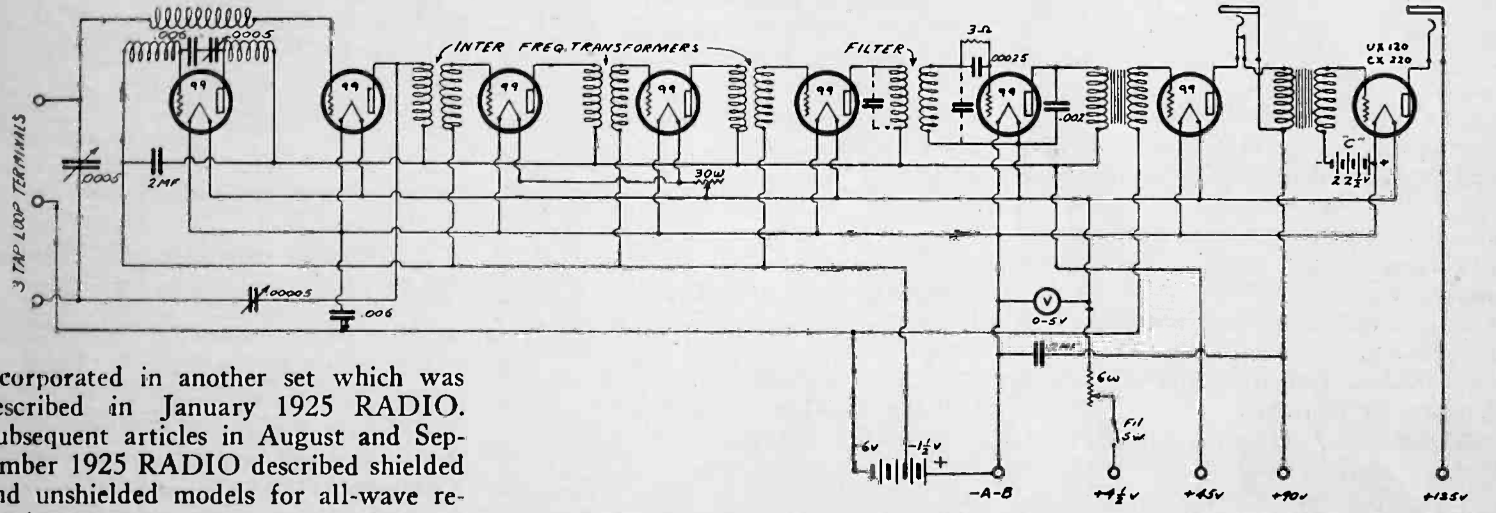


Fig. 1. Best Superheterodyne, using all dry cell tubes, as published in May 1924 RADIO.

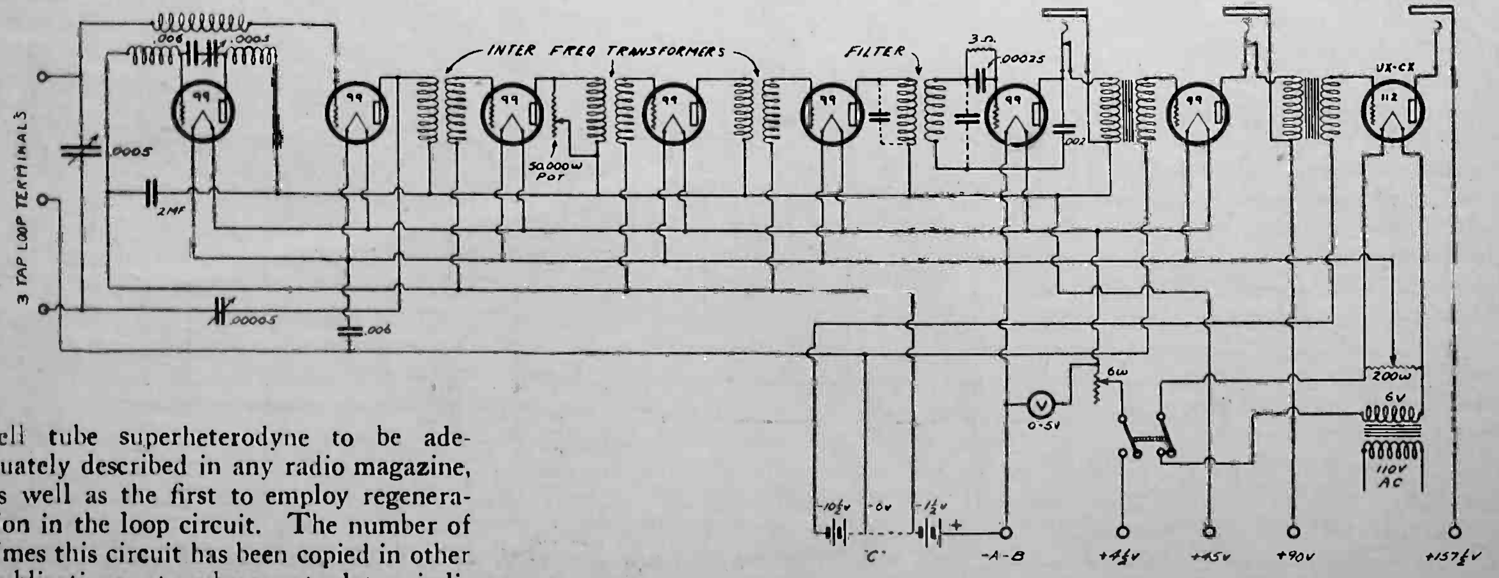


Fig. 2. Improved Best Superheterodyne, with additions, arranged for storage battery power tube.

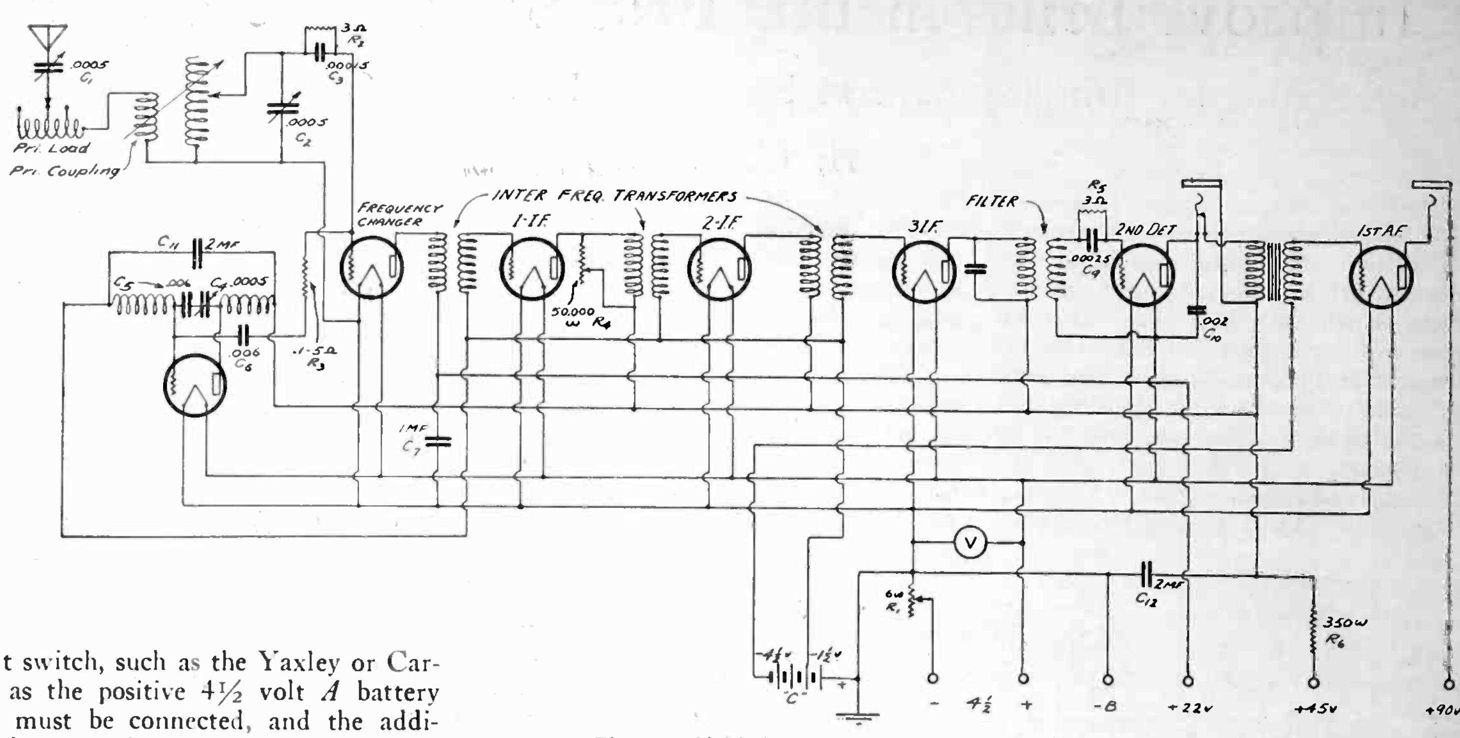


Fig. 3. *Shielded all-wave superheterodyne, using all dry cell tubes.*

ment switch, such as the Yaxley or Carter, as the positive 4½ volt *A* battery lead must be connected, and the additional pair of springs in the switch should be used to disconnect the power tube from the a.c. circuit. As the bell ringing transformer draws no current when the secondary load is removed, it may be left permanently across the a.c. line, and no switch in the primary is necessary or desirable.

A shielded model with 7 dry cell tubes was described in August 1925 RADIO, and Fig. 3 shows the circuit with improvements. The 1500 ohm resistance originally recommended as a volume control has been replaced with one of the new 50,000 ohm variable resistances now available, and much better control of volume, particularly on distant stations, can be had. The grid condenser in the frequency changer tube has been increased to a larger capacity, preferably about .00015 mfd. With capacities below .0001 mfd., except on the waves below 300 meters, the set is not sufficiently sensitive, and so with the increased capacity, the proper sensitivity is had up to 550 meters.

The antenna coupler originally specified for this circuit was rather difficult for some readers to construct, and it is suggested that the Silver-Marshall 110 series of coils be used as a substitute, particularly when working on short waves. This set was designed to work with one of the many power amplifiers, and hence but one audio stage is shown. A power amplifier such as was described by H. W. Armstrong in February 1926 RADIO will work extremely well with this set, and requires no changes to be made in the receiver itself.

Fig. 4 shows the unshielded all-wave model, which uses as many storage battery tubes as is advisable, and works from a 6 volt *A* battery supply. A type 112 power tube is used in the last audio stage, and with the exception of the three intermediate tubes, which are type 99s, all the rest of the tubes are type A. As in the shielded model, the volume control has been changed to 50,000 ohms, and the frequency changer grid condenser has been increased to the best value.

A number of queries have been received in regard to the fixed mica condenser in the plate circuit of the 2nd detector tube. It is asked why this condenser is never shown shunted across the primary of the first audio transformer, as is done in most textbooks and publications. A careful scrutiny of the circuit will show that the condenser does shunt the primary of the transformer, but more important, it also shunts the high frequency currents in the plate circuit around the *B* battery as well as the transformer, and thereby provides the undesired high frequencies with the shortest possible route back to the filament. The condenser should never be larger than .0025 mfd. Otherwise it will tune the audio transformer primary to some frequency within the audio range, and distortion will result.

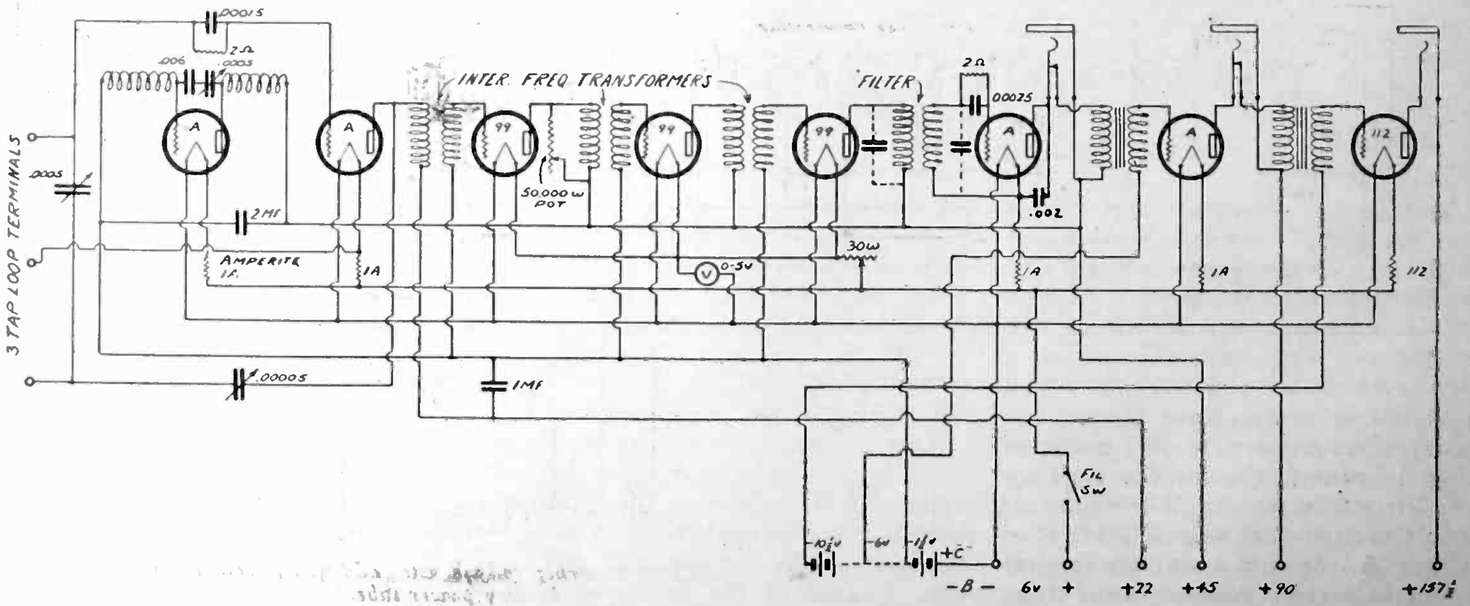


Fig. 4. *Modified all-wave superheterodyne, unshielded model, as published in September* 1925 *RADIO.*

Radio Interference From Power Lines

By Philip S. Donnell

THE immediate source of energy which causes radio interference from power lines is either direct induction or small sparks and arcs from which energy is radiated as high-frequency electromagnetic and electrostatic waves. The former is local in character and may be corrected by placing the aerial at right angles to the line.

But in the case of an arc, the line may act as an antenna to radiate the energy so that the unwelcome noise is carried over a much greater territory than that affected by the immediate radiation of the arc. Furthermore a nearby telephone line may pick up the energy by induction and carry it to a still greater region.

Most of the immediate causes, together with suggested remedies for their treatment are listed in the following paragraphs:

Lines: Only under abnormal conditions do these originate trouble. There are two conditions, however, which cause trouble, corona and arcing grounds. The corona will occur only on high-voltage lines or systems and is of little interest here. The grounds may occur where circuits pass through trees or come in contact with guys, or through swinging contacts between the wires themselves. The usual source of trouble is a ground through a tree. The resistance of the tree is sufficiently great to prevent a sufficiently high-current flow to operate the protecting equipment. Yet each time a contact is made with the tree an arc is formed and if the swing in the reverse direction were small the arc might persist. I have actually observed a continuous arc of this type taking place on a grounded-neutral distribution system with a phase-voltage of 2,300. Such arcs as these probably cause the radiation of more energy than any other type, and when they occur on the high side of the distribution transformers it is apparent that there are a good many miles of antenna for radiating the energy.

Insulators: Trouble here arises either from cracks or a dirty surface over which there is considerable leakage with incipient sparking. An arc on a 66,000-volt insulator has been known to prevent entirely radio reception within a distance of six miles during the period of its flashing over. These are more or less rare occurrences as the factor of safety on insulators is fairly high. They are detected easily as the source of trouble radiates such a great amount of energy. A loop with a sensitive receiver set up in several positions away from the transmission line invariably will locate the source of trouble.

Lightning Arresters: Obviously the discharges in this equipment are most noticeable during electrical storms when they are in legitimate operation and therefore are not a source of much annoyance. However, the necessary formation of the film each 24 hours in the electrolytic arrester is accompanied by an arc which may be heard anywhere on the system. As this is usually at some hour in the night and only momentarily it is negligible in its effect, although often noticed because of the regularity of the charging operation.

Transformers: Defective insulation in transformers will cause very severe interference, but as a rule the insulation breaks down completely within a short time after incipient arcing takes place. Regulators are in the same category as transformers, except for the automatic equipment connected with them such as the contact-making voltmeter, relay switches, etc., all of which are sources of energy emission. The supression of this energy radiation is rather simple as it may be eliminated through the use of chokes and condensing drains to ground.

Generators, Motors and Synchronous Converters: On large systems arcing at the slip rings on a generator as a rule spreads little trouble because of the fact that the generator feeds directly into step-up transformers. On smaller systems, where distribution is at generator voltage, arcing at the rings will cause trouble as the high frequency will be picked up by the power leads and fed to all parts of the city as far as the distribution transformers.

Oscillations set up by the sparking at the commutator of a converter as well as spreading out over the direct-current systems may travel back through the low impedance winding of the armature and out onto the alternating-current system feeding the converter as far as the transformers, which of course in most cases are located near at hand. In one test the noise from a synchronous converter has been picked up from the a. c. feeder almost uniformly for nine miles from the machine, but only in the vicinity of the circuit. It was not perceptible at a distance of more than 150 ft. from the circuit with a 6-tube superheterodyne.

Direct-current motors, especially on street cars, are bad offenders for two reasons: first, because of the continuous operation of the contactor and probable sparking of the commutator; and, second, because of the direct connection with the low-resistance antenna system in the form of trolley and parallel feeders with no transformer winding to limit the distribution.

I recently was listening in 100 ft. away from the trolley, during the passing of a street car, and each opening of the circuit was plainly audible. Other sources of trouble on street cars are the arcing at the trolley and wheels and arcing grounds on the feeder. Insertion of chokes here and there in the feeder and laterals to trolley and also condenser drains to ground may do some good, but are expensive and afford only slight returns.

Arc Light Circuits: A good illustration of the extremes to which the public went with its complaints in the early days of broadcasting was the attempts of the citizens of a certain town in Texas to enact an ordinance to prevent the installation by the public utility of a street arc-lighting system.

From what has been said of arcs it might appear that such a system would be the worst offender possible. On the contrary, when in proper operation the modern arc-lighting system, including the constant-current transformers and rectifiers, should cause no trouble whatsoever. As is well known, the operation of the modern arc does not require the opening of the circuit. When the voltage across the arc rises to a certain value due to its natural elongation from the combustion of the carbon, the shunt magnet is energized sufficiently to pull the electrodes together, after which one drops until caught by the clutch. During this process, therefore, there is no opening of the circuit. The worst condition arising in an arc-light circuit is lamp-jumping. Then, of course, considerable energy is released by radiation. There is little possibility of this if the globes and connections are taken care of.

Under normal operations there should be no interference from the rectifier. If, however, the vacuum increases, due to the combining of the remnant of oxygen with the mercury, a condition prevails called "fading," which may result in the generation of high frequencies which are sent out over the lamp circuit. When the condition becomes still worse, so-called "pumping" of the rectifier sets, serious interference results.

This difficulty is detected by noting whether or not a periodic decrease in load current is accompanied by a decrease in secondary voltage. If it is determined that the tubes are fading, the best thing is to notify the manufacturers, most of whom are prepared to assist in eliminating the trouble. Temporary relief may be obtained by the use of condensers and heating the tube in a steam bath or even letting it rest.

Smoke and dust precipitators are inherently the source of a great deal of trouble, but the interference can be kept quite local by proper shielding and use of drains. No doubt most of you are acquainted with the Cottrell system of precipitation, but for those who are not it may be explained that the precipitation depends upon the application of a high direct voltage between the walls of a long tube through which the dust is passed, and a wire fixed in the center of the tube. This electrostatic field causes the movement of the dust particles to the tube walls. The voltage is obtained either through the use of Kenetrons or with mechanical rectifiers driven by synchronous motors. As there is no physical contact between the brushes and the commutator in the latter type, the continuous arcing is an excellent source of high-frequency oscillations, but as the transformers are very close to the rectifiers the only real source of radiation is the lead to the precipitation plates. This lead therefore should be very short and should be shielded. If the plates are in a steel stack they will need no other shielding. If not they also should be shielded and the shield grounded. Under these conditions the only thing noticeable will be the periodic flash-overs between precipitator plates, i. e., the tubes and wire.

Sign Flashers: These are the worst offenders as far as arcing is concerned. Although there always will be some local interference—a matter of a few hundreds of feet—the situation in general can be remedied by the use of chokes and condensers. Being low-voltage equipment, the condenser drains are not expensive. If no preventive equipment is installed, any leads not in conduit become radiative antennas as far as the transformer.

Heating Pads: Although the manufacturers are improving the types and construction to get rid of interference-producing characteristics, these pads have been among the most noticeable offenders because of the several thermostats connected with them. If a pad is lying out in the open where it heats and cools rapidly, the thermostatic control opens and closes very definitely and distinctly, although fairly often. This causes but a click in the receiver. When the pad is in a semi-warm position, such as next to the body, the change in temperature is comparatively slow with the result that as the control depends upon the unequal expansion of two metals the contacts may remain just out of contact but with a gap insufficient to break the arc. The arc thus hangs on, producing a roaring sound in the receiver, not only in the house where the pad is, but in all receivers near the distribution lines that side of the transformer. In fact, the frequency is so low that considerable energy may pass through the first transformer, but usually there is not sufficient energy to saturate any other house circuit through a second transformer.

Violet-ray Machines: In the usual violet-ray equipment there are two radiating circuits, one including the primary of the high-tension, high-frequency transformer and the condenser; the other the secondary and the body through the tube. The local disturbance is slight except when the tube is raised from the body which does not happen often because of the more or less painful spark resulting from so doing. The disturbance sent out on the supply circuit may be removed completely by placing across the supply terminals (two) one-microfarad condensers in series and grounding the midpoint. In a test a violet-ray equipment was detected on a six-tube superheterodyne at a distance of one block, and when drained as above noted the noise was not detectable when receiver was placed close to the machine.

X-ray Machines: Complete data have not been taken on this type of equipment, but most indications are that when properly operated and connected the modern X-ray machine should not give serious trouble. This is contrary to the popular belief.

Mechanical rectifiers in battery-charging equipment, on account of the continuous arcs formed at the vibrating contacts and to some extent the tube rectifiers, cause trouble which may be eliminated by the use of proper filters.

Electric elevators: There are two types of noises which arise from these: the clicks due to the making and breaking of the circuit by the contactors and the steady hum due to the operation of the motor, which, if it is d. c. and the commutation becomes bad, develops into a roar. With normal operation, the disturbances should not cover more territory than the building in which it is located. With poor contacting and poor commutation the disturbance may spread to great distances. Complete investigations of this have not yet been made, however.

Electric furnaces are a source of much local disturbance; especially during the first or melting period, but fortunately such a furnace is always operated through step-down transformers located as close to it as possible. The result is that the energy does not get out to produce interference. During a test a receiver placed 30 ft. below the high line one mile from the furnace during the melting-down period picked up nothing. —(*Extracts from paper presented before New Mexico Electrical Association.*)

RADIO IN THE CHINESE EMPIRE

By C. A. Reberger

THE embargo on radio supplies in China will be lifted if the various foreign concessions at Shanghai are successful in their efforts to make the Chinese government see the folly of such a ban. For many years the Chinese Customs have been classifying radio material as munitions of war and have consequently seized all imported apparatus. Furthermore, they claim that amateur radio is detrimental to commercial radio, in this way displaying their utter ignorance as to just what good broadcasting would do for their great country.

In a certain sense Shanghai, the gateway to the empire, is part of China and yet is totally foreign. England, America, Russia, Japan, Germany and France have settlements here, which makes it an international zone. And it is run accordingly, although the Chinese government does control the customs, which puts them in a position to work things as they see fit.

Realizing that radio has suddenly taken a long jump in the international settlement, the Chinamen have been carefully watching what enters their country. They are eager to lay their hands on radio material, especially. While the Customs officials seem to be making every effort to hinder the progress of broadcasting in Shanghai, the foreigners, on the other hand, are doing everything to boost it. Shops and stores have suddenly sprung up in every section of the city, for the manufacture and disposal of parts and sets, to meet the growing demand.

"And how do these manufacturers get the material to do the manufacturing, if the Chinese customs at Shanghai control the imports?" I asked an English radio dealer.

He answered, "It is a question of smuggling. We know the Chinamen are closely watching us, and so we must resort to various schemes to beat them. All the concessions here are doing it. We have to, in order to get around the embargo. I guess we won't be doing it long though, as we are slowly making them see the foolishness of such a plan. The lifting of the embargo will mean the opening of a new and wonderful field for the manufacturers of radio materials of the world."

In the Shanghai section there is one broadcasting station, this being KRC, owned and operated by the Kellogg Switchboard Company. This corporation, with main officers in the United States, while engaged primarily in the telephone business, is taking advantage of the radio boom. It was thought there would be a great field in China, and accordingly the 100 watt station was inaugurated.

(*Continued on Page* 59)

Modern Marine Radio Equipment

A Description of a Commercial Type of Tube Transmitter Which May be Used as a Basis for Passing the License Examination

By Howard S. Pyle

"DRAW a diagram of a modern marine radio telegraph station; together with appropriate receiver, source of power and auxiliary power supply; name and assign numerical values and constants to the various individual instruments."

Quite an order but in effect this forms the first demand of the United States Department of Commerce on their question sheets for the first class commercial radio operator license.

For years it has been customary to fulfill this requirement by making a detailed diagram of the well known Type P-8 two kilowatt, 500 cycle quenched spark transmitter originally designed by the Marconi Wireless Telegraph Co. and later constructed and installed by the Radio Corporation of America. Such circuit diagram included the famous old Type 106 tuner as a receiving set employing crystal rectification; an oil dash pot motor starter of several steps and an auxiliary source consisting of two 60 volt banks of storage battery arranged with a suitable switch to enable charging or discharging at will. The resulting sketch was rather a maze of wiring and to properly execute a diagram that would find favor with the Radio Inspector from the standpoints of neatness and presentability as well as being technically correct, took from one to three hours of the aspirant's time. Nevertheless, when complete, it DID represent the latest modern marine radio telegraph equipment and was accepted as such.

We have however, come to a parting of the ways. The P-8 transmitter no longer stands as symbolic of the highest type of modern, up-to-date equipment. True, it still serves admirably as a radio telegraph transmitter on a number of vessels. On others, the original P-8 has been so modified as to now function as an interrupted continuous wave (ICW) transmitter, using the 500 cycle alternating current supply as a source of plate potential after proper transformation. Such modified form of transmitter is a forward step and serves to reduce the interference normally created by a spark transmitter to its greatest possible minimum and at the same time, keep the cost at a reasonable figure. For this reason, marine interests are taking much earlier advantage of the vacuum tube transmission than would be the case were they forced to abandon their spark equipment in its entirety and replace it with an entire new installation of later type.

But in line with the constant progress of the art, as well as the international laws requiring that the apparatus keep pace with scientific progress, entirely new apparatus has been brought forth to meet the constantly increasing use of radio at sea. Foremost among these new marine radio installations stands the latest product of the General Electric Company for the Radio Corporation of America as represented by the type ET-3627-a vacuum tube transmitter which is described in detail in the following paragraphs. It is urged that the student of radio telegraphy preparing himself for a commercial radio operator license and a marine berth, concentrate on this new transmitter rather than follow the precedent established by his predecessors in making a comprehensive study of the Type P-8 transmitter.

To assist the student as well as to offer helpful data to the operator who must some day appear for re-examination and to those who are following the professional radio field in the marine branch today the data incorporated herein have been prepared. A schematic circuit diagram is reproduced herewith and offers an excellent opportunity to the marine operator to familiarize himself with the fundamentals of this latest equipment. We cannot help but see the hand-writing on the wall and it is the wise operator who recognizes that he cannot hope to remain at the top of his profession until such time as he acquires a thorough basic foundation at least in modern marine continuous wave practice. The information offered herewith should be particularly helpful to this class of professional operator.

Fundamentally, the type ET-3627-a consists of a master-oscillator power amplifier circuit using one Type UV-211 vacuum tube as a master oscillator and two as power amplifiers. This tube is a recent development and has an external size and appearance almost identical to the former UV-203 Radiotron commonly known as a "fifty-watter." The UV-211 tube is nominally rated at 50 watts but its specific normal current consumption and potential are indicated on the carton and when the tube is operated at its normal rating, develops an actual average output of 100 watts per tube. For this reason the type ET-3627-a unit is rated as a 200 watt transmitter by reason of its two UV-211 radiotron power amplifiers.

A continuously variable wavelength provision is arranged by using variometers in both the master oscillator and antenna circuits. By this means any desired wavelength can be obtained between 600 and 960 meters on the average shipboard antenna system, with a capacity lying between .0004 and .001 microfarad; a resistance of from 2 to 10 ohms and a natural period somewhere between 175 and 350 meters.

To obtain best results with the particular antenna used, a special adjustment of the antenna circuit transformer is provided.

In adjusting to any desired wavelength within the limits of the equipment it is only necessary to swing the arm of the master oscillator variometer to one of the movable slots which has previously been fixed at a calibrated point; select the proper value on the antenna loading inductance switch (also calibrated at the time of installation) to correspond with the wavelength desired and then slowly swing the arm of the antenna

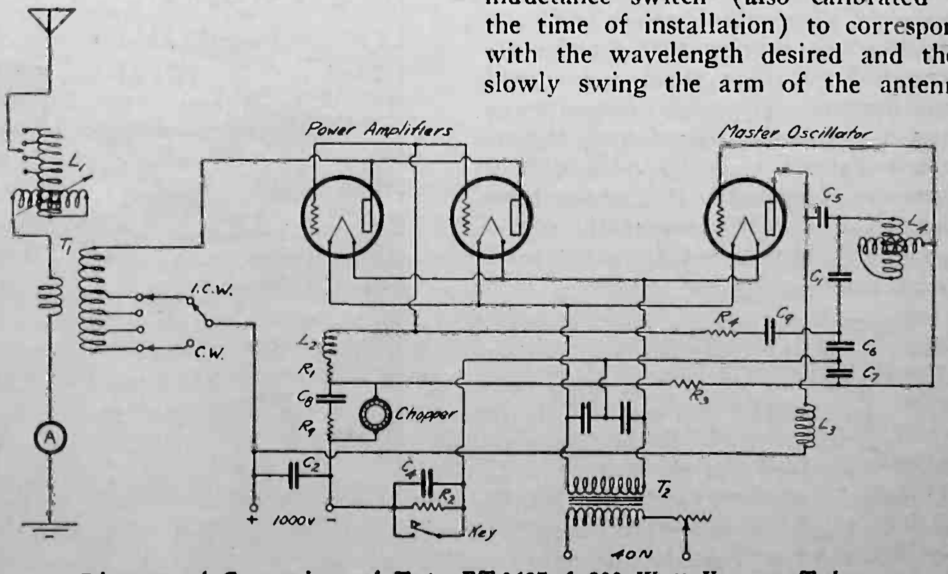


Diagram of Connections of Type ET 3627-A 200-Watt Vacuum Tube Marine Radio Transmitter.

variometer through its arc until the radiation ammeter indicates a maximum antenna current.

The change of signalling from interrupted continuous waves to pure continuous (CW) waves is accomplished by merely throwing the signal change switch to the desired position. In the ICW position, the chopper driving motor is started automatically as well as the necessary circuit changes made through the switch.

In addition to the antenna circuit ammeter having a scale reading of from 0 to 10 amperes, a 0 to 1½ kilovolt meter is provided to permit a proper adjustment of the plate potential, normally 1000 volts. Such adjustment is made by means of the high voltage generator field rheostat mounted on the transmitter panel, which permits of regulation of the plate voltage from 500 to 1500 volts.

Aside from the master oscillator and antenna circuit variometers the panel carries the radiation ammeter, filament and plate voltmeters, plate milliammeter, antenna inductance switch, signal change switch, start and stop buttons, generator field rheostat, filament rheostat and break-in relay. The three tubes are spring-supported just behind the upper half of the panel and on the frame at the rear are carried the antenna transformer, filament heating transformer, chopper interrupter with its driving motor and the necessary capacities and resistance for the proper functioning of the circuits. The hand key is of the usual small Morse signal type with heavy contacts and together with the standard lightning switch and a suitable lead-in bushing, completes the transmitter equipment.

The power plant serving as a supply source to the transmitter, consists of a standard General Electric shunt wound rotary converter driving a high voltage direct current generator. The motor end of the rotary converter operates from the ship's direct current supply lines while the alternating current end delivers 40 cycle current to light the filaments of the tubes through a suitable transformer. The high voltage generator is compound wound and develops normally 1,000 to 1,200 volts of direct current. Starting is accomplished through a one step automatic starter, push button controlled from the transmitter panel.

The receiver may be one of several types, depending upon the requirements of the vessel on which it is to be operated. In several cases, a modified type 106-B receiver, originally of the crystal rectification type but arranged now for regenerative vacuum tube operation, has been supplied. Usually such a receiver includes the type AA-1400 detector-two stage amplifier (audio) as its vacuum tube unit.

A new receiver has been installed in numerous cases, consisting of a tuning unit enclosed in a metal cabinet and comprising the primary and secondary circuit inductances and their respective variable tuning condensers to which is added a metal cabinet regenerative detector unit and as many individual audio frequency stages as may be desired within practical limits.

In some cases where the very highest type of receiver that it is possible to obtain is desirable, type IP-501 receiver of the Radio Corporation of America, together with its two-stage audio amplifier, is supplied.

There are a number of possible sources of auxiliary power supply capable of operating the radio transmitter of a vessel. Any method of supplying the necessary plate and filament current will answer for the type ET-3627-a transmitter. In actual practice, the preferred method is to provide some means of operating the motor-generator unit of the transmitter from some source other than the ship's main turbine generator which is the normal source of supply. Such auxiliary source should be located at a point as far above the water line as practicable. It must also be capable of functioning within two minutes from the time it is first called for.

The two most popular methods are an auxiliary storage battery or an internal combustion engine driving a 110 volt direct current generator. The battery system is preferable because it is not only capable of functioning instantaneously but it involves no moving parts which might have a tendency to break down or lose their adjustment. Nevertheless, the gasoline engine is in fairly wide use for this purpose and seems to answer satisfactorily. A number of Great Lakes vessels are so equipped. Auxiliary power supply is up to the vessel owners in practically every instance but the radio operating companies without exception, always recommend battery in preference to other supplies, when they are consulted.

A modern auxiliary battery generally comprises two units of 60 volts each and with a capacity of from 100 to 240 ampere hours. Either Edison or lead acid cells are used. The total combined voltage of the cells generally runs from 110 to 120 volts which allows operation of the ship's regular motor-generator unit through proper switching devices. However, in order to charge such a battery, the ship's supply line of 110 volts would be inadequate if applied directly to the battery terminals and the battery would have a tendency to feed the ship's supply rather than vice versa. Accordingly the two 60 volt banks of battery are so arranged through a four-pole double throw switch that they are charged in two parallel banks, but in discharging, the throw of the switch places them in series, thus delivering their full voltage output. This arrangement forms the most accepted and modern of auxiliary arrangements.

The foregoing text discusses in detail, the four component parts of a modern shipboard radio telegraph station; the transmitter, receiver, power plant and auxiliary supply source. The operator who familiarizes himself with vacuum tube transmission will find it much to his advantage, for even at so early a date as the present when vacuum tube transmission is just commencing to take its place in the marine radio field, men who have knowledge of this type of equipment are much in demand and as a consequence find it far easier to obtain desirable assignments than the men who can claim only a knowledge of spark equipment. Better assignments naturally await the vacuum tube man for it is the better class vessels which are foremost in changing from spark to tube transmission. A word to the wise is sufficient.

(Columbus Gets His Bearings by Radio Compass and Averts the Mutiny.)

The Panatrope and the Orthophonic Victrola

IT has been customary in the past to reproduce the sound registered upon a phonograph record by the use of either a steel needle or a jewelled point which acted as the transfer medium between the vibrations recorded on the disc and the diaphragm of the reproducer. The diaphragm in turn vibrated the surrounding air, which was confined in a resonant chamber ordinarily called the horn. Due to various limitations, such as the resonant period of the diaphragm and of the horn, a considerable amount of distortion was present which prevented the perfect reproduction of the speech or music.

The last year, however, has seen some radical developments in the phonograph and a brief description of two of these new developments will be of great interest to radio fans as it is due to the phenomenal advances made in the audio frequency branch of radio that these improvements to the phonograph have been hastened. One of the devices is purely mechanical, being an improved reproducer with a specially designed diaphragm and a reflexed horn equivalent to an ordinary horn many feet in length. A cross-sectional view of this horn is shown in Fig. 1.

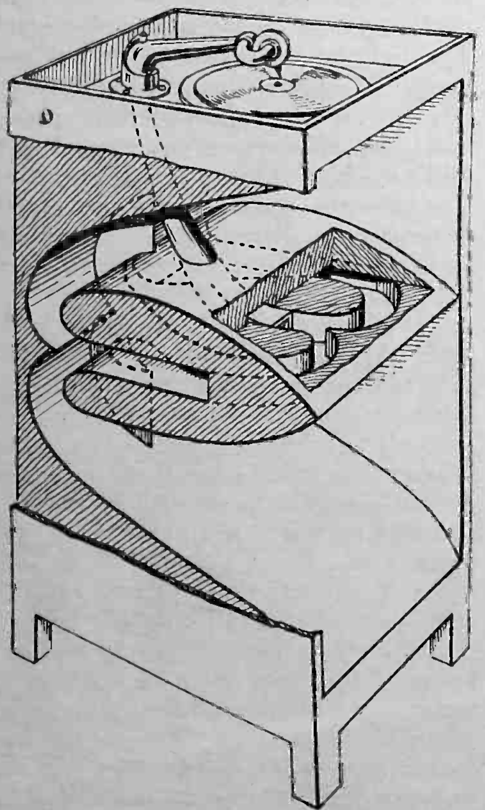


Fig. 1. Sectional View of Horn Type Phonograph.

In a recent paper presented before the American Institute of Electrical Engineers, this new sound reproducing system is described in detail. By means of a condenser-transmitter and a set of amplifiers, together with an electro-mechanical recorder, the quality of tone as recorded on the master record at the factory is as perfect as that obtained from any high-class radiocast station. The pick-up and recording device has a practically flat frequency characteristic from 50 to 5000 cycles and hence the new records are superior in tone quality to any which were obtained with the old method of picking up sound by means of a long horn and diaphragm recorder. The reproducer uses a special very thin aluminum alloy diaphragm having a number of corrugations spaced sufficiently close so that the natural periods of any flat surfaces on the diaphragm are all above the frequencies normally used in speech or music. The sound chamber is designed with logarithmic proportions so that it will pass all frequencies down to 100 cycles without appreciable difference in volume provided, of course, that the volume is the same for all frequencies.

The ingenious manner in which the sound chamber is curved back and forth in a small space so as to produce an extremely long horn can readily be seen from the diagram.

The second new device employs an electro-magnetic reproducer with a vacuum tube amplifier and cone type loud speaker. There is actually nothing new in this device but only a new application of electricity makes it especially interesting. Instead of transforming the mechanical vibrations recorded on the record into sound by means of a needle or jewelled point, the vibrations are transformed into electrical waves having the same characteristics.

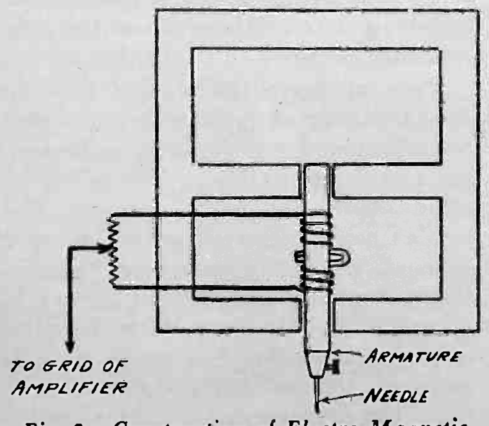


Fig. 2. Construction of Electro-Magnetic Reproducer.

Fig. 2 shows the construction of the reproducer. The needle is solidly fixed in a small armature of soft iron. This armature is so regulated that it can move easily, following the wavy movement which is received from the needle which follows the lines of the disc. Around this armature is wound a solenoid coil of fine wire which is inserted in the strong magnetic field of a permanent magnet. The iron armature in vibrating back and forth inside this solenoid coil generates a feeble alternating current in the solenoid, the current being sufficient to actuate the grid of a vacuum tube. This tube amplifies the received current and delivers it to a power tube, the output of which is connected to a Rice-Kellogg loud speaker, such as was described recently by Dr. John P. Minton in RADIO. The amplifier is operated from the power lighting circuit by means of a system of rectifiers which furnish the filament current and plate voltage for the tube and exciting current for the loud speaker field windings. Volume control is obtained by varying the voltage to the input of the first vacuum tube instead of opening and closing the doors of the phonograph. By means of a small clip the amplifier can be connected to a radio receiver, so that the outfit can be used either as a phonograph or as a radio set.

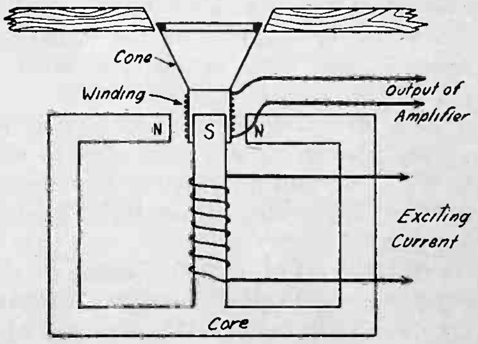


Fig. 3. Cone Speaker Used in Electrically Operated Phonograph.

Fig. 3 shows the details of the cone speaker which is similar to those now available for use exclusively with radio receiving sets. The quality obtained with this device is excellent, for high grade apparatus is used throughout and frequencies as low as 100 cycles are reproduced very satisfactorily.

In criticising the "quality" of the matter sent out by a radiocasting station, first be *sure* that your own set is capable of taking care of the quality reproduction that you desire, and be sure among other things, that there will be no overloading of vacuum tubes due to improper grid potentials, etc.

For small soldering jobs, a wad of rag, soaked in alcohol makes a quite satisfactory temporary "torch," which will last long enough to solder several connections before burning out.

A small dry sponge is a handy thing to keep near a storage battery, as the sponge can be used to absorb any spilled or slopped acid, before it has had a chance to do damage. If washed out quickly, the sponge can be saved, and used again after it is dried out.

Four of the old-fashioned porcelain, or "china" door-knobs will serve as first class insulators under a storage battery.

Adventures of a Ham

By Glenn Ellsworth

HOME from his work in the laboratory of the Wills Radio Corporation, Pete Ormsby went into his own laboratory for some experimental work on an idea of his own. It was this twenty-four-year-old, blonde husky's custom to tune in on NPG or WIZ on the short wave receiver and listen to their signals while making his experiments.

While running over the band from 37 to 41 meters, he heard a very faint CQ. After three or four minutes of the persistent CQ, the general call was followed by L. A. Pete reached over, threw out the antenna switch and proceeded to test his 40-meter transmitter. Setting his filament voltage at 10 volts, he hit the key. The radiation meter showed 1.8 amperes. Closing down the transmitter and throwing in the antenna switch, he could still hear the CQ, L. A. faintly. Then the call letters of the impatient station came thru, weak, but with a steady DC whistle, C-90X.

Pete threw out the antenna switch, lit up his 50-watter, and proceeded to call C-90X long and diligently. Signing his call and L. A., he adjusted the headset and waited.

"6MX, 6MX, C-90X" came in the clear whistle, "QRK abt. R8 hr. RAC note but F. B. O. M. Want to get Mr. A. Gill of 20003 Wilshire Blvd. Have U a land phone?"

Again turning to the transmitter, 6MX gave the information that he had the phone. C-90X came back and asked that Mr. A. Gill be called on the phone and notified that his father had met with a serious automobile accident and was not expected to live, C-90X giving the information that he would stand by until 6MX had Mr. Gill on the phone.

After looking thru the Gills in the directory, Pete could find no Mr. A. Gill living anywhere on Wilshire Blvd., could the operator tell him. He gave the Canadian this information, telling the distant op. that if he could wait for some time he would get in his car and see if Mr. Gill could be located in some other way. C-90X came back saying he would stand by for two hours if necessary.

Pete jumped in the car and taking back streets was soon at the given number on Wilshire Blvd. His ring was answered by a maid, who informed Pete that Mr. Gill had lived there, but had recently moved to Altadena. During the ensuing conversation the new owner of the Wilshire residence came to the door and was informed by the maid of the situation. Pete told this gentleman why he was so anxious to get in touch with Mr. Gill.

This elderly gentleman, Mr. Marsh by name, said he was a friend of Mr. Gill, requested the younger man to step in as he thought Mr. Gill might be located by phone. Mr. Gill was located and Pete was called to the phone, giving Mr. Gill the message that had been received from his father.

By this time Pete noticed it was 7:45, with only fifteen minutes before the hour had elapsed. Mr. Gill was given the address of 6MX station, along with the phone number, Mr. Gill requesting our hero to get more of the details, saying he would drive over as soon as possible. Pete then started for home to get more information about the accident and to inquire of the Canadian op. if Mr. Gill had a chance of making the trip if such a thing should be necessary.

Pete was thinking deeply on the problem of how the ham had again been of some value, when he heard the screech of a siren behind him. Glancing in the rear view mirror, he saw the red and white spot lights on a rapidly approaching vehicle. Looking down at the speedometer, he saw it was hovering around the 35-mile-per-hour mark. The one thought being to get home, 6MX clapped his foot down on the throttle. The speedometer jumped to 45. There was no more warning from the red-lighted vehicle, but a glance in the mirror showed the car to be gaining rapidly. At 54th and Vermont Pete was lucky and found traffic going his way. So he made a quick right-hand turn on 54th, only to hear the officer give a series of shrill toots on his police whistle. Then the shrill note of the siren as the police car whistled for a clear crossing.

Pete ran down the block a few hundred feet, saw an opening beside a store, and clamping on the brakes, made a sliding turn into the alley. This took him behind buildings, in the general direction of home. As soon as the lay of the dark alley was impressed on his mind, Pete turned out the lights of the car and drove slowly. He heard the police car go on down 54th street blowing the siren and with the cut-out open.

At the opposite end of the alley Pete turned west on 53rd street to Normandie and proceeding leisurely south on Normandie turned in at his own residence. Leaving the car in the driveway, he walked hastily into the transmitting room, noting as he did so that it was ten minutes past the hour. He threw in the power switch, and calling C-90X asking if he were still there. C-90X came back and asked for a report. 6MX gave a brief account of what had happened and told C-90X that Mr. Gill was on his way over to get all particulars.

The particulars were meagre. Mr. Gill's father had been run into and sustained a compound fracture of the right leg, three fractured ribs and internal injuries, and was constantly calling for his son. C-90X would QRX until some word was received from Gill, and sliding the headset off one ear 6MX glanced thru the radio room door, down the drive past the car, and saw the reflection of headlights on the pavement in front of the house. The car stopped and two men walked up the drive into the radio room. Mr. Gill and Pete shook hands. The second party evidently was Mr. Gill's chauffeur, from his uniformed appearance.

Mr. Gill read all the particulars, and glancing at his watch he saw it was 9:02. The next train, according to information from the city ticket office, left Los Angeles at 10:15.

6MX informed C-90X that Mr. Gill would leave Los Angeles on the 10:15 train for the trip to Vancouver—all traffic cleared. Pete shut down the transmitter, pulled the switch on the receiver and started to walk to the front with Mr. Gill. Just as the front curb was reached, a car passing the house suddenly stopped and a spotlight was turned on his car, searching over it until the beam finally came to rest on the number plate. The light was finally extinguished and two police officers climbed from the front seat of the car, turning their pocket flashlights upon the group around Mr. Gill's machine. One of the officers asked who was the owner of the car in the driveway, and Pete had to acknowledge that he was. The officer then asked about the doings of Pete prior to his rapid getaway. The story was briefly told. At this point of the story Mr. Gill told his version to the police, and taking one of the officers aside, talked seriously to him for a few moments. Then taking something from his inside pocket he gave it to the man in uniform, and they both returned to the rest of the party.

As it was nearing train time, Mr. Gill shook hands all around and departed, telling Pete he would see him again. There was more questioning in order, so the officers and Pete returned to the radio room. The evening's log was looked over and a notation made of the time first traffic started with C-90X. The police questioned Pete as to his whereabouts just prior to the chase. Pete told them he was at the Wilshire Blvd. address, names were noted. Pete called Mr. Marsh on the phone, giving him a detailed account on the happenings after he had left the Marsh residence, and requested Mr. Marsh to substantiate his claims to the officers.

(*Continued on Page* 57)

Radio Construction Pointers

By Paul Oard

A Tube-Base Switch

THE combination of a base from a burned-out tube, with a socket to fit the same, affords the radio builder a really worth while arrangement, practical and efficient in a number of possible set-ups for making and breaking both low and high voltages in the receiving cabinet, as well as antenna and loop circuits.

The glass is broken away from the base, and the prongs are cleaned of the solder used to hold the four wires running into the stem of the tube. The quickest and most thorough method of doing this last is to put the tip of a hot iron to each prong, and as soon as the solder starts to melt, to jerk the base downward sharply. This will effectually clean the prong of all solder and the small wires may be withdrawn.

Each base and socket will accommodate four leads or connecting cables. The best material for this purpose is ordinary single strand lamp cord, or double strand cable may be unwound for the purpose. It is possible to secure lamp cord in a number of colors, and advantage of this fact may be taken in "coding" the cable, as black or white for low voltage and red for high.

Each cable is cleaned of its insulation for about a half inch, the exposed strands are twisted tightly, dipped in soldering flux and well tinned with solder, then run through the prong of the tube base, and a small drop of solder on the end of the prong serves to make connection. After all necessary cables have been inserted and soldered, they are held rigidly in place by pouring melted wax, which may be taken from discarded dry cells, into the base. The hot soldering iron may be used for this purpose, by holding a small chunk of wax near the base, and "flowing" it into the base by passing the hot point of the iron through it.

Fig. 1, calling for two bases and two sockets, which may be fastened to the back of the receiving cabinet, shows a method of connecting and disconnecting simultaneously, antenna, ground, the *A* battery negative and positive leads, and all *B* battery leads up to four in number. One base and socket afford a convenient method of connecting and disconnecting either a two or three tap loop when used on portable sets. The loudspeaker circuit may be made and broken in this method. If one wants to do a little figuring, a number of more complicated connections may be worked out by inter-connecting sockets and bases, so that almost any combination desired may be secured. The cables may be either rolled or braided for neatness. The 199 type of base and socket are of ample size and point-of-contact, and would be neater than the standard size. Springs in the sockets should be bent up before the socket is fastened to its support, and polished if necessary.

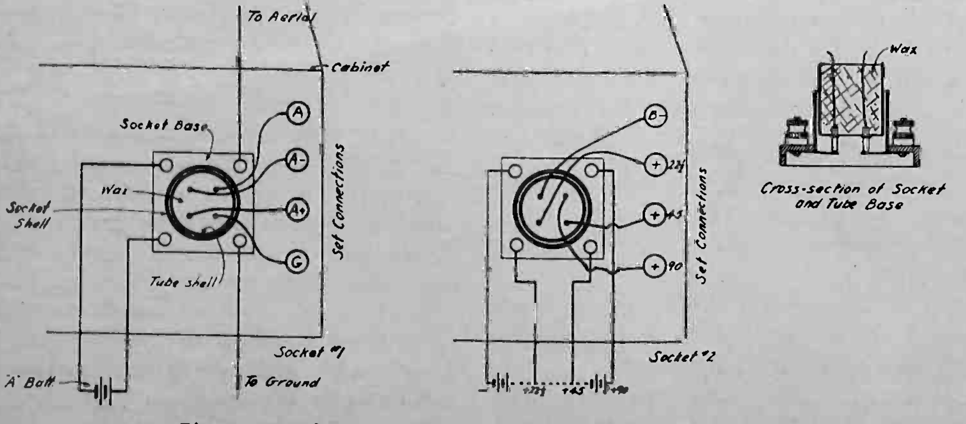


Fig. 1. Handy Antenna-Ground and Battery Connection.

A Non-Corroding Soldering Iron

MOST constructors, in soldering up connections for any length of time, find it necessary to frequently file the point of their irons and then tin the point in order to make the solder flow properly, and to hold to the point a sufficient amount for good contact. This is particularly the case where the majority of the grease forms of soldering flux are used, probably being due to impurities in the copper point of the iron.

If one is a stickler for fine work, and wants to do away with constant filing and cleaning of the iron, and doesn't mind a little additional first expense (which soon is found to be well worth the amount expended) the following method is practical and thorough.

Secure from your dentist a small amount of gold solder, and if you haven't a small blow torch or Bunsen burner in your work kit, talk your dentist out of this item also. File your copper point clean. Heat it thoroughly. Using borax (which your long suffering tooth-jerker should also have) as a flux, flow a thin coating of gold solder over the point of the iron. The gold solder will not melt in heat sufficient for ordinary soft soldering, and you have a point that will not need constant cleaning. The little additional trouble is more than repaid on irons that do not have a renewable point, and which through constant filing are worn down so that they do not hold their heat properly.

The Use of Wood for Panels

MOST constructors adhere to the use of panels made of either hard rubber or of the phenolic compounds, under the belief that the use of wood is neither practical nor proper. However, where the item of expense is a serious one to the radio constructor, wood may be substituted, and properly handled and finished, it gives results equal both in looks and results to those obtained where regular panel material is used.

One of the largest radio manufacturers in the world makes extensive use of wood panels in their highest priced instruments. Changing methods and applications in radio manufacture make this possible, where in early day manufacture this was not practical. Present day manufacture does away with the use of switch point variation, with points and blades mounted directly on the panel, and jacks, carrying high voltage are not as extensively used as formerly. Present day construction calls for the use of units which are individually mounted on bakelite or other insulating mediums, so that metal carrying live circuits need not come in direct contact with the panel.

If the constructor has more time than money, and the ability to handle shellac and a brush, wood may be used in such a manner as to give his finished product a truly commercial appearance. Quarter inch mahogany or walnut veneered stock may be obtained from any cabinet maker or hardwood mill. The average cost of a panel 7 by 18 inches is fifty cents, plus about ten cents worth of stain and shellac.

The panel should be sanded carefully, and stained with an alcohol stain, which is faster and easier to handle than the oil stain. Two to three coats of shellac of medium body, with a good rub down with fine steel wool between each coat, and a final polish of wax, gives an appearance that contrasts quite favorably with some of the standard panel materials now in use. In mahogany, a rather dark mahogany stain should be used, and in walnut, preferably a light stain.

The builder generally wants his panel to resemble a commercial job as near as possible, and if he is to obtain such an appearance with wood, he must use some care in the fitting of dials and other unit material that is used on the face of the panel. Engraving directly on the face of a wood panel is not practical, therefore if a commercialized appearance is desired, fittings must be selected in which distinguishing markings are stamped directly on the fitting itself. The new vernier type dials, with their metal or bakelite housings, and rheostat knobs, in which the pointer is stamped or engraved on the material itself, lend themselves well to wood panels. Of course, cost is an item, and it is not advisable to buy ten dollars worth of fittings in order to harmonize a sixty cent panel, but where the constructor belongs to that clan which has accumulated a considerable store of parts, and is constantly building up new panels for different circuits, the wood panel can be used to advantage.

The writer calls to mind a neutrodyne receiver manufactured by a well known firm, in which the panel, approximately 30 x 10 in., is of quarter-inch mahogany veneer, finished in Adam brown, with three dials finished in mottled mahogany. The markers for the dials are simply straight lines scribed in the wood panel, and filled with whiting. The only metal fitting used is the nameplate of the manufacturer, but the effect is highly pleasing, and a finished job is produced.

The purpose of the above radio construction note is not for the purpose of discouraging the use of standard insulating mediums in panel layout, for aside from the item of expense, the latter is in over-all percentage of satisfaction, the best to work with. However, many of us held back by financial considerations from the purchase of such material, can find opportunity for display of constructive skill in the adaption of wood as a panel material. There is also another practical application of wood panel material, and that is in the building up of the experimental set from a raw start, where it may be necessary to relocate various of the units that are mounted on the panel, before a final form can be decided upon, and wood offers a cheap medium of arriving at a finished instrument, with the final substitution of standard panel material after all details in mounting have been settled.

Improving the Rheostat

MOST of the circuits in use today in receiving sets use regeneration in some form, whether in radio frequency ahead of the detector tube, or in the detector tube only, or in a combination of both. Any sudden change in resistance in the battery circuit is noticeable in disagreeable popping noises in the loudspeaker or headset, and this condition oftimes makes itself apparent in rheostats after they have been in use some time. Most of the resistance wire contains some percentage of iron, which oftimes corrodes, with consequent poor contact. Vaseline or light oil placed sparingly on the winding will help clear up a certain amount of the noise and also prevents undue wear on the moving blade. Investigation oftimes reveals where this precaution is not taken, that the blade has worn badly, and has scattered fine brass filings about the interior of the set. The writer has seen instances where the receiver was finally rendered inoperative through filings shorting out a high voltage part of the circuit.

A weak point in the average rheostat is to be found at the sliding point of contact where the moving blade makes contact with the strip that leads to one of the binding posts. Many rheostats are so made that contact is dependent to a large extent upon the manner of mounting, and if not tightly mounted, loose contact soon causes noise with every adjustment. The remedy here lies in connecting in a piece of flexible wire from the blade to the binding post direct, and will do away in large part with noise induced from this fault.

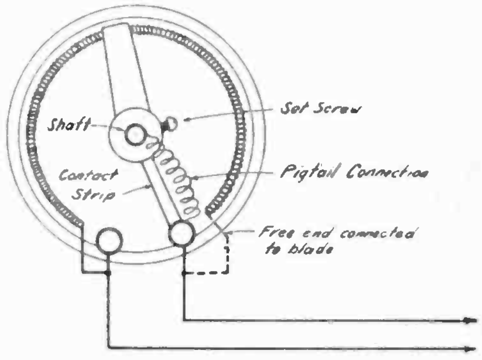


Fig. 2. Pigtail Connection for Rheostat.

Where a switch is used as a final shut-off on the *A* battery circui,t, another improvement may be made in the rheostat by connecting the free end of the rheostat winding directly to the binding post that runs to the moving blade. This means that the circuit can not be shut off by moving the blade to the off position, but will leave a small amount of current flowing through the rheostat until the shut-off switch is pulled. However, this arrangement, in connection with the pigtail, as mentioned above, will do away with ninety-nine per cent of the noise to be found in the *A* battery circuit, when rheostat adjustments are made.

Making Your Own Soldering Lugs

A NEAT and practical soldering lug can be easily made out of scrap bus bar wire, and affords a use for odd ends left over in wiring. A pair of wire bending pliers does the trick. The eyelet can be formed to fit as needed, and the finished lug assumes the form shown

Fig. 3. Home-Made Soldering Lug.

in Fig. 3. If desired, the soldering end may be flattened with a small hammer or a strong pair of pliers for additional soldering surface.

Twisted Bus Wire

SQUARE bus wire that is twisted by placing one end in a vise, and then fastening the other end in a hand or breast speed drill and given a few turns, affords a novelty in wiring. The twist serves to give a better gripping surface to the solder, and inferior grades of wire, that have been bent until they are not satisfactory for wiring, may be made as straight as a ruler through this treatment. Soft wire, tempered in this manner, may be bent more neatly than otherwise. Where one wants a particularly neat appearing wiring job, the use of twisted bus wire is worth considering.

INTERNATIONAL RADIO NOTES

From H. de A. Donisthorpe

A new 10 k.w. broadcast station has been erected at Pennant Hill, Australia.

A new German station is in operation at Frankfort-on-Main.

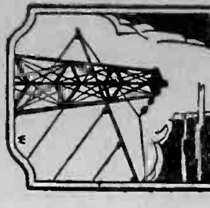
The drastic restrictions imposed on listeners in Italy coupled with the high dutes levied on imported radio receivers and parts are responsible for the lack of support which this new industry receives in that country. A tax of 25 per cent ad valorem on all parts and receivers of foreign make has resulted in the Italian apparatus, which at its best is poor, being offered at too high a figure to allow of the average man being able to purchase. A result of the Italian government's attitude on broadcasting is reflected in the exceedingly small number of licenses that have been taken out. It is expected that there will be changes made shortly in the Radio Laws which will remove these restrictions.

A regular interchange of programs has been established between Daventry station (England) and Hilversum (Holland), the first transmission of Dutch programs for English listeners being on April 19th. The programs from Hilversum are picked up in England by the Keston receiving station and then relayed by land line to Daventry.

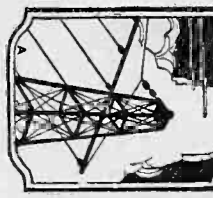
As a result of the recent investigation carried out in Europe for the purpose of eliminating international wave interference certain changes have been made in the wavelengths of some of the stations. These changes are as follows: Bournemouth, 387; Hamburg, 392; Dublin, 397; Graz, 402; Newcastle, 487; Munster, 412; Breslau, 417.

Hard rubber, which is not too badly discolored, may sometimes be restored to lustre and finish by rubbing with a soft rag moistened with carbon bisulphide, and then wiping dry and rubbing up with a soft smooth rag.

A piece of shoe-lace may be slipped over a wire, and then covered with shellac to make a satisfactory substitute for "spaghetti" tubing.



for The RADIO NOTE BOOK



Useful Facts and Theory

Classified According to Dewey Decimal System.

Tear out page, cut along black lines, punch holes with pencil where indicated, and file numerically in standard notebook in accordance with Index Sheets Nos. 1 and 2.

R-030
AUDIBILITY DESIGNATIONS

The system of denoting relative audibility of signals from distant stations by the use of the QSA-QRK-QRZ calls has been abandoned in favor of the set of nine combinations, shown in the following table; they have been generally adopted by the amateur:

Audibility	Readability
R-1—Faint signals, just audible	1—10% Readable
R-2—Weak signals, barely audible	2—20% Readable
R-3—Weak signals, but readable	3—30% Readable
R-4—Fair signals, easily readable	4—40% Readable
R-5—Moderately strong signals	5—50% Readable
R-6—Strong signals	6—60% Readable
R-7—Good strong signals, readable through bad QRM and QRN.	7—70% Readable
R-8—Very strong signals, audible with phones on table	8—80% Readable
R-9—Extremely strong signals.	9—90 to 100% Readable

The readability signals are not ordinarily used in amateur communication, as most amateurs are unfamiliar with the designations. For example, a signal may be R-9, unbearably loud, but due to QRM from another loud station operating a kilocycle or more from the frequency of the desired station, the signals are only 50% readable. Thus, if signals are reported R-35, that would indicate that the signals are weak and only a fair degree of copy could be had, necessitating the sending of each word twice. If the report was R-91 it would mean very loud signals, but due to local interference, it was impossible to get more than 10% of the copy accurately.

INTERNATIONAL INTERMEDIATE DESIGNATIONS

With the coming of international amateur radio communication, the old intermediate signal "de," placed between the call letters of the station being called and those of the calling station, has been changed to a system employing a set of letters designating the country in which the station calling and the one being called are located. The letter for the country being called first, followed by the letter for the country where the transmitting station is located. When calling the general call, CQ, only one intermediate, that of the country in which the calling station is located, should be sent.

A—Ausralia
AU—Alaska
B—Belgium
BE—Bermuda
BZ—Brazil
C—Canada
CH—Chile
CR—Costa Rica
D—Denmark
E—Spain
F—France
FI—Indo-China (unauthorized)
G—Great Britain
H—Switzerland
HU—Hawaii
I—Italy
J—Japan
K—Germany (unauthorized)
L—Luxembourg
M—Mexico
N—Netherlands
O—South Africa
P—Portugal
PI—Philippine Isl'ds
PR—Porto Rico
Q—Cuba
R—Argentine
S—Scandinavia (Denmark, Finland, Iceland, Norway, Sweden)
U—United States
Y—Uruguay
Z—New Zealand.

R-330
POWER TUBE DATA

With the advent of the new UX-171, CX-371 power tube, which makes four in all, some confusion is bound to exist unless the important characteristics of each tube and an idea of its particular use is in the mind of the prospective user. The following table gives the data for the dry cell power tube type UX-120, CX-220, the two storage battery power tubes, types UX-CX-112 and the UX-171, CX-371 and the 1½ watt type UX-210, CX-310. Data are given for three plate voltages, with the exception of the dry cell power tube, which should not be operated at plate voltages in excess of 135, and the 1½ watt tube, normally used with 425 volts plate. This table shows that of the two storage battery power tubes, the CX-371 is capable of giving the greatest power output, but at the same time consumes the greatest amount of power from the *B* supply.

Type Tube	*Plate Volts*	*"C" Voltage*	*Plate Current*	*Plate Impedance*	*Power Output*	*Amplification Constant*	*Fil. Volts*	*Fil Current Amps.*
			M. A.	Ohms	Watts			Amps.
UX-120 CX-220	90	-16	3.2	7700	.04	3.3	3	12
	135	-22½	6.5	6600	.11	3.3	3	.12
UX-CX-112	90	- 4½	4.0	6250	.04	8.5	5	.5
	135	-9	6.0	5400	.12	8.5	5	.5
	180	-12½	9.0	4400	.29	8.5	5	.5
UX-171 CX-371	90	-16	10.0	3000	.13	3.0	5	.5
	135	-27	16.0	2800	.35	3.0	5	.5
	180	-40	20.0	2500	.65	3.0	5	.5
UX-210 CX-310	425	-33	24.0	4600	1.54	8.0	7.5	1.25

The type UX-CX-112 has a rather high amplification constant, and hence a low plate current, so that it is suitable for use in the last audio stage of any set in which the loud speaker is connected directly to the plate circuit of the power tube. The same applies to the UX-120, CX-220, which has approximately the same plate current as the 112 tube at the same plate voltages, and this plate current will not damage the windings of the loud speaker.

When using the UX-171, CX-371 tube, however, it is not safe to pass 15 or 20 milliamperes through the average loud speaker, and some sort of a by-pass for the current is necessary, as here shown diagrammatically. The choke coil, or impedance, should have an inductance of at least 50 henrys, and any of the filter chokes used in the construction of the Raytheon *B* eliminator will serve very satisfactorily.

for The RADIO NOTE BOOK

Useful Facts and Theory

Classified According to Dewey Decimal System

Tear out page, cut along black lines, punch holes with pencil where indicated, and file numerically in standard notebook in accordance with Index Sheets Nos. 1 and 2.

R-080

STANDARD TIME CONVERSION CHART

Figures on the same horizontal line indicate the standard time in each zone at the same instant. A change in date is indicated by the heavy lines at the upper left and lower right corners of the chart; going to the right of the heavy line denotes the following day; to the left, the previous day.

Hawaii	San Francisco P.C.T.	Denver M.S.T.	Chicago C.S.T.-D	Havana Cuba	New York Washington E.S.T.	New York Washington Daylight Saving	Halifax Buenos Aires	Rio de Janeiro Brazil	London Paris Madrid	G.M.T.	Sweden Germany Switzerland Italy	Petrograd Constantinople Capetown Jerusalem	Bagdad Persia	Calcutta Bombay India	Borneo Java Dutch E. I.	Manila P. I. China Western Australia	Tokyo Central Australia	Sydney Melbourne Eastern Australia	Auckland New Zealand	Samoa
1.30P.M.	4.00P.M.	5.00P.M.	6.00P.M.	6.30P.M.	7.00P.M.	8.00P.M.	8.00P.M.	9.00P.M.	Midnight	0000	1.00A.M.	2.00A.M.	3.00A.M.	5.00A.M.	6.00A.M.	8.00A.M.	9.00A.M.	10.00A.M.	11.30A.M.	Noon
2.30	5.00	6.00	7.00	7.30	8.00	9.00	9.00	10.00	1.00A.M.	0100	2.00	3.00	4.00	6.00	7.00	9.00	10.00	11.00	12.30P.M.	1.00P.M.
3.30	6.00	7.00	8.00	8.30	9.00	10.00	10.00	11.00	2.00	0200	3.00	4.00	5.00	7.00	8.00	10.00	11.00	Noon	1.30	2.00
4.30	7.00	8.00	9.00	9.30	10.00	11.00	11.00	Midnight	3.00	0300	4.00	5.00	6.00	8.00	9.00	11.00	Noon	1.00P.M.	2.30	3.00
5.30	8.00	9.00	10.00	10.30	11.00	12.00	Midnight	1.00A.M.	4.00	0400	5.00	6.00	7.00	9.00	10.00	Noon	1.00P.M.	2.00	3.30	4.00
6.30	9.00	10.00	11.00	11.30	Midnight	1.00A.M.	1.00A.M.	2.00	5.00	0500	6.00	7.00	8.00	10.00	11.00	1.00P.M.	2.00	3.00	4.30	5.00
7.30	10.00	11.00	Midnight	12.30A.M.	1.00A.M.	2.00	2.00	3.00	6.00	0600	7.00	8.00	9.00	11.00	Noon	2.00	3.00	4.00	5.30	6.00
8.30	11.00	Midnight	1.00A.M.	1.30	2.00	3.00	3.00	4.00	7.00	0700	8.00	9.00	10.00	Noon	1.00P.M.	3.00	4.00	5.00	6.30	7.00
9.30	Midnight	1.00A.M.	2.00	2.30	3.00	4.00	4.00	5.00	8.00	0800	9.00	10.00	11.00	1.00P.M.	2.00	4.00	5.00	6.00	7.30	8.00
10.30	1.00A.M.	2.00	3.00	3.30	4.00	5.00	5.00	6.00	9.00	0900	10.00	11.00	Noon	2.00	3.00	5.00	6.00	7.00	8.30	9.00
11.30	2.00	3.00	4.00	4.30	5.00	6.00	6.00	7.00	10.00	1000	11.00	Noon	1.00P.M.	3.00	4.00	6.00	7.00	8.00	9.30	10.00
12.30A.M.	3.00	4.00	5.00	5.30	6.00	7.00	7.00	8.00	11.00	1100	Noon	1.00P.M.	2.00	4.00	5.00	7.00	8.00	9.00	10.30	11.00
1.30	4.00	5.00	6.00	6.30	7.00	8.00	8.00	9.00	Noon	1200	1.00P.M.	2.00	3.00	5.00	6.00	8.00	9.00	10.00	11.30	Midnight
2.30	5.00	6.00	7.00	7.30	8.00	9.00	9.00	10.00	1.00P.M.	1300	2.00	3.00	4.00	6.00	7.00	9.00	10.00	11.00	12.30A.M.	1.00A.M.
3.30	6.00	7.00	8.00	8.30	9.00	10.00	10.00	11.00	2.00	1400	3.00	4.00	5.00	7.00	8.00	10.00	11.00	Midnight	1.30	2.00
4.30	7.00	8.00	9.00	9.30	10.00	11.00	11.00	Noon	3.00	1500	4.00	5.00	6.00	8.00	9.00	11.00	Midnight	1.00A.M.	2.30	3.00
5.30	8.00	9.00	10.00	10.30	11.00	12.00	Noon	1.00P.M.	4.00	1600	5.00	6.00	7.00	9.00	10.00	Midnight	1.00A.M.	2.00	3.30	4.00
5.30	9.00	10.00	11.00	11.30	Noon	1.00P.M.	1.00P.M.	2.00	5.00	1700	6.00	7.00	8.00	10.00	11.00	1.00A.M.	2.00	3.00	4.30	5.00
7.30	10.00	11.00	Noon	12.30P.M.	1.00P.M.	2.00	2.00	3.00	6.00	1800	7.00	8.00	9.00	11.00	Midnight	2.00	3.00	4.00	5.30	6.00
8.30	11.00	Noon	1.00P.M.	1.30	2.00	3.00	3.00	4.00	7.00	1900	8.00	9.00	10.00	Midnight	1.00A.M.	3.00	4.00	5.00	6.30	7.00
9.30	Noon	1.00P.M.	2.00	2.30	3.00	4.00	4.00	5.00	8.00	2000	9.00	10.00	11.00	1.00A.M.	2.00	4.00	5.00	6.00	7.30	8.00
10.30	1.00P.M.	2.00	3.00	3.30	4.00	5.00	5.00	6.00	9.00	2100	10.00	11.00	Midnight	2.00	3.00	5.00	6.00	7.00	8.30	9.00
11.30	2.00	3.00	4.00	4.30	5.00	6.00	6.00	7.00	10.00	2200	11.00	Midnight	1.00A.M.	3.00	4.00	6.00	7.00	8.00	9.30	10.00
12.30P.M.	3.00	4.00	5.00	5.30	6.00	7.00	7.00	8.00	11.00	2300	Midnight	1.00A.M.	2.00	4.00	5.00	7.00	8.00	9.00	10.30	11.00

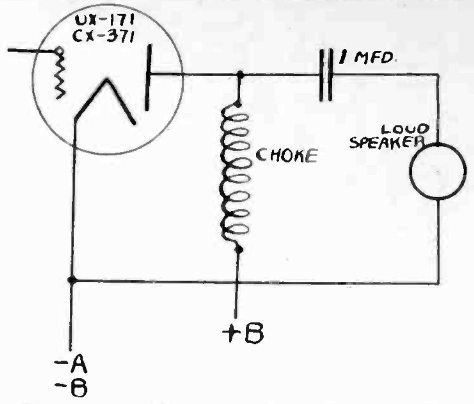
R-330

POWER TUBE DATA

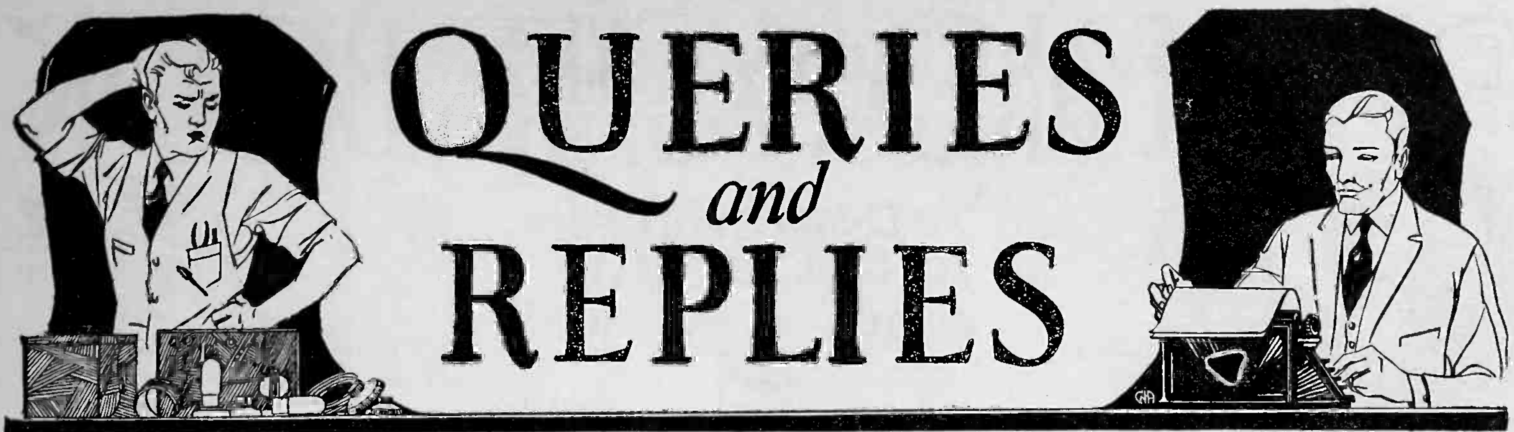
(Continued)

The 1 mfd. condenser should be capable of withstanding the maximum voltage applied to the plate of the tube, and therefore should be a filter condenser in order to assure protection to the loud speaker windings. The direct current in the plate circuit of the tube passes through the windings of the choke, and the alternating current output, being prevented from entering the *B* supply circuit by the choke coil, follows the path of least resistance through the 1 mfd. condenser, through the windings of the loud speaker, and back to the filament of the tube.

The 371 tube will be hard on the *B* battery, unless of the heavy duty or storage battery type. *B* battery eliminators which will supply at least 30 milliamperes at 180 volts will handle the load, but it is doubtful if lower voltage eliminators will supply the power tube as well as the other tubes in the set with sufficient current, particularly if the set has a larger number of tubes. The 371 tube is essentially a current amplifier, with a low amplification constant, and should never be used except in the last audio stage, and under the circuit conditions as shown in the diagram. It is important to note that a large *C* battery is required with this tube, and that the *C* battery should never be omitted. With no *C* battery, or only a small amount such as is ordinarily used in most sets, the plate current consumption of this tube, with battery supply, would be 50 milliamperes or more, and the loud speaker or headphones, if connected in the plate circuit of the tube, would be quickly burned out. This is true to a lesser degree in the case of the other power tubes, but every precaution should be taken to insure the proper *C* voltage in the 371 tube grid circuit. A miniature *B* battery made up of two 22½ volt sections will make a good *C* battery for use with this tube, and the battery will last its shelf life, as there is no load on it.



Connections for UX-171, CX-371 Tube.



QUERIES and REPLIES

Questions of general interest are published in this department. Questions should be brief, typewritten, or in ink, written on one side of the paper, and should state whether the answer is to be published or personally acknowledged. Where personal answer is desired, a fee of 25c per question, including diagrams, should be sent. If questions require special work, or diagrams, particularly those of factory-built receivers, an extra charge will be made, and correspondents will be notified of the amount of this charge before answer is made.

What is the circuit used in the Crosley 5-38 receiver, and can a power tube be used?—H. H. R., Madison, Wis.

The Crosley 5-38 Receiver schematic wiring diagram is shown in Fig. 1. This set is readily adapted to power tube operation.

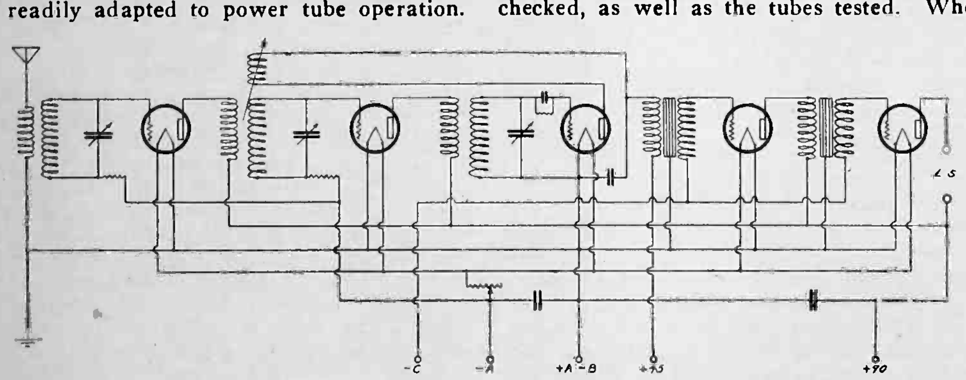


Fig. 1. Wiring Diagram of Crosley 5-38 Receiver.

All that is necessary is to disconnect the negative *C* battery wire coming from the last audio transformer secondary, and to this terminal connect the additional *C* voltage necessary for the power tube. If the type UX-CX-112 power tube is employed, the *C* voltage should be 10½ volts, where 157½ volts plate is available.

Have a Tungar charger of 2 ampere rate, equipped for B battery charging. Could I use this as a B battery eliminator, with the proper lamp in the charger?—F. R., Richmond, Calif.

By the time the rectified a. c. was filtered, you would have very little voltage left for the plate circuit. At the low current drain required for the set, the efficiency of the Tungar rectifier would be low, and it would be cheaper from a maintenance standpoint to use one of the *B* eliminators especially designed for small current drain and economical operation.

Kindly publish what method can be used to approximately determine the functioning of each of the four parts involved in a superheterodyne.—J. J. B., St. Louis, Mo.

Assuming that the set is completed, and ready for operation, turn on the volume control so that the intermediate frequency amplifier is operating at a reasonable amount of gain, and listen in with a pair of headphones plugged in the detector jack. Place the finger on each intermediate amplifier grid terminal in succession, and the following results will be noted: on the third intermediate a dull thump will be heard when finger is touched to the terminal and again when it is removed: on the second intermediate the thump will be much louder and on the first intermediate the set will break into the oscillations, accompanied by a loud hissing sound. When the 1st detector grid terminal is touched there should be high frequency oscillations accompanied by a loud audio frequency howl, or squeal. If these results are not obtained, the amplifier is not giving the proper gain, and the wiring should be checked, as well as the tubes tested. When the finger is applied to the oscillator grid, a click should be heard in the headphones when contact is made, but no audio frequency howl. If the click is not heard, the oscillator is dead, and the coil windings should be inspected to make sure that the connections are not reversed. The audio frequency amplifiers are the easiest to test, by bringing in signals from a local station, and listening to the output of the last stage with a loud speaker. Overloading of the power tube is usually heralded by a scratching sound which accompanies the speech or music, and indicates that if the volume being obtained is only just sufficient for the requirements of the room, more *B* and *C* voltage should be applied to the power tube.

Please publish a low wave, two tube circuit for 40 to 125 meters.—I. K., Berkeley, Calif.

Two short wave receivers, together with their circuits, are described in detail in the amateur section of May 1926 RADIO.

Have a Crosley Trirdyn, and would like to install a variable air condenser instead of the push-pull arrangement now used. How may this be done?—H. S., Spokane, Wash.

The old condenser may be removed and an air condenser of .00035 mfd. capacity mounted on the panel in its place. Some slight re-arrangement of parts will be necessary in order to accommodate the new condenser, but will have to be determined at the time of rebuilding, on account of the varying sizes of condensers available.

Would like to build a three tube Cockaday 4 circuit receiver. Please print the circuit, together with specifications for making the coils.—D. F. L., Cleveland, Ohio.

The circuit is shown in Fig. 2. Sorry we have no details on the coils. Suggest you write to *Popular Radio*.

Read with interest the article by Howard S. Pyle on "Breaking Into the Radio Game" in May RADIO. What he did not explain was how to get an amateur license. Please publish this information as soon as possible. G. Y., San Francisco, Calif.

Assuming that you already know a little about radio theory, it would be a good idea to purchase a book such as Ballantine's "Radio Telephony and Telegraphy for Amateurs," and learn as much as possible about the transmitting and receiving circuits, as well as the theory of transmission. Familiarize yourself with the rules and regulations governing radio communication, and learn the principal international Q signals, particularly those pertaining to interference. If

(*Continued on Page 60*)

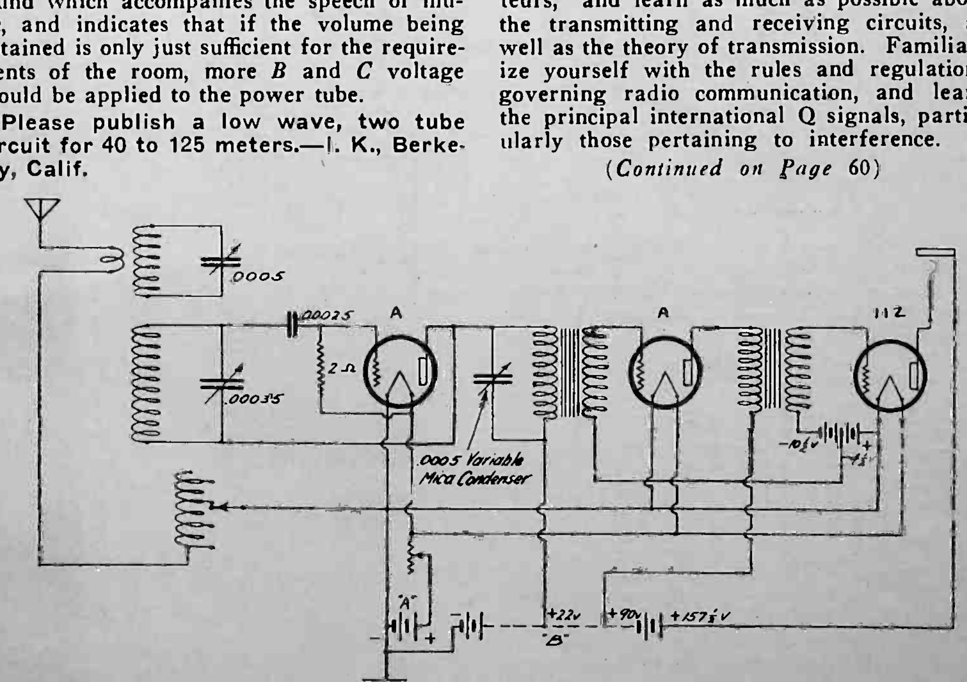
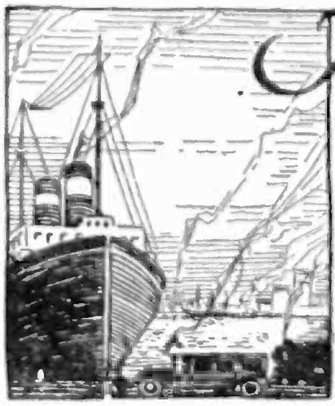
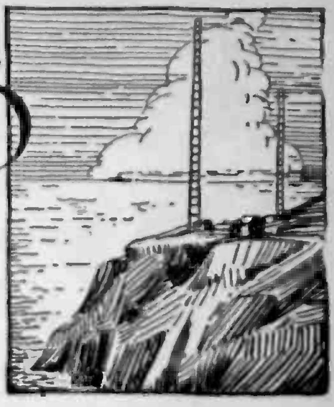


Fig. 2. Three Tube Cockaday Circuit.



The COMMERCIAL BRASSPOUNDER

A Department for the Operator at Sea and Ashore



Edited by P. S. LUCAS
R. O. KOCH, *Great Lakes Correspondent*

MAKING A PLACE FOR OURSELVES

After the first issue of "The Commercial Brasspounder," we have received quite a few letters from operators and ex-operators who have read it and found it to their tastes. Some have offered suggestions and criticisms that are helpful in making this department what it should be; some have praised and offered encouragement, which also helps; some have written some stories. ALL have pledged their support and willingness to boost.

We should like to quote from all the letters we have received, but that is impossible, so we shall have to keep most of our enthusiasm to ourselves. When we heard that one operator to whom we had sent a letter explaining this department, (several of the others of you have received one) had made copies of it to QST for us, we counted in another friend as a hard-working booster. With a few more like him this department will amount to something more than just a few pages of reading matter.

In almost every letter is expressed the hope that some day the C. B. will lead to an organization for the operators similar to that of the amateurs. It is an acknowledged fact that the A. R. R. L. owes its very existence to a magazine. This is true of any organization which has to cover such a wide territory as one of this type does, and it would certainly be so in the case of a group of commercial wireless operators, most of whom are never in the same place a week at a time.

Therefore, fellows, let's not let this opportunity slip by as we have similar opportunities in the past. Keep the C. B. booming by your support. Write up some experiences, talk it up, subscribe, (giving the C. B. the credit), take some pictures, and if you are interested in forming a club in your town or most frequent port we will help you all we possibly can.

They will soon have to change the name of "Sparkplug" Gerdorf to Signor since he has become an exponent of the Charleston and is dancing in some of the best theaters in Los Angeles. These $50 a day contracts on the movie lots, however, have not spoiled him, and he still wobbles a bug at the F. T. Co.

* * *

H. R. Maule has returned to WDK after completing a winter's relief work on the Ann Arbor line.

* * *

That good old sorrehop, Dick Clark, who relieved "yours trooly" on the gude shippe *Yorba Linda* a little over a year ago, is coming ashore to go to Alaska. There he will supervise the installation of the 2 K.W. Federal arc at Icy Bay, near Yukatat. Here's luck to you, Dick.

WFK—FRANKFORT, MICH.

By R. O. KOCH

WAY back in 1908—the days of straight gaps and single-slide tuners—there came into existence a radio station that was destined finally to become one of the most prominent on the Great Lakes. It was no other than the beginning of our old friend WFK—better known in those days of American Morse code as just "FK." The original installation was in the depot of the Ann Arbor Railway where the Morse operators could have easy access to the set as they handled all traffic, whether radio or land line. The station was equipped by the United Wireless Telegraph Company, which company was later absorbed by the Marconi Company.

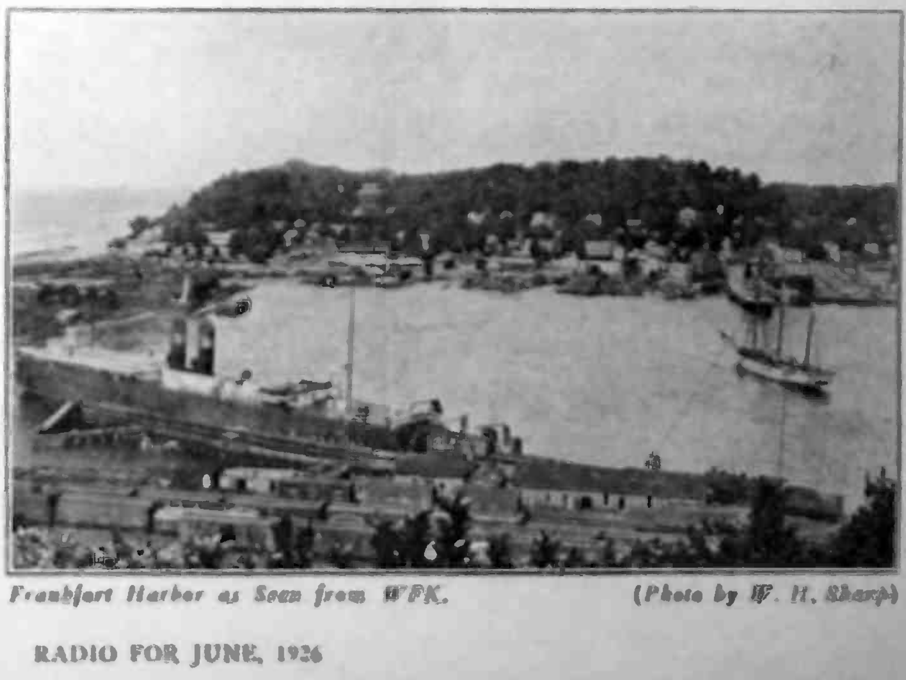
The Leyden jars and spark gap were first located outside the main building in a little annex where there was plenty of air (and moisture). The noise of the straight gap could be heard almost as far as the signals could, the range being some twenty miles under normal conditions. The tuner was a simple affair which was known as type "D" and was replaced with a type "E" about 1912. Keeping pace with new developments, a "107" tuner was later installed which was shortly converted into a "107 A." This permitted reception over a small band of wavelengths and the operators were starting to wonder what the world was coming to with such improvements!

With the increasing importance of radio communication, the station was removed to a box-car immediately adjacent to a 100 foot metal covered grain elevator which had a wonderful "sponge" effect. (No, this station wasn't portable—the wheels were removed from the car). In this lonely car the station remained until 1917 when the U. S. Navy department took over control. At this time the call was changed to "NSR." In the few years that followed, many radical changes were made.

Some one (we have a hunch that he was a landscape gardener) selected a new location for the station on the top of one of the many sand hills immediately surrounding the harbor. Since that time the hill has been known to many as "Signal Hill" or "Radio Hill." A three-room building was erected and a new aerial put up, using the old 125-foot tower for one support and a 55-foot wooden pole for the other. Since the sand is very dry, a counterpoise was also put up and the results with this system have been extremely satisfactory. One is reminded that the sand is loose and dry every time there is any wind, as part of the hill tries to come into the station. During the time of Navy control, two Morse wires were also added. One is to the Western Union relay office at Grand Rapids, Michigan, and the other is a "pony" line to the railroad telegraph office. The station is also equipped with a railroad and city telephone.

The new location is extremely inconvenient for the operators but has the advantage of great effective height for the antenna as well as a wonderful birdseye view over Lake Michigan and the harbor which is immediately below the hill. Local interference is also minimized. The view is worth a great deal in connection with the operation of the five carferrys making this port regularly. This being the home port of the Ann Arbor carferry line, the bulk of the traffic has always been in connection with the Ann Arbor Railroad. However, the station has always been open to general radio public service.

Up to the time of Naval control, 600 meters was used exclusively. The Navy, however,



Frankfort Harbor as Seen from WFK. *(Photo by W. H. Sharp)* equipped the station with a 450 meter wave for point to point work.

In September, 1921, the station was purchased from the Navy Department by the Ann Arbor Railway under whose control it remains at the present time. The call has been WFK ever since and the land line call is FK.

With the coming of the BCL, the 450 meter wave was soon replaced with a wavelength of 1666 meters for point to point work. After the Great Lakes radio conference in May, 1925, the 600 meter wave was also replaced by the new normal wave of 715 meters in addition to the new 875 meter wave for optional use in marine communication.

When the Navy "lifted their hook" they also lifted the "SE 143" tuner and left an old "CN 113" in its place. This tuner was used with a crystal detector for quite a long time and finally a VT detector and two step AF amplifier were added. However, the results were very unsatisfactory and today WFK uses a modern tuner with three steps of AF amplification in connection with a JUNKOLA loudspeaker. (The Junkola is a combination made up of an electric heater, auto horn, Baldwin "C," etc., etc.) The results obtained with this set have been excellent. KEK, KOK and KSE come in loud enough to be copied on the mill, which is pretty fair loudspeaker volume. When WPA is tuned in, the operators have to switch over to the water-cooled fone cord to prevent fireworks. The big east coast stations are real diaphragm benders, of course.

In 1915 the old straight gap was filed under "zero" in the junk pile and the new rotary gap installed. What a pleasure it was to listen to that wonderful musical note! There was little room for improvement now! The improvement came, however, when, two years ago, a Zenith 60 cycle synchronous gap was installed. The note at WFK has been positively wonderful ever since, and is admired by all who hear it (save the BCLs). It is the only note of its kind on the Great Lakes and there are few, if any, like it in the country. With two good operators and such a note, it has been a pleasure to copy WFK. No matter how much one copies it, he never gets tired of hearing this beautiful note and it is very good in heavy static or QRM.

The spark has just about served its time and is to be replaced shortly by an R. C. A. 3602-A ICW and CW tube transmitter. Soon the old apparatus room will be minus the historic 2 KW coffin; the banks of Leyden jars; the huge OT; the large loading coils; and last but not least, the famous gap. In its place there will be a neat little MG set and the new transmitter will be right on the operating table to the left of the operator. Great results are expected when the new installation is completed and if it reaches out like the spark did, there will be no reason for complaint. Indications are that the old spark carried best in a southerly direction, pushing a wicked signal down towards the Gulf. A number of stations have been worked in the vicinity of the Gulf and all report good signal strength. KSE hears WFK occasionally and is the only west coast station that has heard this station as far as we know. East coast stations hear the signals quite consistently.

Traffic averages about 25,000 words per month all year around. Most of it is point to point with similar stations at Manitowoc, Wis., and Manistique, Mich. The fleet of carferries navigate almost every day in the year and considerable traffic is handled with these ships.

Unfortunately, WFK is open but 16 hours out of every 24. The hours are 8 to 12 and 1 to 5 o'clock day and night. The two operators change watches every two weeks. Mr. C. O. Slyfield, "CS," an old timer who has practically grown up with the station, has charge of it. He has a pink ticket and has the fist that rolls the stuff out about 35 W.P.M. with the bug. The other op. is Ferris McKesson, "FM," hero of the *S. S. Ann Arbor No.* 4 disaster. Mac has a beautiful mit on either the straight key or bug and probably will be going after a pink ticket too before long. Both of these men are exceptionally good operators and have certainly put WFK on the map.

WHO'S WHO AND WHERE

George Rang, who has been on the *Utacarbon* for 18 months, just completed a 42 day passage to and from Philadelphia, having a day and a half in that city, with no stops at the canal. Dirty trick, says George. He reports the Quaker City quiet since General Butler turned his attention to San Diego.

* * *

Walter H. Biesmeyer, an old timer that pounded brass at WMW away back in the days of American Morse code and straight gaps, is back in the same old station. Welcome back, OM.

* * *

Among the other seasick members of the crew of the *M. S. Olinda,* a 9000-ton tanker bound for Alaska, George Durand Fell reports that on the trip up the ship made 10 knots an hour—2 knots forward and 8 knots up and down. HI. They get like that.

* * *

George P. Honold who was on the *"Charles C. West"* last season, now has a steady year 'round job on WDP.

* * *

One opr. told the chief of WMW that "Within a year the CB will fill the whole book. Check for sub payday." We have warned the editor to watch our smoke.

* * *

Mickey Doran writes in that the *West Jester* is going on the inter-coastal run. He thinks he will hook up with something that will continue to keep him out of sight of dry land.

* * *

"Doc" Kinne recently became a proud daddy when the Stork left a fine little YL at his house. After spending two weeks ashore, he has returned to WDK again and is plugging away to pay for the doctor bills (and cigars). (Watson: here's competition.)

* * *

Alexander Hempfert took the *Coalinga* out for South America via Martinez and Port San Luis, after she had been undergoing repairs for two months. All the radio equipment is brand new.

* * *

Bill Fisher has finally settled down to one ship and now has a steady job on WDO. We understand that he liked that Manitowoc run. Ahem! !

* * *

F. W. Everett, ex KOK, and now on the *Mojave,* spent a few days ashore to get his feet dry. He was relieved by Goodwin.

* * *

VBB certainly has made SOME improvement this season. They have a brand new tube transmitter that is FB, very. Now other stations of the world will be able to work at the same time VBB is, which will be quite a relief.

Charles E. Paine, formerly commercial agent for the Federal Telegraph Co., has been very ill at his home in Los Angeles for several months. We are all wishing you well, Charlie.

E. M. Tellefson will soon be back on the air at WHQ. He has worked for the Intercity Company at WDI during the winter.

Mickey Doran has just found that much of the schedule material in his published series, together with much additional information which should be in the hands of every commercial op., is contained in the Hydrographic Office Bulletin No. 205, "Radio Aids to Navigation," with supplement to January 1, 1926. This may be obtained for 90 cents from the Government Printing Office, Washington, D. C.

SHIP WEATHER REPORTS TO THE ROYAL OBSERVATORY, HONG KONG

By L. O. Doran

Extract from "Notice to Mariners":

When within range of VSP Cape d'Aguilar, Hong Kong, the Captain will arrange for weather observations to be made at 0600 and 2200 GMT and a message will be handed to the Radio Operator containing the following information: Ship's name and position, time of observation GMT, corrected barometer reading and whether aneroid or mercurial barometer is used, temperature, wind direction and force, state of the weather. These reports will be addressed to the Royal Observatory, Hong Kong, and sent through VPS. They receive priority as government messages and bear no charges, either ship or shore.

* * *

XRT, TSINGTAO, CHINA, WEATHER CODE

XRT sends out these coded weather reports twice daily at 8 AM and 6 PM, China Coast Time, the observations being taken at 6 AM and 3PM. Four groups of five figures are sent, represented symbolically by: BBBDD FwwVC NTTdd WAPPS, and decoded as explained below.

BBB. Barometer, given in millimeters and tenths millimeter (the initial 7 being omitted). Thus 586 represents 758.6 millimeters. Multiply by .03937 to reduce to inches.

DD. Wind direction. Table A.

TABLE A—WIND DIRECTION

00 Calm.

02 NNE.	18 SSW.
04 NE.	20 SW.
06 ENE.	22 WSW.
08 E.	24 W.
10 ESE.	26 WNW.
12 SE.	28 NW.
14 SSE.	30 NNW.
16 S.	32 N.

F. Wind force. Beaufort Scale, 0 to 9. Figure 9 used for force 9 and above.

ww. Weather. Table C.

TABLE C—WEATHER

00 Fair.	16 Fog.
02 Cloudy.	18 Dense fog.
04 Much cloud.	20 Misty.
06 Dense cloud.	22 Hail.
08 Overcast.	26 Thunder shower.
10 Rain.	28 Storm.
12 Squally.	30 Thunder.
14 Lightning.	

V. Visibility. Table D.

TABLE D—VISIBILITY

0 Very dense fog, 50 meters visibility.
1 Dense fog, 100 meters visibility.
2 Fog, 200 meters visibility.
3 Moderate fog, 500 meters visibility.
4 Thin fog or mist, 1000 meters visibility.
5 Visibility poor, 2000 meters visibility.
6 Visibility moderate, 5000 meters visibility.
7 Visibility good, 10,000 meters visibility.
8 Visibility very good, 30,000 meters vis.
9 Visibility exceptional.

C. Form of predominating cloud. Table E.

TABLE E—FORM OF CLOUD

1 Cirrus.	6 Strato-cumulus.
2 Cirro-stratus.	7 Nimbus.
3 Cirro-cumulus.	8 Cumulus or Fracto-cumulus
4 Alto-cumulus.	9 Stratus.
5 Alto-stratus.	0 Cumulus-nimbus.

No code—No cloud.

N. Direction of cloud. Table F.

TABLE F—DIRECTION OF CLOUD

0 Variable.	5 SW.
1 NE.	6 W.
2 E.	7 NW.
3 SE.	8 N.
4 S.	9 No cloud.

TT. Air temperature. Centigrade Scale. Multiply by 9, divide by 5 and add 32 to reduce to Fahrenheit.

dd. Difference between wet and dry bulbs.

W. Past weather.

TABLE G—PAST WEATHER

0 Fair.	5 Snow.
1 Cloudy.	6. Fog.
2 Much cloud.	7 Dense fog.
3 Overcast.	8 Hail.
4 Rain.	9 Thunder shower.

A. Tendency of pressure compared to reading three hours previous. Table H.

(*Continued on Page 62*)

RADIO STATION 6AQA

A 50-watt short-wave transmitter that has been reported as heard in every state, England, France and Australia and its accompanying 100 watt phone transmitter is pictured herewith. 6AQA is owned and operated by an old-timer, George C. Tichenor, 1016 South Flower St., Los Angeles, Calif.

"From left to right," in the picture, are: (omitting the land phone and noiseless typewriter) General Radio wavemeter, W. E. desk type microphone, short wave transmitter—40 to 80 meters CW only, short wave receiver—35 to 160 meters, Navy receiver and amplifier covering from 150 to 24,000 meters, antenna change-over switch, the 100 watt phone transmitter, speech input amplifier—on the wall, and the microphone. Under the table is a Western Electric 25 *B* power amplifier which is used with the 540 AW disc type of speaker (on a table in another corner of room).

The 50 watt short wave transmitter has been heard in all the States, England, France, and is a most consistent Australian worker. The phone transmitter is equally successful, and, while not yet having been heard outside of the U. S. A., the many cards received from "BCL's" with receivers capable of going down to 180 meters attest this fact.

This station hopes to soon be the possessor of a limited commercial license for the purpose of working the many private yachts of the California Yacht Club fleet—the trophy in the picture being a cup won by the "Spoofer," Mr. Tichenor's speed-boat, and not for any "notable achievement" in radio.

The motor generator, battery charging panel, filter system, etc., are all in the adjoining room. Mr. Tichenor would like to hear from those fellows who have the idea that radio apparatus, in order to be efficient, should be sprawled all over the place.

SOUTHERN CALIFORNIA A. R. R. L. BANQUET

Over seventy members of the Southern Section, Pacific Division, of the A. R. R. L., enjoyed one of the most successful banquets ever given by the section on April 9th. A. H. Babcock, Director of the Division, explained the recent changes in the organization of the League to bring about higher efficiency and better contact with headquarters at Hartford. Since the "division of the Pacific division" into Northern and Southern Sections was found successful, steps were taken to put the plan into effect, throughout the United States. The title of "Traffic Department" has been changed to "Communications Department," and along with this, the title of "Division Manager" was changed to "Section Communications Manager." There will be no more ASMs, DS, or CMs, and all ORS stations will report directly to the SCM. The SCM will have the power to appoint assistants, but they will not act in an official capacity. This will make between fifty and sixty SCMs instead of only fourteen DMs. Mr. Babcock also announced that there will be a yacht race in June, under the auspices California Yacht Club of Wilmington, some of the yachts to be equipped with transmitters. Further information will come later.

The "gang" was warned about being "off wave." Mr. Babcock said that a variation in the short bands of one or two meters was very much more, proportionately, than a similar variation in a higher band. For this reason, amateur stations must be operated with greater care. He said that the Navy has been "off wave," but that this condition was immediately rectified, and now there is no Navy transmission in amateur bands. Along with this, full co-operation is necessary, he declared, if we would continue to enjoy the privileges we now have. He again recommended the use of a fixed wave-meter to check the operating frequency, and to indicate any variation. It was such a device as this that made it possible for him to be on a constant frequency when in communication with NRRL during their recent cruise to Australia, and he says that it is highly successful.

Reports made by Southern Section City Managers indicated that while activity was on the decline in some sections, it was increasing in others. There are also many new stations in operation.

R. B. Ashbrook of the Southern California Edison Company spoke in regard to the willingness of the company to co-operate in clearing up power line interference. B. T. Withers, Z3AM, told about some of the conditions of amateur radio in New Zealand.

Ben Mc Glashan, KFWB, 6PI, announced that Warner Brothers Studios program for May 3rd would be carried out with the assistance of the A. R. R. L., Southern Section. He also announced the $1000 cash prize contest for reports on 6XBR, Warner Bros.' portable station which left Hollywood May 4th.

The banquet-meeting was concluded by a guessing contest on the number of feet in a roll of wire in a glass jar. The prize, a "99," was won by ex-8SF. E. Knoch, 6BJX, recited "Paul Revere's Ride" adapted to "ham" arrangement. Myron Hexter, 6CNL, rendered a few selections on his "uke," and Wally Wiggins, 6CHZ, played a $25,000 (?) composition of his on the piano. After the "gang" heard that, they all went home!

Speaking about the meeting, L. Elden Smith, Section Manager, said in part: "This has been one of our most successful meetings. It is a 'loud speaking' evidence that we are all pulling together. I hope that we will continue to do this."

Radio Station 6AQA.

AN EFFICIENT LOW POWER TRANSMITTER

By Bert E. Smith

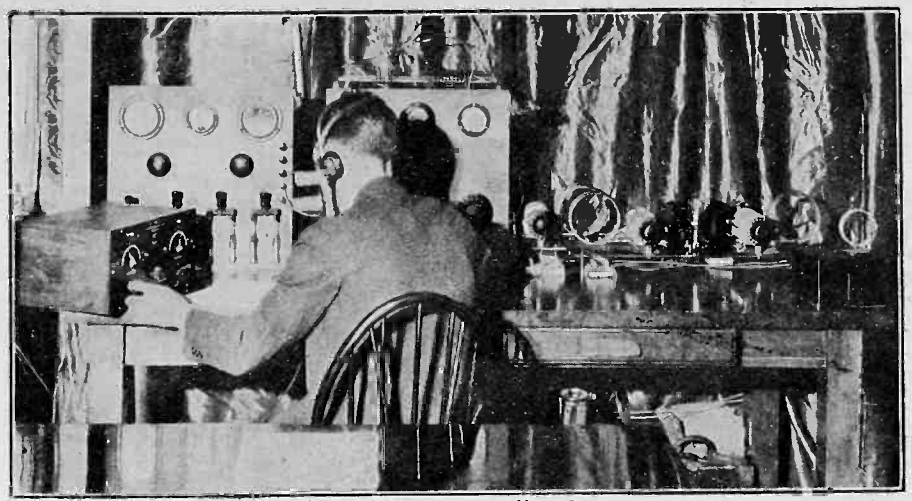
As 2QA was the only outfit actually able to move traffic out of the Hotel Pennsylvania when the radio show was held there in connection with the New York convention of the Second District Executive Radio Council, a description of its construction and operation will interest many "hams." The circuit is a slight modification of the tuned plate, tuned grid circuits used at KFUH and 6XAO. Storage batteries are used for 300 volt plate supply. The key is inserted in series with the grid-leak to reduce key clicks. The blocking condensers have a capacity of .002 mfd.

The set is made in two units, one being the oscillator and the other the antenna coupler. Both were mounted on 2 in. pillars placed at the corners to keep them off the base.

On the 10x24 in. oscillator panel are mounted two Cardwell Type 147 *B* transmitting condensers placed 10 in. apart. Between them is a socket for the UX-210 tube, the grid and plate connections being placed toward the front. The choke coils are mounted on tips and arranged to plug into tip jacks in the base. The edge-wise-wound copper strip inductances are mounted on the condensers by means of 2½ in. pillars. All connections on the under side of the panel are made with copper strip.

The coil of the capacity-inductance antenna units is supported by three ⅜ in. square bakelite strips in which slots were cut ⅛ in. apart with an ordinary hack saw. If a wavemeter is not available at the station the antenna unit can be readily removed for calibration elsewhere, using a galvanometer or neon tube to close the circuit. It may then be used as a wavemeter to tune the rest of the set.

The set is simple of operation. The grid and plate circuits are tuned to a point where with the key up a milliammeter in the plate lead shows either no current or a very small current, at which point the grid and plate circuits are in resonance. At this point depression of the key should result in a large plate current. For 40 meters this should take place at about 23 on the dials of the grid and plate condensers, and for 80 meters with both condensers about 96. The antenna is tuned in the usual manner to the point where maximum resonance is indicated by the radiation ammeter, but best results will probably be secured if it is then detuned slightly. Using a UX-210 tube with 300 volts on the plate the set drew about 80 mils.

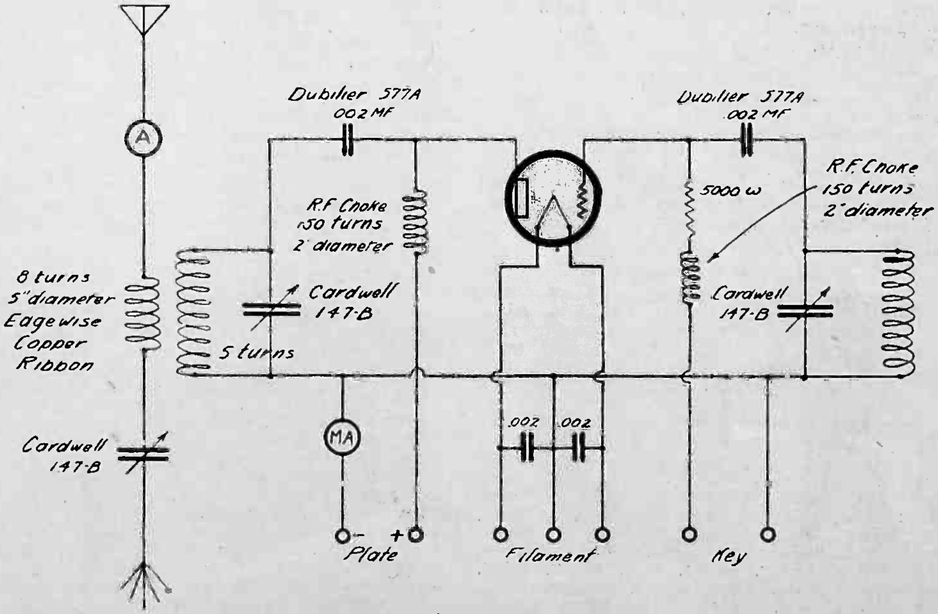


View of 2QA at Radio Show.

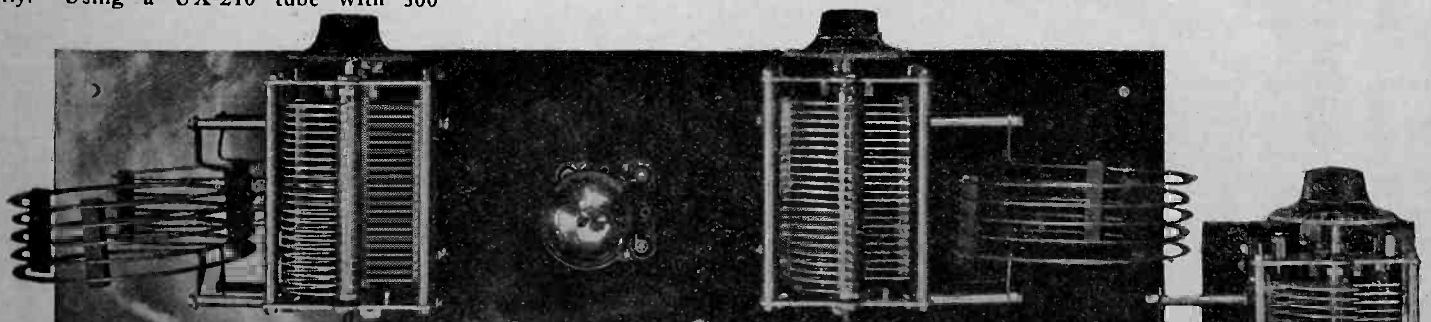
Every unit in the set was constructed with the thought of easy conversion to a 50 watt outfit, and nothing will blow if a tube of this size is used. The variable condensers have a breakdown point which will handle anything a 50 watt tube will put out, and the fixed condensers that were used, Dubilier Type 577A, have a rated voltage breakdown of 2000, and in experimental work have withstood for several hours a voltage of about 2500. When a gridleak of the size shown is used, however, care must be taken not to keep the key depressed for too great periods, as it will heat up sufficiently to mar the varnish of the table on which the set is standing (when a 50 watt tube is used).

In the view of 2QA the short wave set

(*Continued on Page* 59)



Circuit Diagram for Transmitter at 2QA.



Rear of Transmitter Panel Showing Placement of Parts.

By F. Johnson Elser, pi3AA, Baguio, P. I.

A—2bk, (2ns), 2tm, (2yi), 3bd, 3ef, 5ao, 5da, 5ay, 5lf, 6ag, (6bo), (6cj).
B—b2.
F—(8bf), (8tk), 8xp.
FC—(8em), (8zw).
FI—8qq.
G—2kf, (6nf), 6do, 6zk.
HU—6aff, 6aje, (6buc), (6bdl), 6dcf, fxi, wyi.
J—1aa, 1kk, (its).
O—(1sr), a3b, (a3e).
U—1aao, 5agu, 5zai, (6afg), (6abg), (6apk), 6awt, (6ahp), (6apk), (6akm), (6ano), 6akx, (6alv), (6bjx), (6bgc), (6btm), (6bq), 6bpg, (6bon), 6bav, (6bjd), 6bkh, 6ccl, 6cvq, (6csd), 6cuw, 6cst, 6daj, 6dn, (6dat), 6ea, (6daa), 6dao, (6js), 6jn, (6kg), (6kb), (6hv), (6nx), 6ol, (6rp), 6tm, 6yb, 6xi, 6ob, (7ek), (7vh), 7wb, (7tm), 8zw, 9ua, 9wi.
PI—(1hr), (1ar), 1au, 1cw, (1at, (wup), (1dl), cd8.
CH—9tc.
Naval—(Nuqg), nirx, nirk, nipm, npg, (c9m), npm, nnb, (ngy), npo, nupm, c5g, npu, neqq, npn.
Others—fw, (bam), rrp, (gfup), vlt, joc, kfuh, gdvb, geft, glub, dcn.
BZ—(1ab), (1af), 1ac, sq1.

By L. O. Doran on S.S. "West Jester" Between Japan and China.
(40 meters, January-February, 1926)

Brazil: 1ac. Chile: 2ld, 9tc. France: 8hu, 8jn. French Indo China: 8qq. British: 2ao, 2nb, 5ha. Hawaiian: fx1, 6aff, 6aje, 6ajl, 6buc, 6clj, 6cst, 6dbl. Mexico: 1aa. Argentina: aa8, cb8. Samoa: 6zac. U. S. A.: 3ahl, 3auv, 5akz, 5ms, 5sd, 6abg, 6akx, 6ann, 6aus, 6awt, 6bdw, 6bhz, 6bih, 6bjx, 6bol, 6bq, 6cae, 6ccv, 6chl, 6cqa, 6csx, 6dag, 6hm, 6hv, 6jl, 6kb, 6kd, 6oi, 7df, 8xe, 9aot, 9dqu. Miscellaneous: fw, kio, npg, npl, npm, npu, pcll, rrp, sgt, vit, vjz, vkp, wiz, wvy, wyi. Intermediate unknown: pey, 8ug. No intermediate: 6zk, 8cr (probably British).

Philippines, China, Japan.
(February-March, 1926)

Brazil: 1ab, 1ac, 5ab, sni. Chile: 9tc. Hawaii: fx1, wyi, wyq, c3n, 6aff, 6ajl, 6buc, 6clj, 6dbl, 6dcf. So. Africa: a4z. India: 2bg. U. S. A.: 5ain, 5atv, 5ccl, 7adm, 7ay, 7tm, 9msn, 9xi, 6abg, 6afg, 6ahp, 6ahr, 6ajm, 6akm, 6alt, 6alv, 6amm, 6ann, 6ano, 6apw, 6awt, 6bq, 6bav, 6bjd, 6bjx, 6bkh, 6bls, 6bol, 6btm, 6bmw, 6cae, 6che, 6chl, 6cii, 6cls, 6ctd, 6cur, 6cuw, 6cva, 6daa, 6dag, 6dax, 6ddi, 6ea, 6ha, 6hm, 6js, 6kb, 6la, 6nx, 6oi, 6rv, 6rw, 6vc, 6vz, 6xi. Miscellaneous: kfuh, kio, wuq, bam, rrp.

By 9APY, 3337 Oak Park Ave., Berwyn, Ill.
(40 and 80 meters)

1ads, 1ajp, 1amx, 1boq, (1bxg), 1caa, 1cal, 1cax, 1chl, 1cmx, 1wd, 1yd, 2agz, 2aoc, (2apm), 2arl, 2arn, (2axp), 2bnt, 2caz, 2cj, 2cmx, 2ctn, 2da, 2gp, 2ih, 2mw, 2wc, 3abh, 3ade, 3aeq, (3afw), 3ahl, 3ahp, 3aib, 3bnf, 3cah, 4ac, 4cu, 4fh, 4fl, 4kj, 4il, (4ll), 4ov, 4tf, 4we, 5acl, 5acv, 5adk, 5agp, 5ajj, 5anb, 5anh, 5anl, (5api), 5aqu, 5ask, 5asz, (5ata), 5ccl, 5fh, 5hn, 5hs, 5jd, 5jg, 5pi, 5qj, 5rg, 5se, 5va, 5yb, 6adt, 6arl, 6bhh, (6bwt), 6cae, 6cax, 6ckv, 6bk, 6eb, 6nx, 6xi, 7gb, 7jx, 7no, (7ob), 7ry, 7uo. Foreign: c-3abg, c-4aq, c-9ac, q-2jt. Miscellaneous: kio, wir, wiz, wyf. Card for card is motto here.

By 6CLZ-6COW, 1238 Peralta Ave., Berkeley, California.

Alaska: wva, wvb, wvc. Argentine: aa8, af1, af2, ba1, cb8, db2, dg2, fc6, fh4, pt3, pt5. Australia: 2ar, 2bk, 2cm, 2jw, 2yi, 3lp, 3xo, 5ay, 5bg, 5da, 5zf, 6ag, gdvb. Azores: smyy. Brazil: 1ab, 1ac, 1af, 1an, 1ao, 1ar, 2ab, 2af. Canada: 1ar, 2fo, 3aa, 3ad, 3ao, 3fu, 3gb, 3jw, 3kp, 3mv, 3nl, 3oh, 3xl, 4ac, 4af, 4ah, 4bt, 4cb, 4dy, 4gt, 4hh, 5ac, 5ah, 5ak, 5am, 5ct, 5ef, 5gf, 5hp, 9bq, 9ct. Canal Zone: 99x, nba, nosn. Chile: 2ar, 2ld, 3ag, 3an, 3ij, 9tc. Cuba: 2mk, naw. France: fw. Hawaii: 6aff, 6aje, 6asr, 6axw, 6buc, 6cmh, 6cst, 6dbl, 6dcf, 6oa, 6tq, kio, npm, wyi, wyq, fxi, 37c, mh. French Indo-China: 8qq. Java: ane, anf. Mexico: 1aa, 1b, 1j, 1k, 5c, 9a, jh, xam, xda. New Zealand: 1aa, 1ao, 1ax, 2ac, 2ae, 2xa, 3af, 3am, 4aa, 4ac, 4ak, 4am, 4ar.

By G2ACI, 22 Hurst Grove, Bedford, England.
(During December, 1925)

1fu, 1yb, 1aao, 1za, 1zao, 1ch, 1uk, 1xa, 1aiu, 1bl, 1ahl, 1zl, 1bc, 1aco, 1nn, 1cab, 1ay, 1all, 1cal, 1ai, 1bit, 1kai, 1bsd, 1cnp, 1cmp, 1ba, 1hn, 1rd, 1ad, 1hjr, 1hj, 1sj, 1ga, 1ch, 1no, 1cn, 1aiu, 1aof, 1sa, 1ah, 1zt, 2nti, 2uk, 2br, 2qb, 2anm, 2brb, 2uk, 2api, 2ar, 2xz, 2ag, 2ip, 2nn, 2bwc, 2aes, 2akb, 2gp, 2nti, 2ar, 2rd, 2atr, 2ai, 2lz, 2btu, 2awf, 2cyx, 2ago, 2amj, 2cxl, 2aof, 2ais, 2bm, 2co, 2bva, 2cc, 2rs, 2aci, 3ati, 3tn, 3hw, 3cj, 3ja, 3lu, 3bmz, 3ps, 3hg, 3xp, 3im, 4ac, 4rm, 4rr, 5bk, 5wb, 5yd, 5da, 5ph, 5er, 5jf, 5acl, 5jf, 6na, 6ls, 7npb, 7zi, 7ak, 7ug, 7ne, 7ok, 7vx, 7st, 8aly, 8rf, 8dgj, 8dgo, 8daa, 8az, 8mc, 8jq, 8jm, 8bq, 8ksc, 8bso, 8dw, 8bdh, 8di, 8rr, 8drs, 8se, 8rv, 8awu, 8jm, 8cc, 8bww, 8jy, 8cq, 8axo, 8br, 8din, 9cf, 9bh, 9dng, 9bf, 9eji, 9za, 9dyy, 9al, 9st, 9cip, sgc, wir, wiz, nrdm. Canadian: 1uw, 2ax, 2od, 2bl, 3kp, 4ar, 8al.

(During January, 1926)

America: 1bm, 1gf, 1rd, 1aos, 1aiu, 1vc, 1ra, 1ga, 1ae, 1ayl, 1gw, 1aim, 1bdx, 1aof, 1afy, 1yd, 1cmu, 1all, 1az, 1dd, 1sz, 1dxa, 1cnp, 1axa, 1ar, 1aao, 1ch, 2mk, 2aci, 2cje, 2aim, 2kg, 2cft, 2kr, 2rr, 2ahm, 2amj, 2gk, 2ag, 2cm, 2bwt, 2rjj, 2dms, 2gz, 2ip, 2cj, 2xk, 2ago, 2be, 3pf, 3awb, 3bwt, 3ka, 3fz, 3efp, 4fa, 4si, 4bt, 5rr, 5ic, 5alz, 5lc, 5gn, 5iad, 5gw, 5xm, 6iw, 6dsg, 6cd, 6biv, 7sk, 7zm, 8dan, 8ca, 8es, 8jja, 8atv, 8cac, 8bzk, 8aks, 8bt, 8cz, 8dm, 8qc, 8gk, 8yb, 9ear, 9bh, 9xe, 9ado, 9wz, 9cer, 9lz, 9sd, 9pn, 9adg, 9xi, 9aoj, 9zt, 9cn, wir, wiz.

(During February, 1926)

U. S. A.: 1aiu, 1axa, 1sz, 1bz, 1pa, 1rk, 1cme, 1ici, 1aal, 1kl, 1blg, 1ga, 1uw, 1aao, 1cmf, 1aci, 1ajo, 1cal, 1rm, 1as, 1iw, 1aiu, 1bvb, 1yb, 1caw, 1abg, 1al, 1ajx, 1ams, 1akz, 1ac, 1cmu, 1mx, 1ua, 1cnf, 1ja, 1ka, 1zs, 1cnw, 1wl, 1xz, 1ax, 1bdt, 1lam, 1rd, 1xae, 1siu, 1rjj, 1aiw, 2nz, 2ka, 2aci, 2ak, 2be, 2or, 2tp, 2aku, 2mk, 2aky, 2ax, 2ahm, 2dx, 2acs, 2gk, 2ctf, 2acp, 2ago, 2hp, 2fo, 2mm, 2vvi, 2uea, 2rm, 2by, 2ku, 2gz, 2ga, 2apy, 2ahk, 2avb, 2sh, 2oa, 2ts, 2ev, 3bw, 3hg, 3cjr, 3xi, 3qt, 3bwt, 3wb, 3cil, 3auv, 3bne, 3cjn, 3fd, 3st, 3lw, 4cc, 4lz, 4cjt, 4av, 4cu, 4rz, 4pc, 5wx, 5xai, 5ak, 5day, 6cur, 6sw, 6do, 7gb, 7oe, 7ir, 7ut, 7cp, 8qb, 8du, 8ax, 8cug, 8lx, 8adm, 8fa, 8rt, 8jn, 8bby, 9bag, 9bpl, 9aau, 9zt. Canadian: 1ar, 1dd, 2be, 2bu, 7df, §ar, wiz, wir.

By 8DIA, P. S. Van Deusen, 327 S. Willow St., Kent, Ohio.

4aae, 4aah, 4ah, 4bx, 4eo, 4fx, 4hx, 4ib, 4jg, 4kn, 4li, 4lx, 4ou, 4rz, 4sc, 5aap, 5ac, 5agp, 5aij, 5ajj, 5alm, 5apo, 5eo, 5ls, 5mi, 5ms, 5oc, 5ph, 5va, 5vv, 5yd, 5zaa, 6aaf, 6abg, 6aje, 6ala, 6ato, 6bdh, 6bdw, 6bes, 6bhh, 6bim, 6bls, 6bjl, 6bmj, 6bol, 6bvs, 6bw, 6cbj, 6cct, 6clt, 6cnb, 6crb, 6ct, 6cto, 6cvr, 6dah, 6dai, 6dau, 6hv, 6js, 6nx, 6uf, 6uk, 6vz, 6yb, 7ado, 7ajq, 7fl, 7gb, 7ig, 7it, 7kf, 7os, 7uj, 7uw. Australia: 2ad, 2bk, 2cm, 2ds, 2lm, 2rc, 2tm, 2yh, 3hl, 3jk, 3kb, 3yy, 5ah, 5ay, gdvb. Canada: 1ea, 2am, 4ac, 4ak, 4ez. France, 8dk, 8jn, 8xp, 8yor, g5nn, g6al, hu6buc, hufxl, ilma, ihaveus, mbai, 03ij, yr4. New Zealand: 1ao, 2ae, 2af, 2ar, 2bx, 3ad, 4ac, 4ak, 4al, 4ar, 4as, 4ak. Miscellaneous: kfuh, naw, nqg, wvc, wys, yiw.

By Radio U2BUY, 213 9th Ave., Neptune, N. J.

5acy, 5agu, (5ain), 5ajg, (5amn), 5aqg, 5asb, 5ae, 5nk, 5dl, 5yb, 5zo, (6aaf), 6adt, 6aji, 6akm, (6ano), 6ar, (6bav), 6bam, 6bcm, 6bhr, 6bjl, 6bol, 6bpl, 6btx, (6bvg), 6bwn, 6cho, 6csu, 6csx, 6daq, (6dax), 6ddx, 6fz, 6hu, 6kb, 6ml, 6qu, 7alk, 7fq, 7pu, 7vl, (7vq), QRA?: 7wu. Spain: ear2, ear9, (ear20), (ear21), (ear22), ear23. Portugal: 3co, (3gb). Morocco: maroc, (8mb), 8st. Algiers: (8ip), 8aix. Belgium: b2, d4, p7, 4yz. Mexico: (ig), QRA?: 9a. Italy: iad, (ias), (iay), (ibw), ier, igw, ima? (ino), irt. France: (8bf), 8ca, 8dk, (8ee), 8gi, (8gra), 8io? (8jn), 8nn, 8ru? 8tk, 8re? (8yor), (8zo), onm, (ocng). England: 2cc, 2in, 2it, 2lz, 2nm, 2vq, 2wj, 5dh, 5hs, 5rz, 6nf, 6yu. Canada: 1an, 2be, 3el, 3ft, 3hp, (3jw), (5bz), QRA es QRK? Newfoundland: 8ar. Argentina: af1, ba1, db2, fa3. Uruguay: 1cd. Chile: 3ij, 2ld. S. Africa: oa4v, oa6n. Brazil: 1ac, 1ae, 1al, 1an, 1ap, 1aw, "1a," 1bd, 1di, 1ia, 1ib, 5aa, 5ab, sn1, QRA. ? Hawaii: 6aff, 6buc, 6cst, (6dbl), 6dcf. Bermuda: ber. Porto Rico: 4st, 4rx. Cuba: 2jt. Will appreciate cards from 6's es 7's. All cards answered om's. QRK 2BUY on 39 meters???

At 9AGO, Chicago, Ill.

6aij, 6ajj, 6bad, 6bgz, 6cbj, 6aiy, 6ctd, 6daa, 6dua, 6oi, 6xi, 7ki, 7ok, a2vk, a2yi, a5da, g2kf, m1k, m9a, oa4v, oa4z, vaf1, fw, vpm, wve, 6adt, 6ajn, 6ak, 6bhz, 6bil, 6bus, 6cik, 6dcq, 6ddx, 6ga, 6np, 6nx, 7ek, 7gj, 7lq, f6cf, hu6aff, m1k, m9a, oa3b, q2jt, fw, mjh, nitz.

By 5KC, V. L. Rosso, Plaquemine, La.

a2ij, a3bq, a4an, bz1af, bz1ar, bz1ib, bz1ic, bz5ab, bzrgt, c1fi, c2au, c3br, c3kp, c3mf, c3mv, c3xi, c3zb, c4ea, c4ez, c4fv, ch2ld, ch3ag, ch3an, ch3ij, ch9tc, f8eu, f8jn, f8nn, g2lz, hu6clj, hu6cst, hu6dbl, i1di, i1er, i1gw, i1no, i1rm, m1j, m9a, mjh, mxda, oa3b, oa4v, oa4z, pr4rj, pr4rl, q2jo, rba1, r1jz, ssgc, ssic ssmyy, y1cd, yjcp, z1aa, z1ao, z1ax, z2ac, z2ae, z2xa, z3af, z4ac, z4ak, z4al, z4as, z4la, cz99x,. Miscellaneous: kfuh, gdvb, pcuu, pt3.

By L. V. Broderson Aboard S.S. "Grace Dollar" (KFEM)

Address all cards requesting QSL to: L. V. Broderson, 155 Marston Ave., San Francisco, Calif., U. S. A. (6CLV).

At Manila, P. I., March—6ano, 6akx, 6awt, 6ajm, 6bjx, 6bqb, 6bjb, 6cuw, 6dag, 6dtg, 6nx, 6oi, 6rw. Com.: 6xi, kio. China: 1m. Australia: 2cg. 100 Miles East Hongkong, China, March—Australia: 2cg, 2cm, 2cc, 3bd, 3bq, 4la. New Zealand: 2bx. Russian: 2wd. English: 2nm. French: 8jn, 8fn. 125 Miles East Swatow, China, March—French: 8jn, 8ssc. Russian: tuk. Com.: anf, pcll. 75 Miles East Foochow, China, March—China: 8hn. Com.: pcll, ocdj. 400 Miles Southeast Nagasaki, Japan, March—Russian: tuk. Com.: pcll, anf. At Nagasaki, Japan, March—P. I.: 3aa. Com.: ocdj, pcll, hva. At Karatsu, Japan, March—Australia: 3bd, 5kn. French: 8jn. Russian: tuk. U. S.: 6ahp, 6abg, 6emg, 6ea, 1cmp, 4tv. 20 Miles North Moji, Japan, March—Australia: 2cm, 2cg, 4an, 4rb. English: 2od, 2bz. 400 Miles South Hakodate, Japan, March—6zk. P. I.: 3aa. 4457 Miles West San Francisco, March—Australia: 5kn. P. I.: 3aa, 1cw. U. S.: 6zk. 4211 Miles West San Francisco, March—U. S.: 6zk. Russian: tuk. Com.: gha. 3236 Miles West San Francisco, March—U. S.: 6amm, 6bjx, 6dag, 6ct, 6rw, 7tm. Australia: 2yi, 4ab, 5da. P. I.: 3aa. 3020 Miles West San Francisco, March—U. S.: 6ahp, 6amm, 6bjx, 6bpb. P. I.: 1hr, 3aa. 2800 Miles West San Francisco, March—U. S.: 6ahp, 6akm, 6bjx, 6clk, 6ea. Com.: 6xi. P. I.: 1cw, 1hr, 1au. 2166 Miles West San Francisco, April—U. S.: 6ahp, 6bcg, 6dag, 6bq, 6oi. P. I.: 1at, 1hr, cd8. Australia: 3bd. 1941 Miles West San Francisco, April—6ahp, 6awt, 6bjd, 6dag. P. I.: 1cw. 1716 Miles West San Francisco, April—6akx, 6bjx, 6bjd, 6btm, 6dag.

By 6AE, G. W. Carter, 1607 W. 45th St., Los Angeles, Calif.

U. S.: 1ahb, 1ajp, 1bxg, 2bg, 2gx, 2mu, 4bfu, 4bl, 4dm, 4eo, 4fa, 4kj, 4mc, 4ux, 8cbr, 8coz, 8dgy, 8it, 8kf, 8vt, 8xe, z2ac, z2ae, z3af, z4ac, z4am, z4av, a2cg, a2cm, a2cs, a2lk, a2yi, a3ot, a3tm, a5ay, a5da, a5kn, a6ag, ch2ah, ch2ld, ch3ag, ch3ij, ch9tc, rmal, mlk, mln, jh, q8kp, pi1ar, pi1au, pi1cw, pi1hr, pi3aa, picd8, fi8qq, c4dq, c4gt, c5ef.

By Frank Watts, 1716 Park Ave., Shreveport, La.

1abd, 1ahb, 1coj, 1aac, 1aao, 1cmx, 1yb, 1ahg, 1big, 1bux, 1bjd, 2adm, 2ev, 2boy, 2arh, 2cty, 2cvr, 2cqc, 2xk, 2fm, 3pf, 3wb, 3qt, 4aah, 4aa, 4ar, 5aav, 5acl, 5acv, 5avc, 5aij, 5ain, 5atx, 5aua, 5ak, 5adz, 6kb, 6li, 6bai, 6ml, 6dn, 7ub, 9ajw.

By 2AGI, Karl Rossbach, 620 Wyoming Ave., Elizabeth, N. J.

4ax, 4cu, 4fl, 4gy, 4hu, 4tx, 4vl, 5acl, 5acy, 5agn, 5ajk, 5alz, 5amg, 5ann, 5ao, 5apo, 5aqy, 5arn, 5att, 5auz, 5ce, 5dq, 5fc, 5gq, 5jd, 5jw, 5kc, 5nq, 5pa, 5qh, 5sp, 5sw, 5uk, 6aaf, 6afg, 6apk, 6asd, 6bhh, 6bil, 6bqt, 6bvs, 6cbp, 6ccz, 6ci, 6clz, 6cmi, 6cnn, 6csw, 6cuk, 6dcq, 6ddx, 6fz, 6js, 6jy, 6uf, 7ab, 7df, 7ek, 7gi, 7tg, 7ya, 9aiz, 9arr, 9avr, 9bhi, 9bjn, 9bsc, 9cgh, 9cld, 9cye, 9dde, 9dwd, 9eag, 9ean, 9eb, 9egh, 9egn, 9fj, 9gn, 9gx, 9kd, 9nk, 9xh. Canada: 1ar, 4hh, 5go. England: 2cc, 6ox. Italy: 1ad, 1as, de, bbx. QRA?

By 6WU—ex-6FZ, R. E. Calhoun, 1443 California St., Berkeley, Calif.

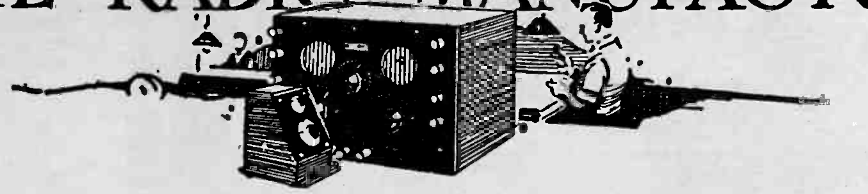
Argentine: db-2. Australia: 2cg, 2ij, 2mh, 2tm, 2yi, 3cb, 3hl, 3jk, 3jp, 3kb, 3ot, 3wm, 3yn, 4rb, 5ay, 5da, 5rm. Canada: 2ax, 4ac, 4ah, 4gt, 4qs. Chile: 2ld, 2lm, 2rm, 3an, 3ij, 9tc. China: nuqg, gfup. Cuba: 2lc. Hawaii: 6aff, 6clj, 6dbl, 6dcf, 6tq, wyi. Holland: pcll. Mexico: 5c. New Zealand: 2xa, 3af, 4ak, 4al, gdvb. Philippines: 1av, 1hr, 3aa, neqq, nipm, nirx, nnb, nn-7. Samoa: 6zac. South Africa: a3e.

At 8ADU-8RDS, Edward Roth, 2749 Wicklow Road, Shaker Heights, Cleveland, Ohio.

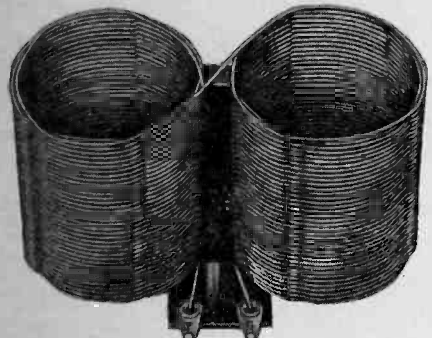
England: 2wj, 2nb, 2sz, 2bz, 2nq, 2cc, 2mo, 2qb, 2sf, 2qm, 2nm, 2sh, 2kf, 5mo, 5ma, 6lj, 6nf, 6yu. France: 8ww, 8bf, 8dk, 8eu, 8yor. Sweden: sfn, sus, sdx, sdk, smzs, sgc. New Zealand: 1ad, 2ac, 2xa, 3af, 4as, 4an, 4ac, 4af. Australia: 2yi, 3bd. Mexico: 1aa, 9b, 9a, 1b, 5c. Porto Rico: 4oi, 4kt, 4rl, 4bj, 4je, 4sa. Brazil: 1ab, 1af, 1it, 1ia, 1an, 1ac, 1al, 1ap, 2ab, 5ab, sq-1. Hawaii: 6dbl, gdi, 6buc. Cuba: 2lc, 2gm, 2jt. Panama: nosn, 99x.

(*Continued on Page* 48)

FROM THE RADIO MANUFACTURERS



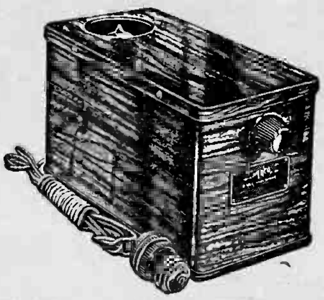
The Benjamin Lekeless transformer is intended for use in any tuned radio frequency circuit. Its closed field minimizes power leakage and feedback, thereby making neutralization easy. It has uniformly low distributed capacity, low resistance and high inductance, making it well adapted for single control sets. A



minimum of supporting insulation in its field decreases power losses. It can be mounted in any position as its external field is so slight that close spacing is possible without appreciable interaction. It will work satisfactorily with any high grade .00035 mfd. variable condenser.

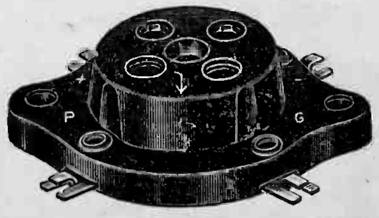
The Pacent powerformer is a combination of a B battery eliminator and an amplifier for the second stage of audio frequency. It can be used with any set as a power amplifier deriving both its filament and plate current from the 110 volt 60 cycle line and it can also be used as a B battery eliminator, these functions being performed singly or combined as may be desired. It uses two tubes, a UX-216B or CX-316B for rectification and a UX-210 or CX-310 for amplification. The filter circuit and the audio transformer are designed to give the best tone quality obtainable. It also has a red pilot light to indicate whether "on" or "off." It is assembled in a neat metal case 8x8x10 in. and weighs 32 lbs. Binding posts are provided for various B battery voltages.

The Webster Super B power supply unit is a high-voltage rectifier and filter delivering direct current from alternating current lines. It uses a Raytheon tube as a full wave rectifier, supplying a maximum of 60 milliamperes. It is made in three different styles for operation



from 110-125 volts 60 cycle a. c. and is another style without tube for operation from direct current. This style gives voltages from as low as 10 up to 180 volts for plate current. It comes in a handsomely finished cabinet 5¼x4⅝x10 in.

The Klosner universal socket is designed to hold either the UX or UV type of base in vacuum tubes, giving an equally good contact on the prongs of either type. The holes for the large UX prongs are hexagonally shaped so as to facilitate indentification. An arrow indicates

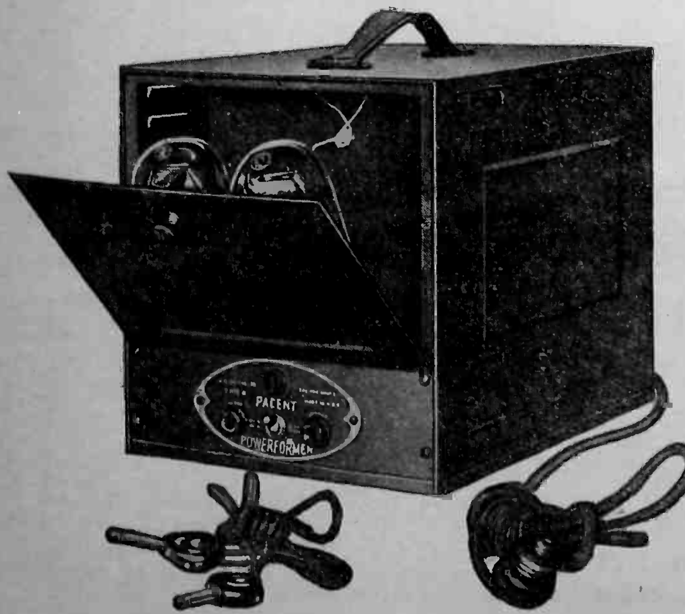


the position of the side pen on the UV type. Losses are minimized by the use of a bakelite base and phosphor-bronze springs. It may be mounted either by means of a single central hole or by means of two side holes.

The G. E. type DO-3 voltmeter is a portable instrument with a double scale, 0-7.5 and 0-150 volts, for measuring both A and B voltages. Its resistance of 66 ohms per volt allows only a slight drain

on the batteries. It operates on the D'Arsonval principle, is rugged in construction and is highly accurate. Each instrument is supplied with a set of 18-inch leads with terminals.

The Elken tickle charger employs a new rectifying unit consisting of two discs, one metal and the other a carbon compound, which, when combined, will conduct current in one direction but not in the other, acting somewhat like a very large crystal detector. It charges 4-volt batteries at 0.25 amps. and 6 volts at .5 amps. delivering a tapering charge as the battery reaches capacity. It contains no liquid or tube. It can be left in continuous circuit without noticeable hum in the set. It is assembled in a neat case 7½x2¾x5⅞ in. and weighs 6 lbs.



CALLS HEARD

(*Continued from Page* 46)

At U6WU, R. E. Calhoun, 1443 California St., Berkeley, California.
(40 meters)

Alaska: kfzh-1. Argentine: r-cb-8, r-db-2. Australia: a-2bk, a-2cg, a-2cm, a2cs, a2gq, a2ij, a2lm, a-2rc, a-2ss, a-2tm, a-2yh, a2yi, a3bd, a-3bq, a-3kb, a3jp, a3ls, a-3xo, a-4an, a-4rb, a5da, a5kn, a6kx, a6mh, a-7gt. Canada: c-2cg, c-3by, c-3jw, c-4ah, c-4dq, c-4ea, c-5am, c-6bb. Chile: ch-2ld, ch-3ij. France: fw. French Indo-China: fl-8qq. Hawaii: hu-6axy, hu-6buc, hu-6cfq, hu-6clj, hu-6clw, hu-6tq, hu-c3n, hu-fx-2, hu-wyi, hu-wyq. Holland: pcll. Japan: j-1sk, jcp. Java: anf. Mexico: m-1b, m-1j, m-5c, m-9a, m-jh, m-xda. New Zealand: z-1af, z-1ao, z-1ax, z-1fq, z-2ac, z-2ae, z-2br, z-2bx, z-2ga, z-2gc, z-2xa, z-3af, z-3ai, z-3aj, z-3am, z-4aa, z-4ae, z-4al, z-4ar, z-4av, z-kfuh. Philippines: pi-1av, pi-1hr, pi-3aa, pi-cd-8. South Africa: o-a3e. Singapore, Malay: ss-8lbt. QRAs wanted for y-1cd, bxw, geft, pbm, pt-3, pt-5, vad. Reports on above reception ready for card. All reports of 6wu will be appreciated. All cards answered.

By Russell Estep, Oak Run, Shasta County, Calif.

5hb, 5amp, 6ckl, 6ahw, 6aat, 6aw, 6cln, 6dh, 6bcj, 6aba, 6cim, 6cbw, 6cmg, 6ckv, 6ahr, 6coa, 6akc, 6cop, 6ajp, 6aah, 6buo, 6cai, 6bmo, 6ahr, 6dck, 6cof, 6ws, 6bru, 6qx, 6um, 6arl, 7vv, 7uo, 7ee, 7or, 9ck, 9dis, 9adi.

By 6AHL, Edgar Peterson, 2209 Garland St., Eureka, Calif.

1aaw, 1abr, 1akz, 1an, 1aof, 1fx, 2bja, 3bjj, 3bwt, 5ajj, 5qk, 6adt, 6aff, 6aje, 6akx, 6bam, 6bha, 6bma, 6bsa, 6cbj, 6cjn, 6cto, 6cve, 6cvg, 6daa, 6dag, 6das, 6ds, 6ew, 6ge, 6kd, 6qi, 6rn, 6vq, 6zac, 7ki, 7wu, 7ya, 9akf, 9bzi, 9djp, 9ebj. Australia: 6cqa. Canada: 4gt. Japan: 1aa.

By C-5CT, Box 445, Duncan, B. C.

U. S.: 1att, 1cmx, 1wl, 1yb, 2aco, 2ku, 3buv, 3cah, 3cjn, 4ask, 4cu, 4rz, 4si, 4tn, 4we, 5adz, 5ahg, 5aky, 5apq, 5asz, 5atf, 5atv, 5avf, 5ew, 5jf, 5kp, 5ls, 5on, 5qk, 5sw, 5ux, 5va, 5vm, 6's and 7's too numerous, 8aly, 8avo, 8bww, 8cau, 8cbr, 8chk, 8cls, 8it, 8rv, 9aim, 9amp, 9anz, 9azn, 9azu, 9bay, 9bfp, 9biy, 9bji, 9bkb, 9bmt, 9bna, 9bnd, 9bpb, 9bqc, 9bsc, 9bvh, 9caa, 9caw, 9che, 9cjp, 9ckm, 9clh, 9clj, 9cpl, 9cvn, 9cwn, 9cyc, 9czc, 9db, 9ddh, 9dex, 9dge, 9dgj, 9dmz, 9doq, 9duc, 9eak, 9eam, 9ecl, 9elt, 9fj, 9hp, 9qr, kfuh, nba, nqg. Canada: 2cg, 3mv, 4dw, 4dy, 4fv, 9bj, 9ct. Argentine: fh4. Australia: 2bk, 2cg, 2cm, 2cs, 2rc, 2tm, 2yi, 3ad, 3ef, 3hl, 3kb, 3xo, 4rb, 5rg, gdvb. Chile: 9tc. France: 8eu.

At 6BCS-6CJI While on Santa Rosa Island, Calif.
(33 55N 120 03 W. Long., 40 meters)

U. S.: 1aao, 1aaj, 1aci, 1ahl, (1ahv), 1ajo, 1ajp, 1ajx, 1akm, 1akz, 1ane, 1aw, 1axa, 1awe, 1aya, 1ayi, 1ayj, 1bes, 1bux, 1bxg, 1bzp, 1cal, 1chi, 1cmn, 1dl, 1gj, 1id, 1kk, 1rd, 1vd, 1wd, 2aan, (2ach), 2ag, 2ahm, 2afu, 2ale, 2alm, 2anm, 2aoc, 2asb, 2auh, 2buy, 2bg, 2cg, 2cty, 2cyw, 2czr, (2gp), 2jb, 2kg, 2ku, 2kx, 2nq, 2mk, 2pf, (2wr), 3aib, 3aha, 3apv, 3auv, 3bwj, 3bx, (3chc), 3cjn, 3ds, 3hs, 3lw, 3mv, 3ph, 3sk, 3wu, 3zm, 4aah, 4bl, 4bx, 4cu, 4ct, 4dy, 4fa, 4fl, 4gy, 4it, 4lx, 4rz, 4si, 4xa, 8aaj, 8aax, 8aju, 8akm, 8alf, 8aly, 8amd, 8anl, 8ax, 8axf, 8bau, 8bpl, (8bna), 8baf, 8cak, 8cau, 8caw, 8cug, 8cvd, 8cwg, 8dk, 8dr, 8dpl, 8es, 8kf, 8lv, 8pl, 8tw, 8uk, (8kc), (8eb), 8xe. Australia: 2bk, 2cs, 2ij, 2yi, 3ef, 3dc, 3ad, 3kb, 4an, 4va, 4rb, 5bg, 6ag, 7gt, 2rc, xk, vkp. Argentina: cb8. Canada: 4df, (4dq), 4hh. China: npp. Chile: 2ld, 3ij, 9tc. French Indo-China: hva. France: 8dn. England: 2sz, 2nm. Italy: ntt. Mexico: 1k, 9a. Philippine Islands: (cd8), 1hr, 1caw. South Africa: oa4v, oa3b. Miscellaneous: kvmk, xk, geft, vkp, gdvb, kfuh, hjs, aqe, y-1cd. New Zealand: 1ao, 2ac, 2bs, 4ac, 2xa, 2ax. 5 watt Portable transmitter used. All cards answered. Route 1, Box 113, Gardena, Calif.

By 6BWT, Bill Pond, Route 1, Box 531, Tujunga, Calif.

1as, 1ayj, 1bbg, 1bie, (hi), 2atc, 2bur, 2fz, 2kg, 2me, 2nz, 2wc, 3aib, bwt, 3fy, 3sf, (hi), 4bl, 4fl, 4ft, 4fx, 4hf, 4io, 4js, 4mm, 4rm, 4wg, 5aay, 5acl, 5agu, 5agp, 5agn, 5ain, 5ani, 5asd, 5ak, 5atv, 5ajk, 5ef, 5fc, 5qa, 5ql, 5qy, 5yb, 5za, 7aek, 7dd, 7df, 7ek, 7fh, 7ho, 7ju, 7ki, 7or, 7pu, 7tk, 7uz, 7vq, a8dm, 8bbl, 8bzt, 8cbi, 8ccm, 8cwr, 8do, 8dr, 8xe, 9cej, 9doe, 9eeh, 9bos, 9fj, 9adk, 9vh, 9dzp, 9im, 9qy, 9ew, 9xi, 9bz, 9uq, 9bwn, 9cwc, 9apy, 9alt, 9cxc, 9ot, 9cku, 9hp, 9akf, 9dr, 9fj, 9bp, 9ix, 9wl, 9ql, 9cmj, 9clr, 9brq. Mexican: 1h, 9a. Navy: nbm, npg, npl, npu, nkf, nisn. Commercial: 2xaf, wir, wiz, why. QRA wanted for: bam, egkk, wva, wvc, fw, spr. Will QSL all cards received.

By 6DDN, Willis L. Nye, 1344 Bernal Ave., Burlingame, California.

(40 meter band)

1akz, 1axa, 1bxg, 1caw, 1er, 1nb, 2ahk, 2apo, 2are, 2atc, 2au, 2buy, 2cjj, 2clg, 2js, 2jt, 2kg, 2mk, 2nm, 2xa, 2xbb, 3ar, 3bmr, 3bva, 3fl, 3ij, 3jw, 3op, 3rr, 3qw, 3zo, 4aa, 4ac, 4bl, 4by, 4cc, 4dq, dy, 4fa, 4fj, 4rl, 4vq, 5acl, 5aig, 5ain, 5al, 5anm, 5aqt, 5ars, 5atf, 5dl, 5il, 5pq, 5oq, 5vu, 5uk, 5yb, 5ys, 5zl, 5zo, 7bz, 7db, 7df, 7dr, 7en, 7fb, 7gn, 7gs, 7gz, 7mb, 7nc, 7pm, 7pu, 7rk, 7rl, 7tk, 7vn, 7wu, 7yt, 8lad, 8alf, 8aly, 8bas, 8bzx, 8cc, 8bcw, 8cpl, 8ded, 8gu, 8ju, 8kf, 8kp. 9aab, 9afx, 9ajq, 9anp, 9anq, 9avb, 9aur, 9axl, 9bbu, 9bdw, 9bfg, 9bna, 9bpb, 9bsc, 9bvh, 9bwx, 9cax, 9cde, 9cej, 9cet, 9cj, cme, 9cn, 9cpq, 9cpu, 9cxc, 9cy, 9ct, 9ctg, 9cv, 9czw, 9dal, 9dbl, 9dbn, 9doe, 9djw, 9dmq, 9drs, 9dv, 9dwi, 9dzp, 9ek, 9eji, 9ekf, 9jo, 9qx, 9rk, 9sd, 9vo, 9xx, 9xax, 9zk, a2aj, a2ac, bam, c-5ae, m-jh, m-9a, pr-4sa.

(80 meter band)

1bxg, 2iw, 7akh, ma, 7ob, 7qc, 7rj, 8bai, 8ki, 8rj, 9ags, 9bdw, 9bfb, 9bng, 9bzi, 9ceh, 9cim, 9cmw, 9cww, 9doz, 9dxz, 9eam, 9ei, 9eif, 9er, 9lr, 9pi. 6DDn is now operating on the 40 meter band with 5 watts pure d.c. note. QSLs appreciated and promptly answered.

By 6ASD, 2347 Lucerne Ave., Los Angeles, California.

U. S.: 1ahc, (1air), 1aiw, 1alw, 1apv, 1azd, 1bhs, (1bxg), 1caw, 1cmx, 1cri, 1de, 1hn, 1vc, 1wl, 1yd, (2acs), 2ahm, 2akb, 2aiu, 2anv, 2bur, 2ccl, 2cua, (2cxl), 2czr, 2efe, 2kg, 2ku, 2kx, (2mu), (2uk), 2wr, 2xaf, 2xc, (2ha), 3aai, 3adb, 3agf, 3aiz, 3auv, 3bcn, 3cc, 3ckj, 3fy, (3ld), 3ll, (3mk), 3wf, 4aab, 4ac, 4av, 4bu, 4cu, 4er, (4fj), (4fl), 4iv, 4lk, 4ll, 4oa, 4rm, 4sa, (4vq), 4wb, (8ada), 8agb, 8ahh, 8ahk, 8aia, 8aju, 8aub, 8bau, 8bds, 8bib, 8bzt, 8cau, 8cbd, 8cbi, 8ccm, (8chk), 8cib, 8cme, 8cjm, 8ctk, 8cty, 8cvq, 8daj, 8dno, 8gz, 8kc, 8kf, 8kw, 8se, 8si, 8xe, 8zu. Argentine: db2. Australia: 2bb, 2bk, 2cg, 2cm, 2cs, 2mh, 2rc, 2ss, 2tm, 2yi, 3bd, 3bq, 3cm, 3kb, 3lm, 3px, 3qh, 3tm, 3wm, 4ad, 4an, 4rb, 5kn, 5lf, 7al, 7cw, 7dx. Alaska: 7jp, wxp. Brazil: 1ab, 1ac. Canada: 3mv, (3qs), 4ald, 4bz, 4cb, (4dq), 4dw, 5am, 5ef, 5go, 5gw. Chile: 2ak, 2ar, 2ld, 3ij, 9tc. Cuba: 8kp. France: fw. Hawaii: 6asr, 6axw, 6dbl, 6dcf, 6oa, fx1. Mexico: 1k, 9a, jh. Porto Rico: 4rx. Philippines: 1ar, 1hr, 3aa, cd8, pi-neqq, npo. New Zealand: 1aa, 1ao, 1fq, 2ac, 2ae, 2bx, (2gc), 2xa, 3ac, 3af, 3aj, 3am, 4ac, 4ak, 4am, 4ar, 4xa.

By U-6ANC, El Centro, Calif.

u(1yd), 1yb, 1aom, 1cal, (1rd), 1aao, 1all, 1adm, 1ay, 1rm, 1ma, 1ax, 1er, 1fx, u-2kp, (2cyx), (2bm), 2buy, 2ff, u-3kp, 3ea, 3csg, 3cky, 3chg, (3bg), u-4md, 4on, 4kn, 4rz, 4je, (4fl), 4cu, 4as, 4aah, 4cn, 4bnm, 4of, 4vi, 4ll, 4fa, (4fq), (5atf), (5uj), (5kp), (5vl), (5aaq), (5ax), (5atf), (5aij), (5nq), (5dq), u-5oc, 5aji, 5agq, 5ls, 5all, (5asw), 5aaz, 5ajk, (5ato), 5oc, 5ako, 5yd, (5fc), 5alw, 5aql, 5aij, 5awf, (5go), 5jf, (5qk), 5asz, 5att, (5aij), (5qy), 5ang, 5alj, 5aig, (5agu), 5aph, 5ain, (5aee), 5atx, 5kc, 5ce, 5zai, 5ll, (5ahg), 5ahr, 5ajf, 5asz, 5amg, 5alj, 5aph, 5ag, 5ain, 5jd, 5sw, (5aid), (5ado), (5ako), (5pb), (5ak), (5se), (5akv), (5aee), (5asw), u-7sf, 7hf, 7vf, 7df, 7ub, 7ip, 7alk, (7wu), 7bf, 7agj. 7jf, (7uw), 7ok, 7adq, 7nc, (7ef), 7df, (7ajb), (7ae), (7uz), (7abf), (7ca), hu-6dbl, (6aff), (6aje), 6buc, (wyi), gd1, npl, npu, nkf, mqg2, ane, pi, 1nr, m, 9a, m, 1aa, mqg2, u8bfa, 8cbv, 8coo, 8ac, 8blb, 8pl, 8agq, 8atv, 8jf, 8ax, 8blb, 8cdv, 8bit, (8ded), 8cau, 8ane, 8acy, 8dno, 8xe, (8cwr), 8aly, 8bpl, 8ccs, 8xe, (8si), (8bww), (8dqz), (8xe), 9hp, 9ecl, (9ctr), (9avj), (9aon), (9dwp), (9fl), (9bab), 9dmu, 9nl, 9eiz, 9bcs, 9bvh, 9ado, 9agy, (9aac), u-9bj, 9bod, 9cfr, (9aac), 9ckm, 9fj, 9cgn, 9dth, u-9cvn, 9bjp, 9anz, 9atq, 9eky, 9zd, 9dzn, 9mm, (9bta), 9bk, (9cwn), 9acn, 9bhi, (9xi), (9zmd), 9bge, 9cni, (9dms), 9aey, (9alt), 9dmz, 9aio, 9jp, 9atq, 9jf, 9ebj, 9cow, 9czu, (9zt), 9efd, 9iez, 9ej, 9dzn, 9zd, 9zk, 9bk, 9ad, (9sd), 9afx, 9epp, 9cfn, 9biv, 9bjn, 9adg, 9ado, 9bwo, 9da, 9ddh, 9cfn, 9cmx, 9wi, 9mp, (9dvr), (9axf), (9qu), (9dbh), (9jh), (9bnd), (9beh), (9dfq), (9cni), (9ckm), (9bv), (9dlh), (9czz), (9cel).

By 6BBV, J. Barsby, 1010 Bates, Hollywood, Calif.

(1abt), 1aiu, 1azd, (1ga), (1id), (1ig), (1iw), 1vc, 2aj, (2bqh), (2cqz), 2kg, (2nz), (2sq), (3mp), 3wm, 4fb, 4lk, (5agu), (5aij), 5ako, 5dq, 5ef, 5kk, (5rg), 5zo, 7afo, (7dc), 7hv, 7ne, (7vr), (7wb), 7wy, 7xf, 7zm, 8ded, (8dx), 8kw, 8qb, 8xe, 9abo, 9abt, (9adn), 9agy, (9ara), (9bdq), 9byh, 9bvs, 9bwn, (9bwo), (9cbq), 9cej, 9cgn, 9che, (9ckm), 9cs, 9cz, 9dud, (9dxz), 9ebj, (9elt), 9ff, (9hb), 9kd. Canada: (4dq). Hawaii: (wyi), 6buc, 6dcf. New Zealand: 1fy, 2ac, 2af, 2bx, 3af, 3as, 4ac, (4ar), 4xa. Australia: 2cg, 2cm, 2cs, 2ds, 2yi, (2zn), (3bd), 4an, (5da), 5kn. Tasmania: (a-7cj). Chile: 2ld. Uruguay: y-jcp.

(*Continued on Page* 58)

WHY RADIO TUBES PETER OUT

(*Continued from Page* 14)

than the cost of producing brand new tubes—and second-hand tubes are not attractive and salable merchandise.

If a cold emitter could be developed; if a material could be found that would efficiently emit electrons, without being heated very much, or which would be of such durable nature as to withstand the heat necessary to its operation, then we would be on the way toward having a tube that would function perhaps for fifty or a hundred years.

It may be said here that radio research engineers have already succeeded in producing a filament that seems to meet these requirements to a remarkable extent; it emits continuously, at a moderate temperature, with but slight apparent damage either to the heating wire or to the emitting material. But it will take a long time to tell how good this filament is. Also, it will be necessary to develop a chemical means for maintaining the vacuum of the tube indefinitely, if full advantage is to be taken of such a filament. Tubes, as at present constructed, lose their vacuum in time, even when they are not used at all. Molecules of air seem to leak in along the lead-in wires. Radio tubes that will last ten or twenty years may be eventually developed, as, also, it is not impossible that we will have tubes that will operate without *A*-batteries—without any filament-heating current.

The filament of the present-day vacuum tube is a hot and tremendously turbulent place; it is a sort of elongated universe, tiny, but complete, full of millions of whirling solar systems, which are all being subjected to a terrific external disrupting pressure (by the *B*-batteries). It is a scene of continual terrific explosions, and it receives and hurls out into space electrons beyond counting. It really is a wonder that the thing hangs together as long as it does.

I hope that the foregoing will have brought to the interested reader a glimpse at least of the astonishing depth of investigation and experiment involved in the creation and evolution of a device that is fast becoming a commonplace object in our every-day life.

I say commonplace; yet, to him who walks with joyous attentiveness within the steadily increasing illumination of modern science, a mere pebble on the strand of the sea is a wonderful thing possessed of inconceivable possibilities. No? Why, look here—a blob of fused sand, a lump of nickel and a speck of rock, and behold, an Aladdin's lamp that brings the musical treasures of all the world to your very fireside. Page the old grouch who said there was nothing new under the sun!

RED DAWN

(*Continued from Page* 28)

at this station also informed listening fans that "The Pilgrim's Chorus" would constitute a special opening number on the program and was being played by "special request." There seemed nothing more than coincidence to account for the fact that two different stations had selected the same opening number for the same hour of that evening.

Far up in the Vermont mountains, a man in an isolated cabin sat before a complicated array of dials that would have intrigued the intense interest of anyone interested in radio. Before him he had what appeared to be a series of receiving instruments, with fixed adjustments which turned them permanently to different stations. On a desk at his elbow was a telephone and a pad of paper. Several loud speakers hung from racks over his head. He was listening to one of the disks as he fingered the pencil thoughtfully. Finally he called over his shoulder.

"Oh, Ed—here comes one now!"

A second man joined him from the backroom and cut in another of the loud speakers. The strains of "The Pilgrim's chorus" filtered into the room softly—one played by a New York station, the other by a station at the national capital. The eyes of the two men met. One grinned.

"That's 'gimlet' ain't it?" he asked, after a bit.

His companion nodded.

"Gimlet's it," he said.

He picked up his telephone and twisted a crank. Far down the mountainside, in a telegraph station on the railroad that connected with one of the big trunk lines, the night operator took down the receiver.

"Zat you, Joe?" inquired the voice on the mountain top. "Well, here's another crazy one. Yeah . . . it's 'gimlet' this time . . . yeah . . . g-i-m-l-e-t . . . like you punch holes with . . . yeah . . . that't it. All ri'. Goo' bye!"

He hung up the receiver. The music was still coming clear and distinct from the two stations.

"Things is warmin' up," he remarked. His companion yawned.

"May ain't far off," he said significantly, and returned to his bunk in the back room.

The code word "gimlet" sped down the railroad line to division headquarters. There it became "gauntlet," hurried through a repeater and chased over valleys and mountains until it came to rest on a bit of yellow paper in the downtown office of the Johnson All Night restaurant company in Chicago. By that time it had become "bake-oven." The gray-haired, keen-eyed man, known to the commercial world as Al G. Johnson, the restaurant man, and to nine other men as "Q," scanned the compound word and smiled softly to himself.

"Cabinet meeting called by the President tonight!" he translated under his breath. A match reduced the paper to ashes which he blew out of the fifth story window and watched filter down on the crowds beneath. He sat for a long time staring at the ceiling.

"Even if they were wise," he said after a bit, "it's too late now . . . it's too late!"

Back in Washington, meanwhile, important dies were being cast for the minting of the national crisis. The Cabinet had gone into one of the most epochal and secret sessions of its entire history, behind locked and closely guarded doors. The session lasted until long past midnight, so that when Maylon dropped into step with a departmental head as the latter emerged from his machine at the entrance to his home, he found a haggard, worried executive head confronting him.

"I suppose there is nothing you can tell me about tonight's meeting," Maylon remarked, lighting a cigaret.

The secretary stared at him curiously.

"By Jove, Maylon," he breathed. "I begin to understand why you get the money you do. How you knew . . ."

"Stop hedging," Maylon snapped. "I want facts. This crisis is too important to be veneered with banalities. What you want right now all of you, is public backing. I've got the means, the public torch to set America aflame tonight, like a beacon . . . but I can't start a conflagration without a match. When will you officials ever learn that?"

"You know that, also?" said the other in sheer amazement.

"I knew it before you did," said Maylon, with a short laugh. "That's what I'm paid to stay in Washington for. Now what's the plan?"

The Secretary glanced cautiously up and down the street.

"The President expects to be up all night working on it," he said. "For that matter, I don't think any of us will sleep . . . It's too awful. Why Maylon—listen here. I know this is safe with you. Do you know that the way the Reds have worked this out, it is positively fiendish? What we can't figure out is how they have been putting it across—their means of communication, I mean. They must have some means, and yet we can't get it. If we could, we could get a line on their details. Don't you see?"

Maylon nodded, thoughtfully.

"Yet," he said, "it can be done. But not in a cabinet meeting. This thing has been planned by a genius—a super-organizer with an imagination. You fellows, bogged down in your governmental red-tape and specialized branches of administration, have stifled your imagination. In my business, we develop it. I'd be willing to bet that a couple of good newspapermen, without knowing a thing about the facts, could dope them out so closely it would startle you—just by intuition and imagination. I've seen it done . . ."

The Secretary nodded.

"In the last war?" he asked.

"Yes," said Maylon, "and not only there but every day in the run of a day's work. That is part of our trade—building patterns of what probabilities lie at hand. It is the secret of the giant power wielded by the press—the ability to not only ferret out, but to anticipate and build upon a structure of possibility, an edifice that fits imaginative specifications. And it is often so closely a duplicate of the real thing that it gives courts and grand juries ideas on which to work. It stimulates the power of suggestion. It has, in fact, no limits . . ."

"I'm not sure that you are not right, Maylon," said the other, after a moment. "Come up to my rooms. Let's talk this over."

It was dawn of the following morning when two tired, disheveled men, thrust back the papers before them on the table and turned to the tall, sharp-eyed individual who had been a silent spectator of their efforts for nearly six long hours—Dan Byrne, head of the national secret service—the man on whose shoulders rested the safety of more things than the public ever knew or understood.

"Then as I understand it," he said quickly, "you figure that there are at least three ways in which a network of communication could be kept up without suspicion, and that the use of coded music in broadcasting stations would be the most feasible?"

Maylon nodded wearily.

"It would be the safest," he said slowly. "If I was an organizer of imagination, if I wanted to escape the usual channels of espionage I would most certainly do that. It is by far the simplest—and the most effective."

The head of the secret service threw down the stub of the cigar he had been smoking, and lighted a fresh one.

"You can assure us of the cooperation of the naval stations, Mr. Secretary?" he asked.

"Every resource—without hesitation," said the other.

Dan Byrne stood up.

"Very well," he said. "We'll try it. If you're right, Mr. Maylon—it's the cleverest piece of elimination I've ever seen done . . ."

Maylon flipped over the calander on the Secretary's desk and then settled back in the chair.

"If I'm right . . . I'm about twenty-one days right," he replied cryptically. The others understood thoroughly what he meant.

Foreign diplomatic interests at Washington, who keep closely in touch with American affairs at the capitol, sent a number of interesting dispatches within the next few days. The general tenor of all of them was of a similar nature, namely that there was "something doing" at Washington. But with strange unanimity, they all admitted their entire and complete inability to determine just what it was. For despite her national habit of telling all she knows to the casual listener, when a national crisis threatens, American diplomats can be the most close-mouthed aggregation in the world.

Maylon kept his chief constantly in touch with developments. The contents of many of his coded telegrams would have made thrilling reading for the European press could they have been obtained or deciphered. It was five days after the famous cabinet meeting and the all-night session of Maylon and the Secretary that the head of the secret service called Maylon just as he was leaving his hotel.

"If I promised you a dinner the other night, you can have it now," he said.

"No!" The newspaperman's voice expressed joy, surprise, incredulity.

"I'll say you can. By the way—you'll get an important message in a few minutes. I'd stick close to the hotel until it comes if I were you."

"Right," said Maylon, a bit dazed. "That all?"

"Accept congratulations," said Byrne, and rang off.

It was less than half an hour afterward that the President's secretary called Maylon on the wire for a conference at the White House at a certain hour that evening. He gave no intimation of the purpose of the conference, other than that the request came from the President personally, and was "important."

Maylon's first impulse was to call his editor on the long distance. But he thought better of it. There are some things that one does not tell even one's editor. Instead he sat himself down to wait, smoking innumerable cigarets in the interim.

He remembered the meeting with the Chief Executive long afterward. It was not his first . . . he was one of the inner circle that broke no White House confidences and the usual audience was quite a matter of routine with him. But this was different . . . a hand on his shoulder and a high compliment that was somewhat embarassing to him.

"I am glad I was a good guesser," he had said simply.

The President smiled.

"Thank God—that America still has your kind of a guesser," he had said, with a sincerity that had made him blush in spite of his hardened contacts with life. One thing, however really thrilled him—the information that he was to be in at the finish.

"The President thinks you have earned that right," his secretary explained and Maylon had accepted the opportunity with deep gratitude. It meant an exclusive story for his paper, no matter what official statement was given out at the White House after ward, to his rival associates, with whom competition was always of a most friendly nature.

EVENTS moved rapidly after that, up until the twenty-fifth of April when an occurrence took place which startled America from coast to coast. It was the announcement, by every newspaper in the country, that on that night, the President of the United States would speak to every loyal American in person over the radio from the White House.

"Emergency Broadcast Tonight!" was the headline. "President to use interlinked telehone lines and broadcasting stations to reach 120,000,000 people on a matter of vast national importance! Washington silent as to issue involved but admits importance of matter to be broadcast, second only to declaration of war!"

This was the gist of it—set forth in extras that sold on the streets like hotcakes. Thousands turned from their ink-damp sheets and asked each other with startled faces, what it meant. The papers contained the information that all musical and entertainment broadcasts by radio had been abruptly cancelled under orders from the government to make way for the Presidential utterance. By nightfall of that night, millions were in a ferment of excitement.

The inter-linking of all radio units with Washington had been set for 9 p. m., Eastern Standard Time. Telephone officials working with terrific speed, had co-ordinated their mechanical equipment with giant stations, achieving the almost impossible within a few hours. Practically all business suspended over land-line wires, all long distance calls having been cancelled for some mysterious reason. Messages accepted for filing in telegraph offices were accepted "subject to twenty-four hours delay." The only explanation given was "government orders." This added to public excitement.

It is estimated that probably 50,000,-000 actual listeners were on the air the night of the memorable broadcast, when the President of the United States stepped before the microphone on his desk in the White House, and for the first time in history addressed his people on a matter of grave and national peril—the purposed overthrow of the government at the hands of Red conspirators.

"Even as you sit, peacefully before your loud speakers, listening to these words," he said, "the wheels of the government, set in motion almost too late to be of service, are combating this internecine danger which was to have come to a dramatic and tragic climax on May 1—the Red May, which has been heralded as the day of so-called restitution."

And then, as his speechless listeners sat thrilled and shocked by the revelations, he told them in simple language of the scope of the thing—of the utilization of the nine radio districts as the basis for the mapping out of the Red cantons, with a director in charge of each, of the coding of broadcasting music and its use in communication between the various directors, of the plans made to seize arsenals, and coast defense, railroad yards, and communication system.

"At this moment, thousands of loyal government employees have taken the ringleaders of this vast conspiracy into custody," said the voice in the loud speaker . . .

In the back room of the Johnson All Night Restaurant company in Chicago, the man known as "Q," the center of the web, suddenly paralyzed by the government's peremptory halting of the vast system of national comumnication, paced to and fro before his radio set. He was gnawing his grey moustache nervously. Something had gone wrong somewhere. His directors had not been able to communicate with him. Especially the one in Washington. This one he desired to hear from most of all. The announcement of the forthcoming Presidential broadcast had worried him still more—this and the suspension of all telegraphic and telephonic communication. Did it mean that he had a weak link in his chain somewhere?

Of all who listened to the words of the President there was no more interested listener than "Q." As the voice from the loud speaker, speaking over the interlinked wire and radio system of the country poured into his ears the details of his cherished scheme—the scheme he had taken years to perfect, for which he had enlisted the brainiest and most competent of the world's radicals, he sank back in his chair.

"Not one of them will escape the justice that must always be the fundamental keynote of American national institutions . . ." said the voice.

The man known as "Q" sprang suddenly from his seat. He had unlimited funds at his command. His identity was known only to a certain few. No need to sit in his office, like a rat in a trap—Suppose there had been a leak. He had the perfect system, and yet it had failed—There were spots in the world where one could build up an ideal government . . .

Only a moment he hesitated, then he grabbed his hat. A hasty look at his watch. He could catch a night train for New York. The *Mauretania* . . .

In his haste, cramming papers into a bag, burning others, he did not hear the soft footfall outside the door. It was a scant three minutes that he dallied there, the voice in the horn droning into his ears with monotonous insistence on American ideals, American beliefs, American desire for order and supremacy of democratic institutions. Damn them—damn them all—their prating of patriotism, their talk of vested rights, of constitutional freedoms. But for a miscarriage of his plans, he would have been the biggest man in America tonight . . . a king! King of America!

He whirled and jerked open the door, to jump back in sudden fright. Three men stood there—three, grim, hard-faced men.

"We have a federal warrant for you, Mr. Johnson!" said the taller of the three.

The man called "Q" stared at the speaker. Abruptly he sprang back and twisted the lock on the door. It would take them a moment to break it down. From his pocket he whipped a small black automatic. At his elbow the horn droned on . . .

" . . . he would have made of himself a King—a King of all the States . . . A King, my friends . . . a King elected by any means, is intolerable . . ."

A King! The man called "Q" suddenly laughed—insanely, wildly, as the satire of the whole thing was borne in upon him. As the three secret service men smashed against the panel of the door, he placed the muzzle of the weapon against his head and pulled the trigger.

The shot brought the men in the hall up with a jerk. The tallest of them—Dan Byrne—raised his hand and they listened a moment in silence.

There came to their ears, the sound of a falling body. And then—a loud speaker, talking into the silent room . . .

". . . That a nation so conceived and so dedicated shall not perish from the earth . . . !"

(The End)

A B C OF "A," "B" AND "C" CIRCUITS

(*Continued from Page* 15)

negative potential is by means of a *C* battery which gives a constant negative bias to the grid. The *C* battery voltage is made just great enough to completely block the plate current when there are no oscillations in the grid. When the grid is made more negative by the oscillations the plate current is still blocked. But as it is made more positive the plate current starts to flow and to reproduce the positive variations in grid current and thus rectify or detect it.

To understand the action of a vacuum tube as a generator or oscillator imagine that a small hose is run so as to take a part of the steam from the cleaner output to the tire pump input, using the pressure of the discharged steam instead of your hand to move the piston up and down. Once such a system is started it will continue to function as long as steam is supplied from the kettle.

The application of this principle to the vacuum tube is so obvious as to require no elaboration. This is the feed-back used in regenerative sets and in transmitting. Its action is more dependent upon the characteristics of the associated circuit than upon those of the tube itself.

ADVENTURES OF A HAM

(*Continued from Page* 36)

However, one of the officers was still a little doubtful, and would not talk to Marsh, but looked up the name in the phone book, and proceeded to call this number himself. Mr. Marsh told the officer of Pete's call earlier in the evening. After the officer had satisfied himself regarding the time and location, he thanked Mr. Marsh and hung up the receiver. He then reached in his pocket and brought out a piece of cardboard, which he showed to Pete. The card read: "Mr. Arthur Gill, Prosecuting Attorney, Pasadena, Calif."

The officer then informed Pete that earlier in the evening a coupe driven by a young man in a dark overcoat and a light cap had abducted a young girl at 16th and Vermont Sts. This car was last seen speeding south on Vermont. The police machine had been looking around on the side street and just about to turn on Vermont when Pete sped past in a car that resembled the one they were hunting. Then at 54th and Vermont the traffic officer, who had also been notified of the abduction, took the number of Pete's car and gave it to the pursuing officers. After being certain that Pete had been lost, the officers had referred to the California Blue Book and learned that the car was owned by Pete Ormsby at 19073 Walton Ave., and had immediately proceeded to that address.

Pete was then given the third degree as to the past ten years of his life, and the police even called Mr. Wills for a further guarantee of Pete's integrity. To Pete's amazement, the officers wrote out a ticket charging reckless driving at 35 miles per hour in a 20-mile zone, setting his hearing for two weeks from that date. Then the minions of the law departed, leaving Pete with a few thoughts not fit for publication, when he retired to a much needed rest.

The next morning, after the formality of punching the time clock, Pete was informed by the office boy that Mr. Wills wished to see him in his office. Upon his entry Mr. Wills asked about the events of the previous evening and why the officers of the law wanted a character reference for Pete.

Pete gave Mr. Wills a detailed account of the events of the evening along with a humorous description of the race and evasion of the law. Mr. Wills asked to see the ticket given by the officers, stating he would see what could be done regarding the cancellation of the ticket.

Pete went back to the testing and neutralizing of the Wills Co. neutrodyne, thinking very little about the matter. About three o'clock in the afternoon Wills' office boy appeared and presented Pete with an envelope. Upon opening the note, Pete found his speed ticket and a note which read:

"Ormsby, find this ticket is made out

in triplicate form, you have been booked this morning, so the best thing to do is to make your appearance as ordered by the officer. WILLS."

Some time elapsed before anything occurred to disturb the routine of events, but on the evening of the third day Pete found a night letter, which read: "Thanks to amateur radio and your resourcefulness, I was in time. Father doing fine. Will see you upon my return. (Signed) A. Gill."

When Pete appeared before the judge the next morning he was sentenced to serve 30 days in jail or pay a $30 fine, but sentence was suspended for one year.

Upon returning home that evening he found two letters, one from his fellow-operator in Canada, M. Auburn, Vancouver, giving full details of the accident and also of his 5-watt transmitter, and the other a word of thanks from Mr. Gill, who promised to call when he returned and saying that his father was rapidly recovering.

He fulfilled his promise on the following Sunday morning, presenting Pete with a large package, in which was a 250-watt tube and also a picture of a fine looking girl, which Mr. Gill had appropriated from the Canadian operator's room, because it was a picture of the operator *herself*. All of which constitutes a good start for an account of this ham's further adventures.

CALLS HEARD

(*Continued from Page* 49)

By H. Kidder, U. S. S. Blackhawk, at Manila, P. I.

United States: (1aao) (morning in the Philippines), 1cmp, 1cre, 2ag, 5aif, 5ain, 5amw, 5aqi, 5atv, 5atx, 5aua, 5he, 5kn, 5ms, 5nw, 5qw, 5sd, 5xaba, 5zai, 6aaf, 6aag, 6abg, 6ado, 6adt, 6aff, 6ahp, 6aji, 6ajl, 6ajm, 6ak, 6akw, 6akx, 6ann, 6ano, 6anr, 6ase, 6atn, 6awt, 6baz, 6bch, 6bhz, 6blh, 6bil, 6bjd, 6bjx, 6bq, 6bqe, 6btm, 6buc, 6cae, 6ccv, 6cfe, 6cgw, 6che, 6chl, 6cii, 6cj, 6clj, 6clp, 6cou, 6cpg, 6cqa, 6cqu, 6crj, 6csw, 6ctd, 6cto, 6cuw, 6daa, 6dag, 6daj, 6dao, 6dax, 6dcn, 6dn, 6ea, 6hm, 6ji, 6js, 6kb, 6kg, 6kt, 6la, 6nx, 6ob, 6oi, 6pn, 6rj, 6rp, 6rw, 6uf, 6vc, 6wi, 6xi, 6zac, 7adm, 7akv, 7akx, 7bb, 7ek, 7gr, 7ho, 7lq, 7tm, 7uj, 7vh, 7wu, 8bau, 8xe, 9ado, 9asr, 9cby, 9cfy, 9ek, 9elt, 9xi, 9zl, fxl, kfuh, ngy, nisv, npg, npl, npm, npn, npo, npu, nqg1, nqg2, nqt, nupm, nuqg, whl, wiz, wqo, wuj, wvy. Africa: a3b, a3e, a3z, a4a, a4g, a4l, (a4z), a5z, a6a, a7b, dx, 1sr. Argentine: cb8 lpw, lpz. Australia: 2bb, 2cg, 2cm, 2dp, 2ds, 2gh, 2jw, 2lk, 2rd, 2rj, 2ui, (2yi), 2yr, 3ad, 3ak, 3bd, 3bl, 3bm, 3bp, 3bq, 3ef, 3el, 3hl, 3jp, 3kb, 3lm, 3qh, 3ta, 3tm, 3wm, 3xo, 3yx, 4at, 4rb, 4wi, 5ah, 5bg, 5bo, 5da, 5ho, 5lf, 6ag, 6bo, 6cj, vhm, vit, vjz. Belgium: (p2), b82. Brazil: (1ab), 1ac, 1af, 1aq, 1ar, 1aw, 1bc, 1ia, 1sq, 2ab, 2af, 6qa. Canadian: 4gt. Chile: 1eg, (9tc). China: (fc-8em), gfup. Dutch East Indies: (andir), ane, pkx, pkh. England: 2kf, 2lo, 2lz, (2nm) voice,, 20d voice, 2sz, 2xy, 5lf, 5sh, 6nf, 6td, byc. France: 8al, 8bf, (8dk), 8gz, 8hsf, 8jn, 8kl, 8tk, 8ug, fw. French Indo-China: (8lbt), 8qq, hva. Germany: pox. Holland: pcll, (pcuu). India: (2bg). Ireland: (g-5nj). Italy: 1re, ics. Japan: (1aa), 1kk, 1pp. Mexico: 1aa. New Zealand: 1aa, 1aw, (1ax), 1fq, 2ac, 2aq, 2ax, 2bx, 2iz, 2za, 3ad, 3af, 4ac, 4ag, 4ak. Palestine: 1dh, 6mk, 6yx, 6zk. Russia: rcrl, rgc, rpc, rrp. Spain: ear6, ear8, ear21. Sweden: 2se. Misc: anf, bam, crp, 1z, 6b, 82e.

By 6CQW, Bx 261, Heber Calif.

1awe, 1we, 4fl, 5arn, 5amw, 5zai, 6cev, 6anc, 6kd, 6cuw, 6crr, 6abs, 6bmj, 6pw, Cards fr all. Pse report mi sigs. 6js, 8daj, 9xi, 9efs, 9amb, 9ff, 9any, 9pu.

RADIO IN CHINA

(*Continued from Page* 32)

According to Mr. Ray DeLay, manager of the Kellogg offices:

"In the past our station has been a losing proposition. There would be a wonderful field for radio here, if the embargo was lifted. The Chinamen hereabouts are showing much interest in the fad, and we have sold several hundred receiving sets in the past year or so. While this is not a great number, it is no small amount in this section.

"We could sell scores of sets to customers scattered throughout the empire —Canton, Pekin, Tientsien, Woochow, Hong Kong, etc., but the minute the stuff crosses the Shanghai boundary, it comes under the jurisdiction of the Chinese government, and is seized. Generally, if it is seized while being transported by an individual, the person is likewise arrested, and in view of the fact that he is smuggling munitions of war, could be shot. It is a dangerous game for outsiders to enter into."

"When Sherman was American minister at Pekin, he made several efforts to have the embargo lifted, but without success. German, French and Japanese officials suggested its repeal, but the results were all the same. At present, though, the Chinese Minister of Communications seems to be realizing what it would mean to the country to have radio and broadcasting, and accordingly is giving the question much attention, and foreign manufacturers encouragement. It looks as though the embargo will soon be lifted."

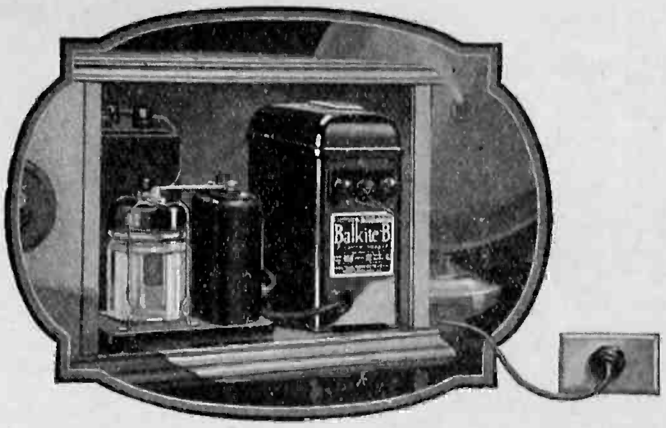
There are several powerful radio stations scattered throughout the country but these are controlled by the government. Several new ones are to be erected within the next year, but little is being done toward the erection of municipal broadcasting stations. Those who are fortunate enough to own sets, are forced to get their entertainment from either the one Shanghai station, or from the big broadcasting stations of Japan.

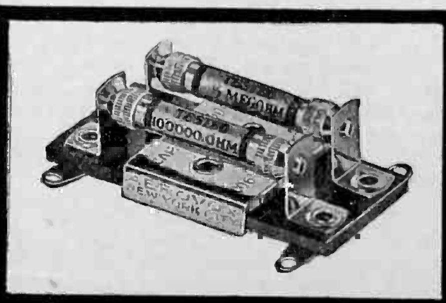
LOW POWER TRANSMITTER

(*Continued from Page* 45)

stands at the right end of the table, in front of it is the wave meter and about in the center of the table may be seen the current supply switch and the antenna-counterpoise change-over switch. The radiation ammeter is in the center of the table shaded by the operator. At the left end of the table are the power supply unit and 100 watt set which failed to produce results, and on the extreme left end is the R. E. L. receiver which was used during the week coupled to the amplifier at the extreme left. The antenna and counterpoise leads can be seen going down in front of the curtain via Pyrex insulators.

The antenna consisted of about 80 ft. of No. 12 enameled wire supported by Pyrex insulators direct across the center of the ballroom, and the counterpoise was about 60 ft. long across the top of the booth under the balcony at the west end of the ballroom.





QUERIES AND REPLIES

(*Continued from Page* 41)

you do not know the code, you can either purchase an Omnigraph, or rent one from one of the radio schools. If neither is practical, build a simple short wave receiver, and listen in as much as possible to amateur short wave transmission. It ought not to take a very long time to be able to recognize the various call letters and numerals which are so frequently transmitted, and after these have been mastered, the rest will be easy. Obtain a telegraph key and a buzzer, and practice sending until you can send at least 12 words of 5 characters each, per minute, without errors. Then you should be able to pass the amateur examination without difficulty.

Would like to have data necessary for construction of a 47 kilocycle air cored intermediate frequency transformer.—K. R., Columbus, Ohio.

Data for constructing a 47 kilocycle filter transformer was given in April RADIO, in the article on the Best 5 tube superheterodyne. Two of these transformers could be used in cascade without difficulty, but to use more than two would not only impair the quality obtainable with the set, but would require extreme care in matching, as well as laboratory apparatus needed to do the matching work accurately. It would be better to construct two of the iron cored transformers as described in the same article, and two of the filters, than to attempt to build air cored transformers for such a low intermediate frequency.

I wish to hook up a receiver using a lot of old left-over material. Have a basket weave coil of 75 turns, and a 100-turn honeycomb coil, How many turns can I take off one of these to make a tickler coil? How can I make a variometer selective?—P. V. L., Berkeley, Calif.

If you unwind the honeycomb coil until only 35 turns are left, you can use it as a tickler coil. It is easiest mounted to some sort of a rotating mechanism, and can be turned through an angle of 90 degrees to provide proper coupling. Your question about the variometer is not clear. If you have it connected in the antenna circuit, in the form of a single circuit tuner, it is bound to be unselective. It would be necessary to know the circuit in which the variometer is used in order to give an opinion.

In experimenting with a single control superheterodyne, I notice that while the loop and oscillator condenser dials have approximately the same settings over the center portions of the scale, there is quite a variation at the upper and lower ends of the scale. Is there any way for this difficulty to be overcome so that both dials may be geared together?—R. J. B., Ft. Pierce, Fla.

A large portion of the difficulty is caused by the fact that while the inductance of the loop and oscillator coil may be the same, and the air condensers are identical, the distributed capacity of the loop and oscillator coil are not the same, being lower in the loop, due to the wide spacing of the turns. Most oscillator coils are wound with insulated wire, with the turns placed as close together as possible, and the distributed capacity is bound to be high. In the loop, the spacing is usually ¼ in., and the capacity between turns, being less, causes the tuning curve with any given air condenser to be different from that obtained with the oscillator coil and the same condenser.

Is there any way of repairing a blown-out filter condener, which has an intermittent short circuit when connected to my power amplifier, but on 110 volts d. c. it seems to be O. K.?—H. L. V., Passaic, N. J.

Occasionally a paper condenser with trouble such as yours can be repaired by boiling in a kettle of paraffine for several hours. It will not be necessary to remove the condenser from the metal can, but simply remove the compound on the top and expose the end of the condenser so that the hot paraffine can reach the interior easily. In large condenser repair shops shorted condensers are frequently repaired by placing them directly across a 500 volt d. c. line in which is installed a circuit breaker set at 25 or 30 amperes. By the time the breaker operates, the short is burned out and the boiling process then heals the break and the condenser is as good as ever. The latter method is not a safe one to employ unless you are equipped with the proper apparatus and are experienced in handling high voltage d. c.

In the power amplifier circuit described by H. W. Armstrong in February RADIO, could I use Western Electric 205-D tubes in place of those specified.—E. V. H., Hawthorne, Ill.

You may use the 205-D tubes for the rectifier and last audio stage but it will be necessary to place a filament rheostat in both the filament leads, as the transformers specified have 7½ volt filament secondaries and the 205-D tube requires 4.4 volts and 1.6 amperes. You can use a 102-D tube in the first audio stage but as this tube requires 2 volts and 1 ampere of current you will need a filament rheostat of at least 6 ohms in the positive filament lead.

Am having trouble with radio frequency surges in the 110 volt a. c. power circuit supplying my transmitter. When the key is closed, the lights go up instead of down, and have been unable to stop it, even by the use of radio frequency chokes. What can be done to eliminate the trouble?—R. G. S., San Bernardino. Calif.

Probably your chokes were not of the right size and you had no shunt condensers. Wind two chokes of at least 200 turns of No. 12 wire on a 1 in. hub and place one in each side of the 110 volt line, on the line side of the apparatus. Shunt the power line with a .1 mfd. condenser, placed on the apparatus side of the choke coils. It is important that the condenser be capable of withstanding considerable voltage and current, as otherwise you will have trouble, and plenty of it, from broken down condensers.

CORRECTION: In the article by F. J. Marco on Short Wave Receiver Design, in May RADIO, the "throttle" or feedback condenser in the plate circuit of the detector tube should have been placed between the tickler coil and the filament circuit, instead of as originally shown. The rotor plates of the condenser should be connected to the filament and the stator plates to the tickler coil, with the choke coil connected to the stator plates, as is shown in the corrected diagram, Fig. 3.

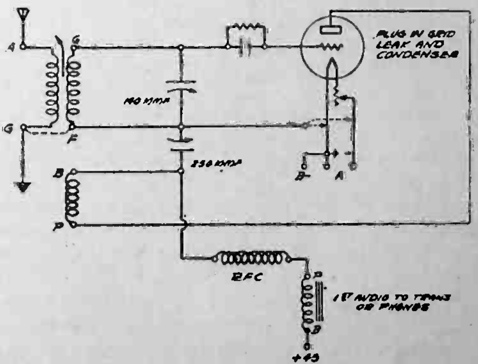


Fig. 3. Corrected Arrangement of Aero Coil Tuner.

TUNED R. F. AMPLIFIER

(*Continued from Page* 21)

amplifier will be adequate, with the tap at the 250th turn connected to the .006 mfd. by-pass condenser leading to the antenna binding post on the set. If the receiving set is arranged so that the parts are easily reached, it would only be necessary to disconnect the antenna coil in the set, and connect the output of the circuit shown in Fig. 1 to the grid and filament connections of the first r.f. tube in the receiver. No other changes would be necessary.

Many superheterodynes already employ regeneration in the loop circuit, and this control is mounted on the panel of the super itself. As the secondary of the r.f. transformer has a center tap, a certain amount of regeneration can be employed, but it is advisable to adjust this control so that the set does not oscillate at the lowest wavelength setting, and then make no further adjustments to this particular condenser. There will be ample regeneration with the control in the r.f. amplifier, and two regeneration controls will surely lead to trouble, unless the set is in the hands of an expert.

Just one more word about the shielding. There is nothing to be afraid of in sawing up a few pieces of sheet brass, drilling the necessary holes, and installing the pieces in their correct places, on the back of the panel and the inside of the cabinet. Nearly all the 1926 model factory built sets will be shielded, and the public will become more and more educated into the necessity for its use, so that here is a good opportunity to become familiar with its advantages, at small cost, and with immediate results.

NEW RADIO CATALOGS

The Grebe CR-18 low-wave receiver, 10 to 200 meters, is illustrated and described in a bulletin from A. H. Grebe & Co., New York City. They also publish an instruction and operating manual giving many essential facts regarding high frequency reception, the price of the manual being 25 cents.

The Resistor Manual from the Daven Radio Corporation illustrates and explains the use of resistance coupling in connection with many standard circuits, including the Daven bass note circuit.

A new catalogue, No. 8931, describing the various measuring instruments, medium and small sizes for use in a variety of ways has just been issued by the Westinghouse Electric and Manufacturing Company. It tells of instruments for alternating and direct current for use in radio, in checking operation of motor starters and starting controllers, in power plants to check opens and shorts on relay circuits, and many others. This catalogue is neatly arranged and well illustrated with the various designs of instruments.

If your storage battery is getting old, and the case is damp with acid, you may be getting quite a bit of strange noise due to leakage through this source. Glass paper weights, such as can be obtained from stationery stores for a small sum, will serve as first-class insulators.

SHIP WEATHER REPORTS TO HONG KONG

(*Continued from Page 43*)

TABLE H—TENDENCY OF PRESSURE

0 Stationary.	5 First stationary, then increasing.
1 Irregular.	6 First stationary, then decreasing.
2 Increasing, continuous.	7 First decreasing, then stationary.
3 Decreasing, continuous.	8 First increasing, then stationary.
4 First decreasing, then increasing.	

PP. Difference of pressure compared to reading three hours previous. By millimeter and tenth of millimeter; thus, difference 0.5 m/m, code is 05. If the reading three hours previous is higher than the reading at 6 AM or 3 PM, 50 is added to the code figure for wind direction. Thus, if the previous reading is 1.2 higher and wind is NW, the code for wind direction is sent as 78.

S. Characteristics of the swell.

TABLE I—CHARACTERISTIC SWELL

Sea smooth to moderate—	Sea rough—
0 No or slight swell.	5 No or slight swell.
1 Moderate swell.	6 Moderate swell.
2 Heavy swell.	7 Heavy swell.
3 Long low swell.	8 Long low swell.
4 Confused swell.	9 Confused swell.

As a matter of convenience, it might be well to include the following Tables. All the French stations use millimeters for barometer readings and the Japs also use them frequently . . .

CONVERSION TABLES

TEMPERATURE Centigrade to Fahrenheit		BAROMETER Millimeters to Inches.			
C.	F.	m/m	Inches	m/m	Inches
		710	27.95	750	29.53
0	32.	711	.99	751	.57
I	33.8	712	28.03	752	.61
2	35.6	713	.07	753	.65
3	37.4	714	.11	754	.68
4	39.2	715	.15	755	.72
5	41.	716	.19	756	.76
6	42.8	717	.23	757	.80
7	44.6	718	.27	758	.84
8	46.4	719	.31	759	.88
9	48.2	720	28.35	760	29.92
10	50.	721	.39	761	.96
11	51.8	722	.42	762	30.00
12	53.6	723	.46	763	.04
13	55.4	724	.50	764	.08
14	57.2	725	.54	765	.12
15	59.	726	.58	766	.16
16	60.8	727	.62	767	.20
17	62.6	728	.66	768	.24
18	64.4	729	.70	769	.28
19	66.2	730	28.74	770	30.32
20	68.	731	.78	771	.35
21	69.8	732	.82	772	.39
22	71.6	733	.86	773	.43
23	73.4	734	.90	774	.47
24	75.2	735	.94	775	.51
25	77.	736	.98	776	.55
26	78.8	737	29.02	777	.59
27	80.6	738	.06	778	.63
28	82.4	739	.09	779	.67
29	84.2	740	29.13		
30	86.	741	.17		
31	87.8	742	.21		
32	89.6	743	.25		
33	91.4	744	.29		
34	93.2	745	.33		
35	95.	746	.37		
36	96.8	747	.41		
37	98.6	748	.45		
38	100.4	749	.49		
39	102.2				
40	104.				

((0.1 millimeter equals 0.004 inch.)

Glass knobs, such as are used for "drawer pulls" for furniture, make handy articles around a radio table if used as insulating knobs.

Although the day of the old fashioned waxed paper condenser has long since passed, very good bypass condensers still can be made up out of tinfoil and waxed paper, either or both of which can be usually located much easier than copper foil and mica.

Rubber insulating handles may be made up by filling the soft rubber bulbs on fountain pen fillers, with sealing wax, imbedding a screw or nut in the hot wax, to permit the device to be used.

Electric Soldering Iron

given to you FREE!

GET a dandy 110-120 volt electric soldering iron free with only a one year subscription to "RADIO." We have received a quantity of CHAPMAN Electric Irons, with large renewable copper tip, wire stand, paste and solder—all complete. These irons have been given a thorough test by us and we know that they will give good service. Everybody can use an electric iron. Simply send us $2.50, the coupon at the foot of this page—and you will receive the iron on the same day your order reaches us. We will also mail "RADIO" to your address every month for a full year.

The Supply Is Limited. Only One to Each Subscriber. Don't Delay!

OTHER FREE PREMIUMS

If you do not want the electric iron with your subscription, you can have your choice of one of the following:

Induction Filter for cutting down AC noises and power line hums, etc. Very effective. Made especially for "RADIO." Thousands have been given away.

Phonograph unit, made by Union Fabric Company.

"ELEMENTS OF RADIO COMMUNICATION," by Lieut E. W. Stone. A real good radio book. Sells for $2.50.

Remember—you get one of the above premiums FREE with only one subscription to "RADIO" for one year. Full price, $2.50. You get double value for your money.

Use the Coupon and Mail It Now!

IMMEDIATE DELIVERY

The premium goes forward to you on the same day your order reaches us. We pay the forwarding charges. All that you pay is $2.50 for the subscription to "RADIO." Nothing "suspicious" about this offer. We want to increase our subscription list.

"RADIO,"
Pacific Building,
San Francisco, Calif.

Here is $2.50 in full payment for a one year subscription to "RADIO" and the following premium—

....

Ship premium prepaid today and start my subscription to "RADIO" with the issue of.................................

Name.................................

Address.................................

City and State.................................

GUARANTEE

The publishers of "RADIO" guarantee this merchandise to be new, standard and fully covered against defects. We will cheerfully refund your money if you do not think that you have received double value for your money. This great offer good for only 30 days. No orders for premiums accepted after June 15, 1926.

The importance of cleanliness in the care of apparatus cannot be overemphasized. Cheese-cloth and elbow grease are known to be successful eliminators of dust and their use is recommended. The cloths must have no oil on them as it is sure to transfer itself to some of the switch contacts and set up resistance where it is not needed. Another enemy of dirt is fine sandpaper judiciously applied to the various movable contact points such as switch blades, plugs, and points on jacks. The connections to the B batteries should be sandpapered now and then to care for any oxidation that may take place. Also watch the rheostats and the four contact points on each vacuum tube base.

Correction: In the article on "Design of Small Power Transformers" on p. 23, March, 1926, RADIO, the practical rule used by A. H. Babcock for finding the length of the core in feet should be: length = .3 wt. in lbs. *divided* by area in sq. in.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

"RADIO," published monthly at San Francisco, Calif., for April 1, 1926.

State of California, County of San Francisco, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared H. W. Dickow, who, having been duly sworn according to law, deposes and says that he is the Business Manager of "RADIO," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Pacific Radio Publishing Co., Pacific Bldg., San Francisco; Editor, Arthur H. Halloran, Berkeley, Calif.; Managing Editor, None; Business Manager, H. W. Dickow, Pacific Bldg., San Francisco.

2. That the owner is:

Pacific Radio Publishing Co., Pacific Bldg., San Francisco; Arthur H. Halloran, Berkeley, Calif.; H. W. Dickow, Pacific Bldg., San Francisco; H. L. Halloran, Berkeley, Calif.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 26th day of March, 1926.

(SEAL) JOHN L. MURPHY,
Notary Public in and for the City and County of San Francisco, State of California. My commission expires May 20, 1929.
