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# RADIO

*Established 1917 as Pacific Radio News*

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## Contents




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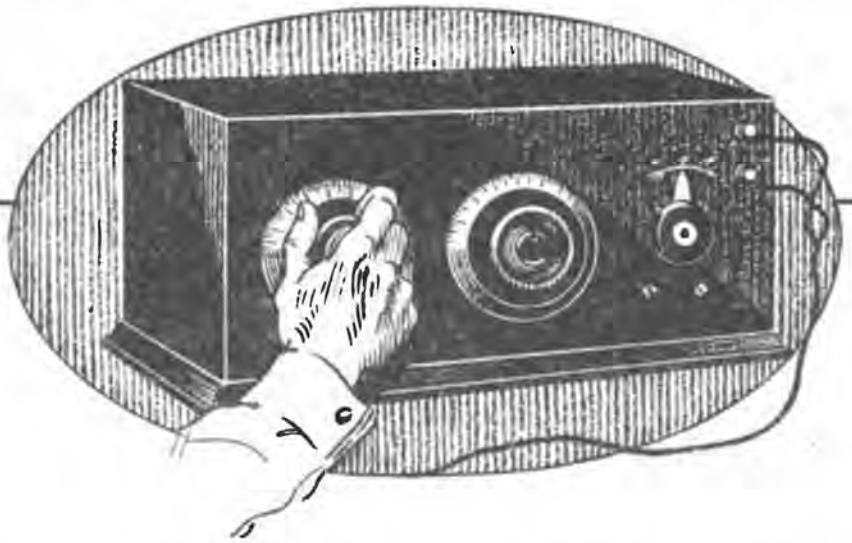

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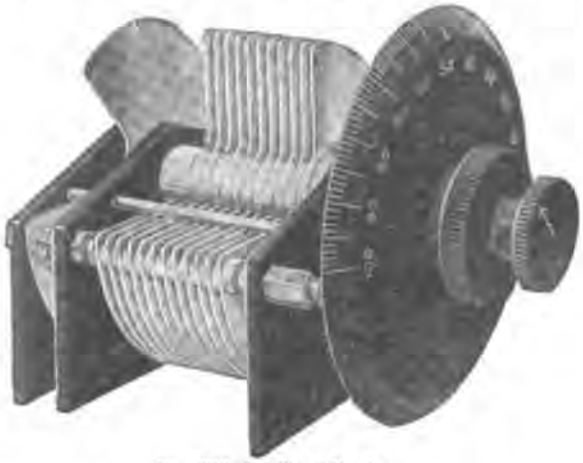

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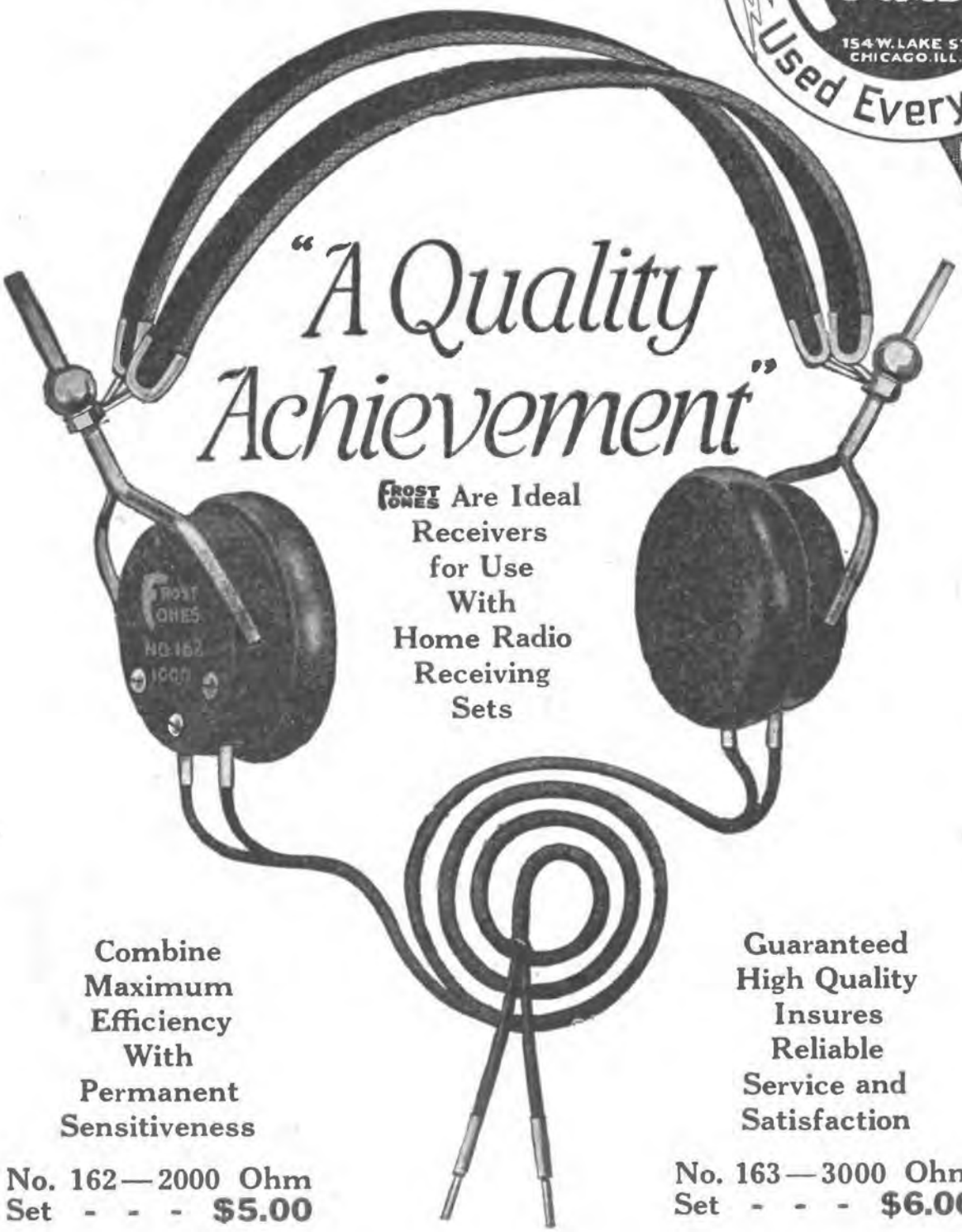

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# HERBERT H. FROST

## 154 W. LAKE STREET, CHICAGO

Tell them that you saw it in RADIO

October, 1922 **RADIO** Vol. 4 No. 10

# Radiotorial Comment

HERE is a proposal well worth the consideration of every amateur owning a spark transmitter which is interfering with the reception of radio broadcasts. In order to reduce such interference a number of dealers have tentatively proposed to supply the equipment for a tube transmitter at wholesale cost if the amateur will dismantle his spark set and agree to keep it off the air. At present this plan is proposed only for Sixth District stations and is subject to general acceptance by the amateurs. If it proves satisfactory locally it will probably be applied nationally. With the manifold advantages of C. W. transmission and the probability of eventual prohibition of spark sets this offer is most opportune. Readers are invited to write their opinion of the idea to the Editor.

---

THE relative rights and privileges of those who transmit by radio is a universal bone of contention. Now that the practical limit of wavelength appropriation has been reached, the "air" is no longer as free as it used to be. So recent are the demands for its use that neither legislation nor court decisions are available to settle disputed points.

The first squatters on this part of the public domain were the amateur operators. But they were soon crowded off into the far confines of the reservation by the Army, the Navy, the ships, and the commercial radio companies. The former two classes have appropriated unto themselves large tracts of the air which they are not adequately using and, in addition, some of them are poaching on the amateurs' preserves with lower harmonics.

The latest settlers in the promised land are the broadcasters, who have been forced to take what is left, although their service to the general public is at least equal to that given by any other class. It is recognized that there should be no interference with such important services as ship communication, but, nevertheless, the present 360, 400 and 485 meter wavelengths are insufficient to care for the public interest in broadcast news and entertainment.

The whole situation is much like that prevailing among the early miners after the gold rush to California in 1849. Coming to a land where there was no established law and order, they protected themselves by the adoption of local customs, which later were incorporated into the law. Strangely enough, these customs, especially those regarding the use of water, are peculiarly applicable to the use of the "air." In fact, the men who will eventually be delegated to formulate a radio code might well pattern their rules upon the established water laws. While the analogy is far from perfect, still, it is suggestive of what radio needs.

As the western pioneers soon found that the old English law of riparian rights did not meet their needs, they developed the doctrine of appropriation, which is now an integral part of the law of almost all of the western states. Its basic principle is that water is regarded as the property of the public.

Priority is the governing factor in appropriation. "The first in time is the first in right." This is modified, however, by the recognition of the rights of a subsequent claimant who proposes to put the water to a higher use and a greater development than the first appropriator. As the public is the real owner of the water, the right to use it is granted to the one who gives the best public service.

Water rights, like other real property, may be lost by abandonment, which "simply adds to the unappropriated public waters and the benefits therefrom are not intended to accrue to a particular person." "The popular notion of the exclusive ownership of water finds no authorization of the books."

The right to the use of public waters is granted for a definite time, after which the title reverts to the public if proper compensation is made for the equipment utilizing the water. An annual license fee is charged for the use of the water. The water rights cannot be capitalized.

Without going into further details, it is evident that these principles are well adapted to the regulation of radio broadcasting. In fact, these very ideas, because of their common sense and their common justice, have been used by the Department of Commerce in deciding disputes about the use of the medium whereby radio communication is maintained.

No one should question the decision that the "air" is public property, that the needs of the Government are paramount in the use of the public domain, and that there is no basis of claim for private ownership. The priority rule as modified by the greatest service to the greatest number also seems just, as likewise does the rule for forfeiture by abandonment. In order to protect the broadcasters' investment in a station, it will be wise to grant a license for a definite tenure, not revocable at the whim of a Government official, provided, of course, that adequate service is being given the public. A license fee also seems desirable if similar charges are made for other classes of service.

There are many other questions, such as the equitable allocation of hours and the determination of wavelengths in the proposed bands, for which little precedent is provided in the law of water. Such questions as are peculiar to radio are being settled amicably by mutual agreement among local broadcasters. The best of these local customs will undoubtedly survive in the ultimate law which will enable those on the air to live together in peace and harmony.

# The C. W. Manual

*Final Installment*

By J. B. Dow, Lieutenant, U. S. N.

### NOTES CONCERNING MECHANICAL PROCESSES

1. Following is a list of tools and equipment that every experimenter should possess: Small electric soldering iron and accessories; three inch bench vise; small breast drill and set of drills, size 0 to 60; tap wrench and taps of common sizes; jeweler's saw frame and supply of saws; combination square; pliers, including flat nose side cutters, long nose side cutters, diagonal cutters, gas pipe, and round; an assortment of screw drivers; small calipers; eight inch scale; drill gauge; thread gauge; assortment of files; small hammer; center punch; countersink tool; scriber; dividers; hack saw, and an assortment of machine screws. Wood working tools are also necessary if the experimenter does his own cabinet making.

2. Large holes are easily cut in bakelite or similar substances by using a boring bar in a drill press and boring half way thru from each side. In this connection a small centering hole must first be drilled for lining up the tool.

3. A jeweler's saw is one of the handiest tools that the experimenter could possess, yet one is rarely ever found in the average constructor's workshop. To those who are unfamiliar with such a tool, it is simply a very fine hack saw which finds an almost unlimited number of applications.

4. A metal cutting band saw is much preferred to a circular saw for cutting bakelite and similar substances.

5. Black crystalizing enamel is used to produce the beautiful checked finish oftentimes found on metal parts of radio

*Fig. 70. Two Bearing Single Unit Motor Generator*

apparatus. This is easily applied with a camel hair brush and checks in the process of drying.

5. The modern tendency in the construction of vacuum tube transmitters is to use Litz for conductors of high frequency currents of any appreciable magnitude and this excellent tendency is somewhat thwarted by the difficulties usually experienced in soldering same. Litz composed of individual wires smaller than No. 32 does not ordinarily warrant usage in view of the difficulties encountered in soldering. Where the wires are larger than this, the enamel may be removed quite easily by heating to redness in a clean flame such as is given by hydrogen gas or alcohol, and plunging the heated section in alcohol, repeating the process once or twice. This procedure breaks down the enamel in such a manner as to make it easily removable by immersing in hot solder and scraping lightly. The enamel comes off quite easily and floats to the surface of the solder. The application of a very small quantity of good anti-corrosive soldering paste will then cause the solder to run in, making a solid mass when cool. The greatest difficulty that will be experienced will be in obtaining a clean flame such as is given by hydrogen gas.

### NOTES UPON THE SELECTION OF APPARATUS

1. Litz inductances are far superior to edgewise wound copper strip inductances or to inductances wound with copper tubing as regards high frequency resistance. The latter type, however, has a slight, though unappreciable, advantage

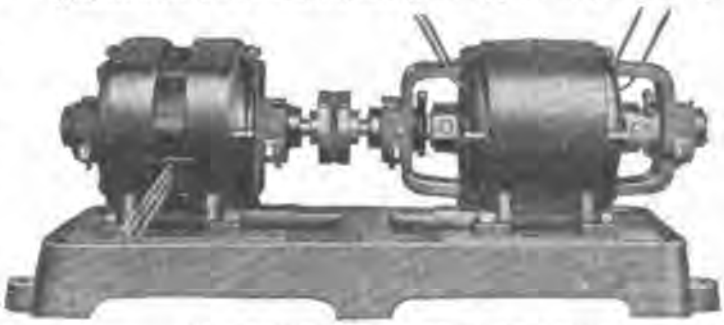


*Fig. 71. Double Commutator Generator*

over the second type. Inductances wound with solid round conductor are inferior to other types and this inferiority increases as the size increases beyond a certain limit for a given current flow. It likewise increases as the size decreases below a certain limit for a given current flow.

2. Generally speaking, a modulation transformer having a primary to secondary turn ratio of 1 to 30 will be found most satisfactory.

3. Small motor generators having outputs under 200 watts are most desirable in the form of two bearing single unit machines. A unit of this type is shown in Fig. 70. Larger sets for generating voltages under 1500 are most satisfactory in the form of two unit four bearing machines. Where the output voltage is in excess of 750 volts the generator should be of the double commutator type. Such a

*Fig. 72. A Rugged Grid Leak Resistance*

machine as manufactured by the Electric Specialty Co. is shown in Fig. 71. For producing voltages in excess of 1500, two such generators connected in series and having their frames insulated from each other and from the motor which may be most conveniently mounted between them, are recommended.

4. Fig. 72 shows a type of grid leak resistance manufactured by the Radio Corporation of America. This device is meeting with great favor because of its ruggedness and facility for mounting.

5. Though not mentioned heretofore, a motor driven chopper is an ideal device for modulating the output of C. W. transmitters for non-oscillating tube or detector reception. A device of this kind may be inserted either in the grid, or oscillating circuit.

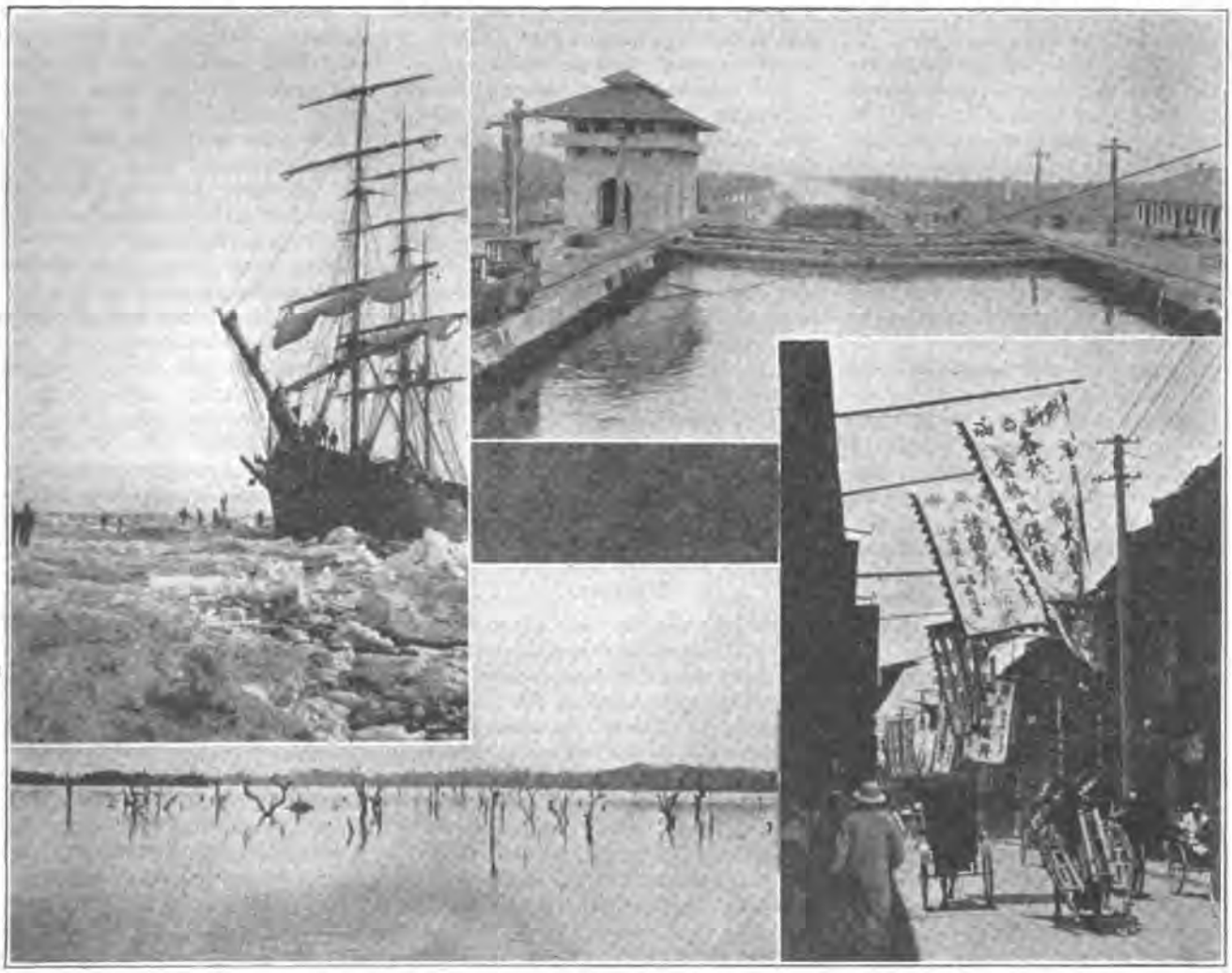
# The Professional Radio Operator

By Volney G. Mathison

*Photographs by the Author*

## The Radio Operator's Future

MANY complain that there is no future in commercial radio operating. To learn radio, they say, obtain a license and become an operator, is well—but what then? What can the wireless operator look forward to? What can he, as an operator, aspire to become? For what will his commercial radio experience qualify him?



*The trail of a radio operator may lead from the cruel ice-pack of the Bering Sea to the strange sights and smells of the Far East, and even to the sun-burnt tropics, where man has cleft two continents with a Panama Canal and drowned an ancient forest with Gatun Lake.*

Commercial radio operating, it is true, cannot be regarded as an end in itself; it does not rate high enough. In the operating field there is little reward for experience. The salaries are fixed, unvarying, with no regard as to whether the operator is a beginner with the ink hardly dry on his license, or a straight-gap pioneer with enough certificates to paper the walls of his wireless shack. The experienced operator's only important advantages are somewhat steadier employment and prior claims for the most desirable ships. As has already been pointed out, the older radio men have a monopoly on the shore berths, but there is not at present room in the land radio field for every shellback; and, even so, once settled down in a shore station, the operator is liable to become a fixture, with no great prospects for betterment financially or otherwise in his condition through the passing years.

In conformity with the demands of truth, this, the unfavorable aspect of the radio operator's future has been touched upon. But to look into the matter, as many do, no further than this, is to draw a somewhat erroneous conclusion; erroneous because we have considered only the field; we have not considered the man.

I happen to be acquainted with an old fellow tending generators in a small street railway power plant, who knows how to keep the most wonderfully soft polish on his commutators that I have ever seen; for he has been polishing them right in that same power station since 1894. Dynamos, boilers, machinery have come and gone, but the old tender is still there, and considering present prices, he is not getting much more pay now than he got twenty-eight years ago. Again, I have a friend who wore the phones six years, then he became foreman in the shop of a small concern manufacturing radio equipment; soon he was in full charge; and now he is half owner of a factory completely equipped with expensive automatic machinery and employing nearly a hundred men—one of the largest manufacturers of amateur radio apparatus in the United States today. Deprived of his ability and forced to compete with it instead, the old concern has gone out of business. This former radio operator started with no capital; he had no extraordinarily good luck; but he had

ambition and the kind of brain back of it that makes success inevitable.

This is all very fine, but we cannot all build wireless apparatus, some one may rejoin—there are already so many apparatus-maker magnates that, like the moonshiners, they almost have to carry badges in order to avoid canvassing one another. True, perhaps, but I have cited merely one example of many that I could present. A number of former radio operators are engaged in important radio construction work, both at home and in foreign countries; others are at the manager's desk and higher among the commercial wireless companies; while to a very great many more radio operating has been a rung or two in the ladder which they have climbed to success in other lines.

The popular assumption that ambition and determined hard work always bring success is a shallow fallacy. It is maintained by some, who argue that not every one can be at the top—somebody must hew the wood and draw the water—that it were better therefore for writers generally to leave off harping on this worn-out theme and turn their efforts upon present social injustices, that these may be uprooted and every worker, even the most humble, be assured a wage that will permit him to live in reasonable comfort.

While there is much food for thought in this, in the present article we are necessarily confined to dealing with things as they are, not as they ought to be; and so it is here asserted that the youth who has really something in him will find that he has as good opportunities for advancing himself in the commercial radio operating field as in any other.

No, he has vastly more, for what field of endeavor is there on earth that has even comparably such possibilities and such titanic development yet to undergo as has radio? Other branches of electricity are well established; they have already traveled far on the road to ultimate perfection; applications have already been made in almost every conceivable place and manner; while radio —why, radio has just begun!

Ten years ago we were glad to cover a hundred miles on a kilowatt of transmitter input, and in long distance high power work ten kilowatts for each hundred miles was found hardly sufficient. During the few short years that radio has been put to commercial use, six or seven distinct types of equipment have been "the latest," only to be doomed to disuse in a few months by the advent of something tremendously better. A great amount of highly improved shipboard radio apparatus was built during the war, and, compared with earlier equipment, this apparatus of four years ago appeared to have approached very near to perfection. Some even went so far as to say that the end of improvement had been about reached. What a short-sighted view!

Our highest class quenched-spark sets do well to cover two thousand miles over water at night—ideal conditions—on a full two kilowatts input; and now transmission over prairie and mountain-range from California to New York is being accomplished on four five-watt vacuum tubes. Not long ago an operator on a ship two thousand miles out in the Pacific successfully copied on a one-step amplifier a lad in eastern Oregon sending on a single five-watt tube. Who dare say that the end of radio development has been reached, or that it is even in sight? Who knows what mightier potentialities lie in this vacuum tube, an instrument justly entitled to a place among the greatest wonders of modern science—and yet brand new!

The upshot of this rather elaborate discussion is this: the radio operator with ability and live energy will find opportunities opening before him which are to be grasped in no other line of electrical work today. And in reaching at these opportunities, the prospective operator, indeed the veriest beginner, will find himself able to stand on an equal footing with the oldest and most experienced man now in the radio game, because the future is destined beyond any doubt to bring the entire abandonment of both arc and spark wireless. We all, expert and novice alike, must learn a new radio—vacuum tube radio. Who cannot read the signs of the times?

### Will the Radio Telephone Eventually Displace the Wireless Operator?

RADIO telephony has advanced with such incredible rapidity during the last three years that many are beginning to speculate whether this, the most marvelous application of the three-element vacuum tube so far achieved, may not eventually replace the wireless telegraph —and the operator.

Coincidently with the development of the "hard" vacuum tube, or rather, as a result of this development, the radio telephone has evolved from early arc and other crude devices to at least comparative perfection. Musical concerts and speech transmitted on a fifty-watt radiophone have been received with ample audibility and remarkably good modulation over a distance of 2500 miles; and this is only the beginning. The "radio link" between Los Angeles and Catalina Island has connected the Bell telephone system to the local telephone lines on the little island out in the Pacific, and so perfectly has the feat been accomplished that the subscriber at his ordinary city phone can hardly believe that his voice is being relayed by radio across thirty miles of ocean. This is virtually the first application commercially of the wireless telephone so far attempted. It is almost comparable to Marconi's wireless telegraph operations of 1900; and if the radio telephone is destined to undergo, in turn, the vast development that has already taken place in the field of the wireless telegraph since its first commercial utilization—but who will venture to carry out the comparison?

In the marine radio field it is possible that the wireless telephone will supplant the telegraph on a few ships. The employment of the radiophone on shipboard will be facilitated through the ultimate universal adoption of the vacuum tube transmitter. This last is inevitable. The spark transmitter of whatever type will eventually by strict legislation be barred off the air. Where a hundred tube sets can work simultaneously without interfering in the least with one another, a single spark can destroy all harmony. When the use of the vacuum tube transmitter becomes general, the spark outfit will no more be tolerated on the air than would an unmuffled automobile in the city streets, or an urchin beating a dishpan in a high school band.

Now it is evident that the eventual universal employment of the vacuum tube set will make it a simple matter to introduce commercially the wireless telephone, because the same apparatus, both transmitting and receiving, can be used for either telegraphing or telephoning.

A radiophone equipment aboard ship, tuned to some standardized telephoning wave, will be able to call the desired shore station, which will answer likewise on "phone." Certain hours for wireless telephone work may be assigned in order to simplify ship and shore and ship to ship communication; and a vessel out of reach of the coastal stations might relay through an intermediate ship. In this way traffic could be cleared.

Nor will the availability of radio-compass bearings be in any wise curtailed. Each ship will carry its own radio-compass equipment; and the navigating officer will take his own bearings upon continuously transmitting coastal stations. No knowledge of code will be necessary to recognize the different coastal transmitters, since these will be automatically operated by motor-driven contacting devices adjusted to give certain prearranged combinations of long dashes and dots (analogous to lighthouse flash signals) sent so slowly as to be easily recognizable by anyone. If this seems a far-fetched idea, it may surprise the reader to learn that the installation of such automatic radio transmitters in the more important lighthouses is actually being planned. These "radio beacons" will, of course, be operated only in foggy weather, and being purely automatic, could be cared for by the light-keepers. This will be

Continued on page 42

# The Electronic Theory of Matter

## First and Second Text Assignments in Correspondence Course on Elementary Radio Conducted by University of California Extension Division

By Ellery W. Stone

THE transmission of intelligence by means of radiotelegraphy or radiotelephony is essentially an electrical phenomenon. Hence, in order that the student may have the proper grounding for this course, we shall consider, in the first assignment, the fundamentals of electricity, the electronic theory of matter, and definitions of the more common electrical terms.

At the outset you may be interested to know that the electronic theory is probably the most comprehensive, the most amazing, of the various theories and hypotheses which have been advanced, and accepted, in all science. For the electronic theory explains the structure of all matter; it explains the foundation on which all life, active and inanimate, is based. Too much importance, therefore, cannot be attached to this theory and the student is urged to acquire a thorough understanding of it before passing on to the later assignments of this course.

Briefly, the electronic theory sets forth that matter—that is to say, everything material and physical in life, all solids, liquids and gases—is simply condensed energy. This energy is electrical energy.

Whether or not you have studied chemistry, you probably know that all solids, liquids and gases are divided into three classes—elements, compounds and mechanical mixtures. Zinc and copper are elements because no matter how much either of them may be disintegrated through heat or other agencies, it cannot be so separated or decomposed as to produce any substance other than itself. Brass, on the other hand, is a compound, and through heat and other means may be dissociated into the two elements of which it is composed—copper and zinc. Water, also, is a compound, composed of the elements hydrogen and oxygen. If suitable proportions of sulphur and oxygen, already combined into a compound, are added to the hydrogen and oxygen which together compose water, we shall have another compound—sulphuric acid. But if oil, let us say, which is a compound of the elements hydrogen, oxygen, and carbon, is mixed with water, a new compound will not result. These two compounds will not combine to form a third compound, oil will not dissolve in water—we say—and while we may keep both compounds in the same container, may even shake them vigorously, they will not blend together to form a new compound. The result of this combination is called a mechanical mixture, each of the two compounds, oil and water, retaining its own identity and characteristics even though in physical contact.

In disintegrating an element down to the most minute portion of it which can exist, we arrive at the *atom*. In breaking up a compound, which is composed of two or more elements, into the smallest part of it which can exist and still retain the compound's characteristics, we obtain the *molecule*. A molecule of any compound is thus seen to be composed of two or more atoms of the various elements of which the compound is formed.

As may be imagined, the greatest interest in the field of advanced chemistry centers around the atom. Recently it has been found possible to break up the atom—not into combinations of new elements, because the atom itself, as we have seen, is the most minute particle of any one element which can exist and still retain all of the characteristic features of that particular element—but into the electrical charges, called *electrons*, of which the atom is composed.

What is the electron itself? That is something which no one knows. It is the nearest approach to the infinite to which the scientist comes. He is able to measure the amount of its electrical charge; he knows that there is a positive electron always associated with some indefinable mass 1845 times heavier than that associated with the negative electron. Both positive and negative electrons, however, have the same degree or quantity of electrical charge, except that they are of opposite polarity or sign—that is to say, the charge of the heavier electron, if we may speak of its weight, is positive, while that of the other is negative.

It is a fundamental law of electricity and magnetism that like charges repel each other and unlike charges attract. Thus, if two positively charged electrons, or two negative ones, happen to be near each other for an instant, their like charges cause them to repel each other and they fly apart. On the other hand, a positive electron has the greatest attraction or affinity for a negative one, and if two of these dissimilar electrons are near enough together to exert their influence on each other, and if there are no other electrons in the vicinity and no other adjacent electrical or magnetic force which might affect their normal behavior, their unlike charges will cause them to fly together and unite.

Bear in mind that the electron, whether positive or negative, is simply an electrical charge. It is not associated with anything tangible, any element, of which we have knowledge. It is believed by some scientists to be associated with a magnetic strain in the *ether*, that mysterious, all-pervading medium which is said to fill all space and which serves to conduct or transmit the great family of electrical waves—the wireless or radio waves, heat, light, and ultra-violet rays, such as the X-ray and the emanations from radium and other radio-active substances. In the next assignment we shall consider this great family of electrical waves in more detail.

What complicates our understanding of the true identity of the electron is the fact that since the publication of the Einstein Theory of Relativity, the opinion has grown among scientists that it is no longer necessary to have our conception of the ether at all. This being the case, one can understand why the theory that the electron is a magnetic strain in the now dubious ether does not mean very much.

However, because it has been scientifically proved, the student must be asked to accept on faith the theory that the basis of all matter is the electron—an infinitesimally small, weightless electrical charge.

In the study of chemistry we find that the hydrogen atom is the lightest of all the atoms of the different elements. This hydrogen atom is now definitely known to be composed of a single positive and a single negative electron. It is believed that the negative electron revolves in a circular path or orbit around the positive one, but this is not definitely known.

The atoms of the heavier elements are indicated simply by adding to the hydrogen combination of one positive and one negative electron additional negative electrons, together, always, with an equal number of positive ones. This is really one of the most amazing phenomena of all science—that out of the electron, simply by building up various combinations of these minute positive and negative electrical charges, always an equal number of each, should emerge the atoms of all the elements.

Now, since the atom is composed of an equal number of positive and negative electrons, it follows that the resultant atom itself is not characterized by any electrical charge or activity. The number of positive electronic charges is

exactly balanced, neutralized or cancelled by the equal number of negative electrons, since the *degree*—not the kind—of electrical charge is the same with both positive and negative electrons. The resultant electrical charge of the atom is thus seen to be nil, or zero.

It has been conclusively proved that the atom consists of a relatively heavy nucleus of positive electrons—it is only in the hydrogen atom that we have but one positive electron together with its single negative neighbor—surrounded by a ring, or by rings, as we approach the heavier elements, of negative electrons. Fig. 1 represents what may be considered as a hydrogen atom, consisting

*Fig. 1—Representation of Hydrogen Atom* *Fig. 2—Representation of Atom of Heavier Element*

of the "heavy" positive electron to which is clinging, or around which is revolving its companion negative electron. (The plus sign, +, represents the positive electron, and the minus sign, —, the negative electron.) Fig. 2 represents the atom of one of the heavier elements. In Fig. 2 the positive nucleus is shown as a single circle with eight positive charges. In reality, this positive nucleus actually consists of eight separate and distinct positive electrons. It will be noticed that the positive nucleus, with a positive charge of 8, is surrounded and neutralized by eight negative electrons.

In the above, we have briefly considered the electron and the electronic theory of matter. In addition to being, in a passive or static way, the basis of all matter, let us see what other characteristics or properties the electron possesses.

Since an electron is really an electrical charge, a stream of electrons proceeding from one point to another results in a flow of electrical energy and we have the familiar *electrical current*.

Certain substances are said to be conductors of the electrical current—that is to say, they permit an electrical current to freely pass through them. These conductors are usually the various metals (copper is the best practical conductor), although certain solutions, usually acidic, are also fairly good conductors.

When a substance is in solution, *i. e.*, dissolved in a liquid, usually water, one or more of the negative electrons of which it is composed become detached from the atom and are free to move about in the solution. So, too, it is believed that the factor which makes the metals conductors of the electrical current as distinct from those substances, like glass, for example, which are non-conductors or insulators, is the fact that at least one of the negative electrons of each atom is free to leave the atom and move about among the other atoms. Thus, a concerted movement, or drift, of these negative electrons through the metal—usually in the form of a wire—constitutes the electrical current.

## Electrical Definitions

We have just seen that the flow of the electrical current through a wire is the movement of a stream of negative electrons. What causes these negative electrons to flow in a definite direction?

We have previously observed that it was a fundamental law of electricity that unlike charges attract each other and like charges repel each other. Negative electrons thus flow from one point to another in a wire only because the latter point is maintained, or is at a higher degree of positive charge. The attraction of the greater positive charge, then, causes the electrons to move toward that point in the wire, and since each electron carries—really is—an electrical charge, the movement or translation of all these negative charges from one point to the other constitutes, as we have seen, the electrical current.

The difference between the amounts of positive electrical charge at the two different points on the wire between which the electrons flow is called the "difference in potential" and is measured in *volts*. (Named after Volta, an Italian physicist of the early nineteenth century.) This difference of potential is sometimes called the *electromotive force* and is abbreviated as *E. M. F.*, or in formulas as *E*.

The greater the difference of potential between the two points, the greater will be the attraction exerted on the negative electrons and the greater will be the number of negative electrons passing between the two points in a given length of time. Thus, if we double the attracting force, we double the number of electrons or negative charges or the electrical current flowing in the wire. The electrical current is measured in *amperes* (named after Ampère, a famous French physicist of Volta's time), so we say that as we double the voltage, we double the amperage.

We may liken the voltage or E. M. F. to the head or pressure which forces a stream of water through a pipe, the stream itself corresponding to the electrical current or amperage.

Just as a stream of water flowing through a pipe encounters friction or resistance from the inner wall of the pipe and a certain amount of energy must be expended in overcoming this friction, so a conductor offers resistance to the electrical current. The resistance is actually friction between the negative electrical charges or electrons and the atoms or molecules of which the conductor is composed. This resistance is measured in *ohms* (after Ohm, a German scientist).

The relation existing between the E. M. F. between two points on a wire, the resistance of the wire between these two points, and the number of electrons, or the electrical current, flowing between these points is known as Ohm's Law, and is written as follows:

$$I = \frac{E}{R}$$

where $I$ represents the amount of the electrical current measured in amperes, $E$ represents the difference of potential or E. M. F. measured in volts, and $R$ the resistance measured in ohms.

We might express Ohm's Law, then, as: the amperes equal the volts divided by the ohms.

Thus, if the E. M. F. is 110 volts, and the resistance of the wire—the filament of an electric lamp, for instance—is 220 ohms, the current will be ½ ampere (110÷220=.5).

There are two kinds of electrical current—*direct* and *alternating*. Direct current is that in which the electrons always flow in one direction through the wire toward the point of higher positive charge or potential. If we

Continued on page 52

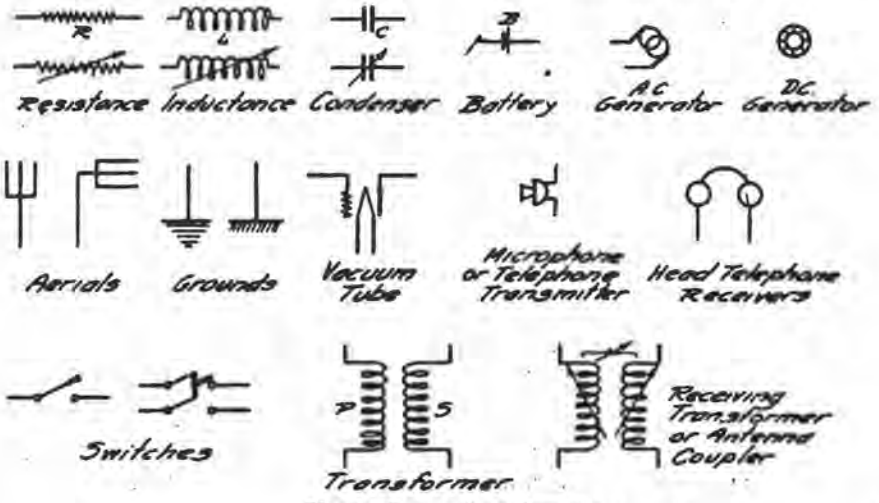



*Fig. 4—Conventional Symbols*

# Armstrong Super-Regenerative Circuit

By B. F. McNamee

MANY experimenters have been busy lately trying out the various forms of the new Armstrong super-regenerative circuit, with varying degrees of success. Most of them have come to the conclusion that it is, to say the least, extremely critical in its adjustments. The writer believes that Fig. 1 shows a particular form of this circuit which has not been given publicity and which is easier to adjust and gives better results than many of the other forms that have been shown. Of course, the underlying principle is the same in this as in the other forms.

Referring to Fig. 1, *A* and *B* are two closely coupled coils of a size suitable for the wavelength to be received. For 360 meters *A* may be a 100 turn honeycomb coil, and *B* 35 or 50 turns. However, small honeycomb coils do not permit a very close coupling and much better results may be obtained by making *B* the rotor and *A* the stator of a variometer. Of course, it is necessary to break the connection between the rotor and the stator before using it for this purpose. *F* and *G* are two extremely small fixed condensers. For each of these condensers the writer used two pieces of annunciator wire, about 4 or 5 inches long, twisted around each other. The insulation on the wires forms the dielectric.

It is reasonable to suppose that a high non-inductive resistance would do in place of condenser *F*, since all that is necessary is to prevent free oscillations in the aerial circuit.

*C* may be a Giblin or honeycomb coil of 600 or 750 turns; *D* is a similar coil of 1250 or 1500 turns, and *E* is a 1000 turn coil. They may be mounted in a triple coil mounting or simply placed one on top of the other with a few folds of paper between them.

The battery *H* consists of half a dozen small flashlight cells, variable in steps of one cell each. The B battery may be as high as 200 volts. The variable tap connected to the phones will usually be found to work best on about half the total B battery—in this case about 100 volts. However, the circuit will function nearly as well with the 86 volt battery usually at hand, with the variable tap at about 43 volts.

The voltages mentioned above have been determined when using two C-301 amplifier tubes (or two UV-201 amplifiers). The proper voltages for any given set-up must be determined by the experimenter himself. While it is not extremely critical, the circuit will not function if the ratio of the voltages applied to the two tubes is very far out. The alternating voltage developed by the second tube is quite high when the circuit is working properly, and consequently more care must be taken with insulation than in ordinary receiving circuits. For example, fixed condenser *J* should be a mica condenser, as paper condensers will usually puncture. The coils *C*, *D* and *E* must also be properly insulated from each other. A convenient way of doing this is to place a sheet of thin bakelite or empire cloth, or even a few sheets of dry paper, between these coils.

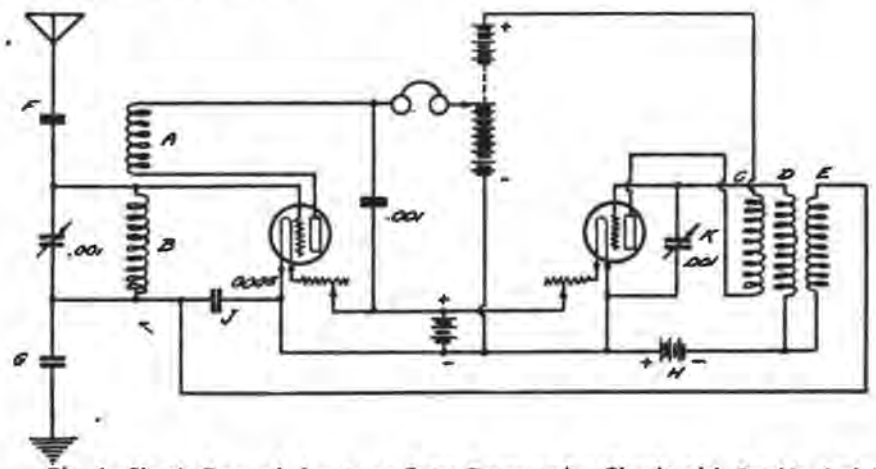


*Fig. 1—Simple Form of Armstrong Super-Regenerative Circuit with Outside Aerial*

To operate this set, turn on the first tube only, and by varying the coupling between coils *A* and *B*, make sure that *A* is connected in the proper direction for regeneration. It is to be noted that when the second tube is not lit, the first tube and its circuit constitute simply a single-tuned, regenerative receiving set, and consequently one should be able to hear signals with this tube alone. Therefore, before lighting the second tube, it must first be determined that this simple receiving set is working properly.

When the second tube is lit and variable condenser *K* is set at full capacity, there should be a very high-pitched note in the phones. In order for this to take place, coil *C* must be connected in the proper direction for the second tube to oscillate. Once this high-pitched note is heard, the tuning condenser should be varied until signals are heard in the phones.

If the B battery on the second tube is too high, the voltage developed in coil *E* will be too great and nothing but the high-pitched note can be heard in the phones. If the B battery on the second tube is too low, the voltage developed in coil *E* will not be sufficient to paralyze the first tube and stop it from oscillating.

It will be noticed when this circuit is functioning properly, that coils *A* and *B* may be much more closely coupled than when they are used with the first tube as a simple regenerative circuit.

The filament rheostats on both tubes will be found to offer further means of controlling the operation of this circuit.

Fig. 2 shows one method of using this circuit with a loop aerial. Only the first part of the circuit is shown,

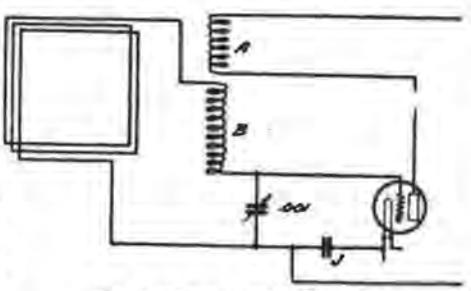


*Fig. 2—Loop Aerial Connection*

the remainder being the same as in Fig. 1. It is important that the loop be small enough so that when connected in series with coil *B* and the variable condenser, the circuit will tune to the desired wavelength.

So many adjustments present themselves in the use of the Armstrong super-regenerative circuit and many of them are so critical that it is not the kind of a circuit one would install with the reception of broadcast music the chief object in view. Rather, this set may be classed as the "experimenters' delight." The results that can be obtained are certainly amazing, especially if little or no aerial is used. Due to the fact that the aerial circuit must not be allowed to freely oscillate, this new Armstrong circuit cannot take advantage of a large aerial.

Using a good aerial, one or two steps of some form of tuned radio frequency

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## BROADCASTING BY "WIRED WIRELESS"

EXPERIMENTERS may be interested in carrying out tests with radio transmission over electric lighting wires and thereby eliminating interference with and from the "air" transmitters. Under the direction of Major-General Squier a series of such tests has been carried on at Washington and Cleveland by R. D. Duncan, Jr., Chief Engineer, U. S. Signal Corps, Research Laboratory, Bureau of Standards. The information herewith is taken from his report as published in the *Electrical World*.

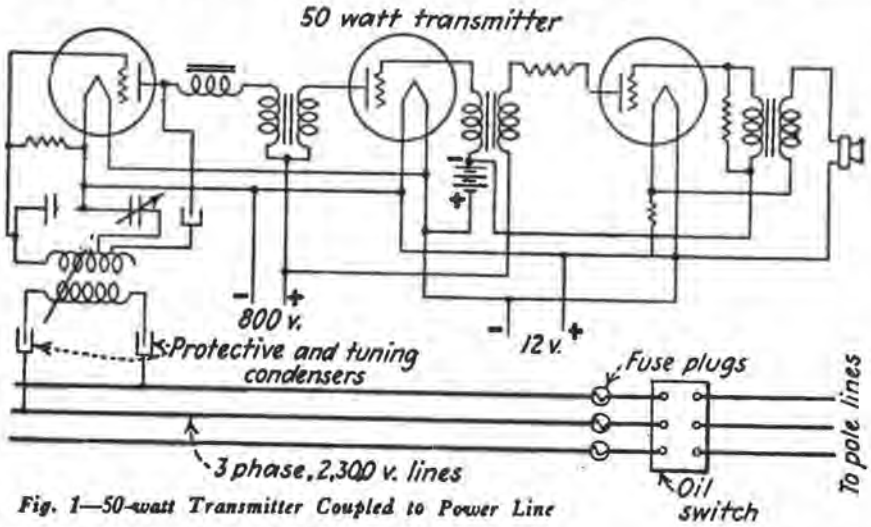



*Fig. 1—50-watt Transmitter Coupled to Power Line*

The transmitter was a 50-watt set with plate modulation and the addition of protective and tuning condenser for coupling to the high voltage power lines as shown in Fig. 1.

The receiving apparatus consisted of a coupled circuit tuner, a vacuum-tube detector and a two-stage audio-frequency amplifier, as shown in Fig. 2. During most of the tests the receiving circuit was purposely maintained in the non-regenerative condition, so that the only amplification obtainable was that due to the amplifier. The receiving set was plugged into the light socket of the 115-volt lines with a blocking condenser. Ground connection was effected in the usual manner.

Five wavelengths—*viz.*, 350, 420, 710, 3800 and 13,000 meters—were tested. Of these the three lower gave neither consistent nor dependable results when received at different points on the lines. Furthermore, on the short wavelengths there was appreciable radiation from the lines, as was evidenced by the fact that fair radio reception was obtained on an antenna several miles from the transmitter. The latter result is more or less contrary to certain theoretical predictions which have been made relative to radiation from transmission lines at high frequencies. To reduce the radiation effect and also the attenuation or linear dissipation of the useful high-frequency energy, which should decrease with increasing wavelength, the wavelength was increased first to 3800 meters and then to 13,000 meters, of which 3800 meters gave the best results, both as to the quantity of speech received and as to the quality of modulation. Assuming the transmitter conditions to be the same for both wavelengths, this would indicate the existence of an optimum wavelength for the particular distribution system operated on. It points to the possibility of the existence of similar optimum wavelengths for other transmission systems. Time did not permit investigation of the region of wavelengths between 3800 meters and 13,000 meters to settle this point definitely.

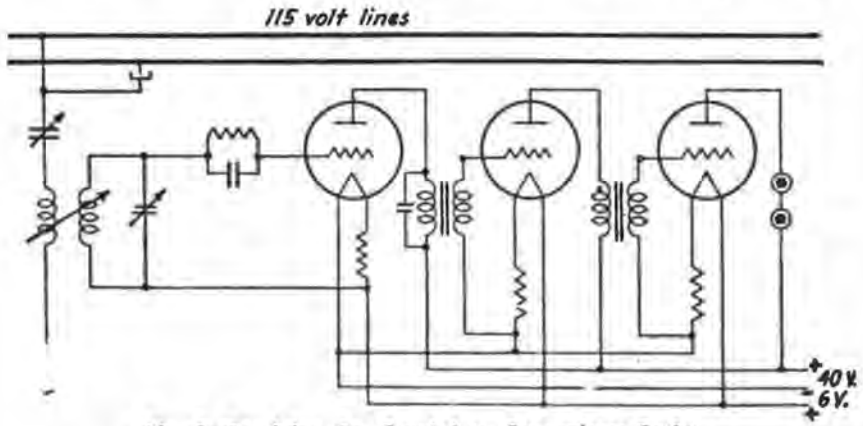



*Fig. 2—Receiving Set Coupled to Convenience Outlet*

Further to investigate the radiation effect, wherever possible, careful comparison was made between reception over the 115-volt lines and on an antenna. On the 3800-meter and 13,000-meter tests and with the same order of magnitude of line current obtained at the shorter wavelengths the very faintest reception was observable on the antenna at certain times only. With the same receiver conditions a good quantity of speech was receivable from the lighting wires. This result was obtained on a number of tests, and it is believed it is perfectly general.

## PIONEER AMATEUR RADIO WORK

*By* HOWARD C. SEEFRED

READERS of RADIO may be interested to learn what was done in long distance amateur work before radio laws were adopted, when amateurs used to use anywhere from one to five kilowatts on a wavelength from 300 to 1000 meters.

Such "old-timers" as Clarence Keller, Dean Farran, Harold McIntosh, Frank Hopkinson, Fritz Faulk and others, who are active in amateur radio of today, will no doubt remember "them was the good ole days, but no more." These fellows live in or near Los Angeles and have been in the radio game for nearly fifteen years, including myself and my brother.

My first experience in long distance amateur reception was made in the fall and winter of 1912, using a pair of 2000 ohm Superior Brandes phones (bought on December 19, 1911, and used up to February 17, 1922, when they were sold), a home-made 1000-meter loose coupler, fixed condenser and galena detector, using an antenna (4 wires) 50 ft. high and 50 ft. long.

During this time I heard SJB (Palo Alto, Calif.), SAZ (San Jose, Calif.), SAG (San Francisco, Calif.), DO (Hollister, Calif.), PH1 (Burlingame, Calif.), PH2 (Santa Cruz, Calif.), and PH3 (Pacific Grove, Calif.). All are from 300 to 350 miles from Los Angeles. Later on I made a quarter kilowatt transformer, using straight gap and helix. I worked NPL (San Diego, Calif., 115 miles), which was my best distance covered. At that time I used KM or CFS for call letters. Some time later I made some improvements by adding a rotary gap and oscillation transformer (helix type). One good night I worked KH (Bakersfield, Calif., 100 miles), the first long distance amateur I worked.

"Ye good ole days, eh, fellows!"

# Radio Frequency Amplification with Standard Regenerative Sets

By Donald K. Lippincott

THE following hook-ups were developed owing to a conviction that the mere possession of a standard type of regenerative receiver does not necessarily kill the urge to experiment, and that many a man who owns one would add a stage of radio frequency if it could be done without a major surgical operation.

Tuning raises the efficiency of any amplifier of this class to such a marked degree that its use is always advisable, especially on the shorter wavelengths. This has been done in the circuits shown, which use the Aerovox inter-tube coupler. For any other type of coupling device or transformer a modification of the circuits would be necessary.

The easiest type of set to convert to this plan of operation is that using the tuned plate circuit feed-back. Most of the short wave sets come under this head, as do the Kennedy Universal and Intermediate outfits when used on short wave reception. The materials needed for making the addition are: tube-socket, amplifier tube, rheostat, and inter-tube coupler.

Fig. 1 shows the connections. No wires are to be disconnected inside of the set, but the grid condenser must be shorted out, and the amplifier tube substituted for the detector tube, which is now placed in the new socket. The only other change within the set is an additional wire connecting the plate terminal of the tube to the terminal post *P* on the inter-tube coupler. The output binding posts are shorted, and from one of them a lead is carried to the post on the coupler *B*. From *G* the wire is taken which connects to the grid of the detector tube. The phones (or the primary of the audio-frequency transformer where used), connect to the variable B battery and to the plate of the detector tube.

Tuning is carried out as usual, but will be found to be very sharp, especially on distant signals. The diagram shows a single circuit set, but this is only for the sake of simplicity. In the case of a loose coupled oufit the procedure is exactly the same. The tuning of coursé is still sharper in this case. Whether this is an advantage or not depends on the taste of the operator, as well as his skill.

With tickler regeneration the change is not quite as simple. Fig. 2 shows the hook-up. The tickler connection is shifted to the plate of the second tube, and the lead from terminal *P* of the coupler substituted for it. A variometer is connected to terminals *B* and *P*.

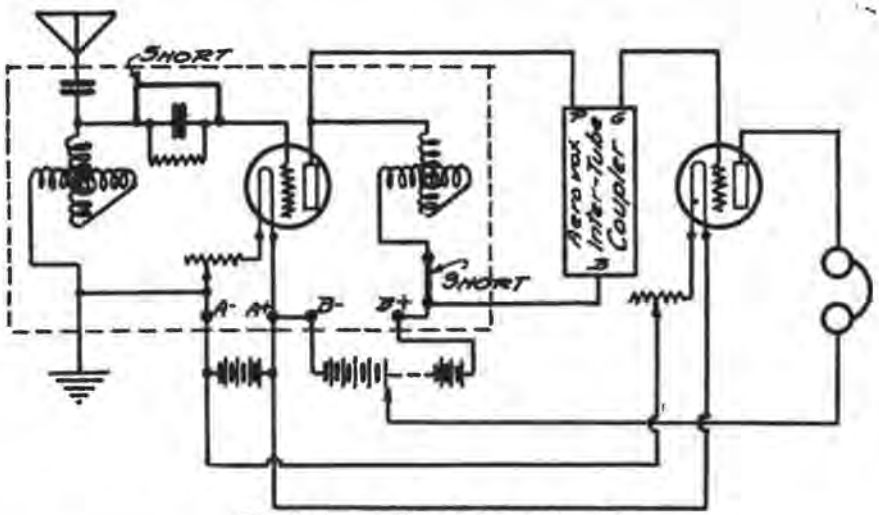



*Fig. 1—Conversion of Single Circuit Set*

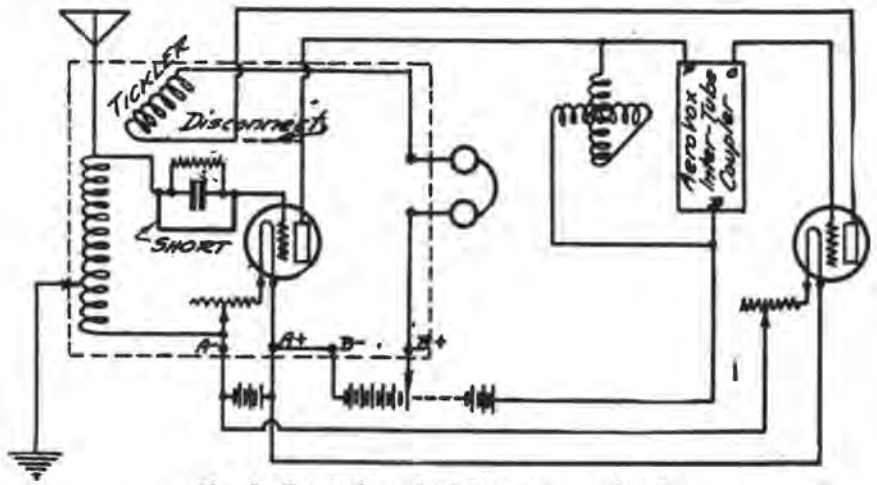



*Fig. 2—Conversion of Tickler Regenerative Set*

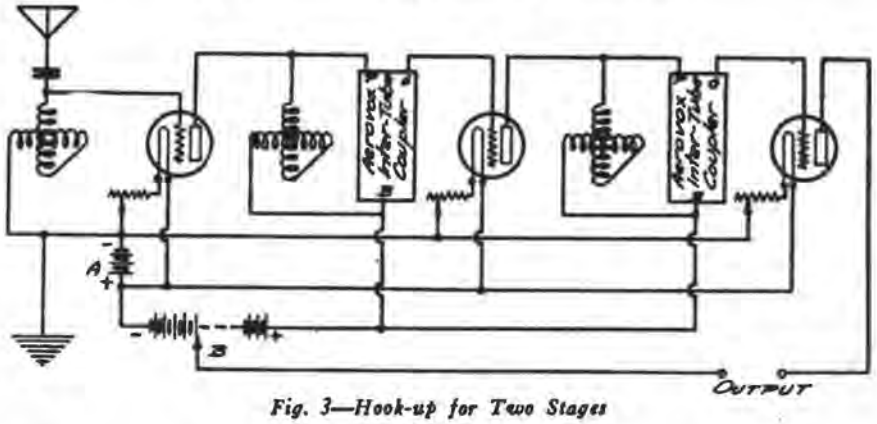



*Fig. 3—Hook-up for Two Stages*

The grid condenser is shorted out as before. This gives a hook-up which is identical with the previous one except for the addition of the tickler coil.

Since the current in the plate circuit of the second tube is 180 degrees out of phase with that of the first the tickler is now reversed. It is used in this manner, but with a coupling approaching zero, to prevent oscillation of the first tube, which may therefore be used at such filament current and plate voltage as give maximum amplification, and still allow the variometer to be sharply tuned. This is not only the condition for maximum feed-back from this

source, but also for maximum output from the second tube. With the tickler direct, the set becomes capable of a highly complicated series of howls, as is true of any system of double feedback.

Having mastered one stage of radio frequency, many amateurs yearn to try the effect of two. Fig. 3 gives the hook-up. More stages may be added *ad lib.*, the limit being the ability to tune. Three stages have been used successfully, but the writer feels that it would take a better operator than he to handle four.

In using any of these hook-ups success is dependent on careful construction. Reckless use of soldering paste seems to rank first as a cause of failure, with loose contacts a close second, but careful construction and close tuning will bring results.

# Radio Fire Alarm Test

Demonstration of the possibilities of radio as a public safeguard in time of disaster was a feature of the parade in connection with the Golden Jubilee convention of the International Association of Fire Engineers at San Francisco in September.

A general alarm of fire, under emergency conditions, was sent from a 200-watt radiophone broadcasting station, installed by the Radio Corporation of America at the Civic Auditorium, and the signals were picked up by motor apparatus in transit on the streets. The signals were also picked up by a Kennedy receiver and a Western Electric loud speaker in the convention hall and at the central fire station on a Westinghouse aeriola, Sr.

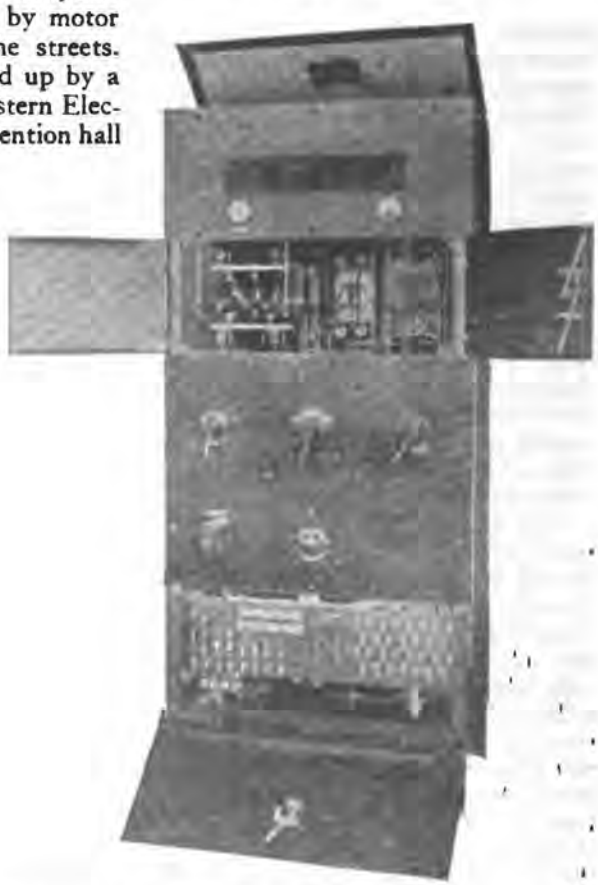
A United States army truck, operated by Sergeant David Reeves of the Air Service Unit, traveled through the streets at high speed. This truck received the fire signals and was controlled and maneuvered for a demonstration of the mobile possibilities of emergency work from the broadcasting station in the Auditorium. Records of two-way work between truck and station were kept at the central fire station.

The demonstration was arranged by Fire Chief Thomas R. Murphy and members of the Pacific Radio Trades Association, with the co-operation of the Radio Corporation of America, the Electric Railway and Manufacturers' Supply Co., the Colin B. Kennedy Co., the United States Army Air Service, Ralph Wiley, chief of the department of electricity, and the National Carbon Co., who supplied batteries.

The purpose of the demonstration was to show visiting fire chiefs to the annual convention the practical application of radio in fire protective work, as already incorporated in the budget plans of several cities for addition to existing equipment.

*Fire Chief Thomas R. Murphy Listening to Signals from Radio Equipped Fire Truck (in upper left-hand corner)*

Photos by T. P. Stroupe, Staff Photographer, S. F. Bulletin, and by U. S. Air Service.



*Radio Corporation 100-watt Radiophone Transmitter Used in Test*

## COMMON RADIO CODE ABBREVIATIONS

| | |
|---|---|
| AHR—Another | HR—Here or hear |
| ABT—About | KW—Know |
| AGN—Again | MNY—Many |
| B4—Before | MK—Make |
| BT—But | MSG—Message |
| B—Be | NW—Now |
| BK—Break | NR—Number |
| CNT—Can't | OTR—Other |
| C—See | R—Are |
| CUM—Come | RCD—Received |
| CUL—See you later | STP—Stop |
| DNT—Don't | TT—That |
| DWN—Down | TMW—Tomorrow |
| DA—Day | TNI—Tonight |
| ES—And | TKS or TNX—Thanks |
| GA—Go ahead | U—You |
| GG—Going | WI—Will |
| GT—Get | WIX—Wireless |
| GM—Good morning | WL—Well |
| GN—Good night | WT—What |
| GB—Good-bye | 73—Regards |
| HW—How | 88—Love and kisses |

## AIR MAIL RADIO SERVICE SAVES MONEY

A report of the communication activities of the Air Mail Radio Service shows that during the first six months of 1922 nearly four million words were handled at a total cost of $35,000, for messages transmitted between Washington, New York and San Francisco. In view of the fact that there are only fifteen stations in the Air Mail Radio Circuit, it is believed that this traffic total is an achievement, as is also the extremely low cost of .009 cents per word, as compared with an estimated cost of .02½ cents per word for commercial telegram service. This gives a saving of over $50,000 for the six months' period.

# Variable Condensers

By D. B. McGown

A CONDENSER is a piece of electrical apparatus so designed that the most important and principal property is its electrical or electrostatic capacity. The device may be constructed to have a fixed capacity, or it may be variable, the actual difference being in the mechanical construction. In general, a condenser consists of two conducting surfaces, usually in the form of parallel plates, carefully insulated from one another, and separated by an insulating medium. The capacity or "size" of the condenser depends on the area of these plates, their separation, and the medium between them. For example, two sheets of copper, or other metal, separated by one millimeter of air will have a certain capacity which we may assume as unity. Now, if this distance is increased to two millimeters the capacity will be equal to half of the first, or one-half unity; if it is decreased to 0.5 millimeter the capacity is two units. If a means is provided for varying this distance at will, say, by means of a screw or lever, a variable condenser is obtained, with limits of capacity from 0.5 to 2.0 units (the edge effect being entirely neglected).

Suppose the same plates are taken and arranged as above, and instead of being left in air, are immersed in oil. Now, in this case, if the distance remains the same, as in the case of unity, we will, however, have a much larger capacity. This is due to the fact that the oil intervening has a much greater inherent dielectric capacity than has the air. Thus, for most oils, the capacity will be from two to four times unity, although no actual change has been made in the mechanical arrangements of the plates. The insulating value of the condenser is also very much greater, as oils, unless damp or impure, have a very much higher insulating strength than air.

Generally speaking, practical variable condensers are made up of inter-leaved plates or sheets of metal of various forms. The commonest type is the familiar semi-circular plate type, where there are a number of carefully spaced semi-circular stationary plates with end bearings supporting an equal or approximately equal number of similar plates, which are mounted on a shaft, the shaft turning in the bearings at the end of the stationary plates. A condenser of this type is shown in Fig. 1. The plates are usually made of aluminum or brass, and are separated by accurately cut spacers or washers. The dielectric used in such condensers is the air between the plates. This is the type condenser used most commonly on radio sets today

*Fig. 1—Variable Condenser*

and it is used chiefly because it is easily constructed, convenient and can be made up to have a large capacity in small bulk.

Various types of rotary variable condensers have been manufactured, but very few differ in any important particulars from the one illustrated. Sometimes very thin sheets of hard rubber are cemented to the plates, which forms the dielectric, as well as the intervening air. Again, as in the Kolster decremeter, the plates are made of peculiar shape (that of a logarithmic spiral), so that the capacity increases in such a way that the circular scale used to indicate degrees will indicate an equal change in wavelength, per degree, over the entire limit of the condenser's capacity. Large condensers of the ordinary type with wide spacing between the plates immersed in oil are used on transmitting sets, such as vacuum tube equipment. A precision condenser (the Seibt) is on the market, which is made up similar to the ordinary type of rotary variable, but which has the rotary and stationary plates milled out of solid aluminum blocks. This enables the spacing to be made very much closer, and, furthermore, permits a condenser of much greater accuracy than the usual type possesses.

A simple condenser may be made up by taking two concentric metal tubes, the smaller of which is, say, 1/16 in. smaller outside than the inside diameter of the larger, and of any convenient length. Ends may be provided for the smaller tube, and a rod mounted inside in such a manner that one tube telescopes inside of the other, and still remains insulated, and if proper leads are taken off they may be connected in the circuit wherever needed.

A number of flat plates may be taken and arranged to slide between an equal number of stationary flat plates, and connections taken off and connected to the circuit wherever needed, and the capacity varied by sliding the plates in and out.

Liquid condensers have been designed, using mercury for one plate, the other being composed of some suitable metal separated by thin celluloid or other material. One type has a single semi-circular plate with thin mica or celluloid overlaid. On the other side of this insulating material is placed a small quantity of mercury and the whole condenser as a unit is revolved. As it is of circular shape the capacity can be varied, depending on the amount it is rotated, and a circuit tuned as required. Another type using mercury forces a cylinder down into a small pot of mercury, which mercury then is raised up in the container and acts as one plate of the condenser, a tinfoil or other metal covering on the outside of the glass containing vessel forming the other plate.

In general, variable condensers should be made up so that their capacity will not change, due to wear or warping of the parts. They should be well insulated, even for receiving, as large losses may occur in them if they leak. They should be made up with sufficient ruggedness and rigidity to withstand considerable handling. If used in receiving circuits they should be shielded, so as to prevent detuning, as a result of the body capacity of the operator.

Variable condensers are little used outside of radio and high frequency circuits. In the first place, they are of very low capacity, very rarely exceeding a capacity of 0.005 mfd. (and very seldom that large), so they are only useful at extremely high frequencies. Furthermore, resonant circuits are little used outside of radio and kindred high frequency circuits. A radio circuit handles extremely little power, even in transmitting, as compared to the thousands of kilowatts handled by the huge power houses and supply lines. A radio circuit can be tuned with a condenser so it will resonated to a given frequency and handle all its power without danger to the condenser, even though it might be a power of several kilowatts, with excellent results in radio, while the same amount of power would practically never be noticed in a power plant. True, some alternating current lines use huge condensers on their circuits to balance up their power factors, but these are so much larger than those used in radio work that there is absolutely no comparison.

One of the chief objects in using a variable condenser is to allow the person using a receiving or transmitting apparatus to tune and adjust with the greatest ease. For example, in tuning the antenna circuit of a receiving set

it is possible to take out a large number of taps and do away with the need of a condenser. The same thing could be done, although less easily, with the secondary circuit. If we take a primary coil and put a condenser in series with the aerial, what is the effect? First, we have reduced the capacity in the aerial circuit, and therefore must "load up" to get to the wave we want, but the greater ease in tuning and the increase in sharpness well makes up for this. Again, take a secondary circuit in a receiving tuner. We may take a 25 turn honeycomb coil and with the condenser we may cover a wavelength range of from about 150 to 400 meters, with a single condenser of .0015 capacity or less. To cover this same range with a multi-point switch would entail countless contacts and then we would not be able to tune sharp enough to be sure of getting in all of the C. W. and phone signals wanted. A variable condenser can be used with great success as a variable "feedback" in an oscillating circuit and most minute adjustments may be made.

For a wavemeter a variable condenser is absolutely necessary. A coil of wire of suitable dimensions with a low reading ammeter in series with a condenser in shunt to the coil will make an ordinary wavemeter. Now, it would be useless to try to change the coil, while in use, but if the capacity and resultant wavelength of the circuit is varied by the use of the wavemeter, accurate results can be had.

The condenser's place may be taken in some cases by a variometer, but generally no other instrument can take its place unless radio changes considerably in future and all stations are put on one or two wavelengths.

## RADIO TANKS PLANNED FOR ARMY AND MARINES

Efforts to produce radio-controlled tanks appear to be the very latest step in Government radio work for the Army and probably for the Marine Corps materiel. Today one out of every ten Army tanks has a radio transmitting and receiving set, enabling this leading or control tank to keep in close touch with headquarters constantly, and communicate by signals with its fellows in battle. Such efficient liaison would be a tremendous step in military science, as the tanks could also serve as message centers for the infantry troops, as well as spot artillery fire, and keep headquarters posted as to the position of the advance lines. Before the year is out, it is believed that all Army tanks will be equipped with radio communicating outfits and that the Marine Corps will also have tanks equipped with radio.

## 9BRE

The radio station of A. Maxwell, located at C-1 Park Apartments, Evanston, Illinois, has as yet made no great DX records, due to an inconvenient location, but since the C. W. set has been in conditions seem to be improving.

The station is located in a corner of the parlor (but that does not make it a parlor radio set). The receiver is the standard regenerator, using one tron tube, baldies, etc. Formerly an amplifier was used, but as it did not make any material difference in the distance covered, it was sold.

The spark set employs a ½ kw. Thor oil immersed condenser, "Super" Benwood gap on a 1750 r. p. m. motor, and a Thor O. T. The transmitter is kept in the "smoke room" behind the boiler. This deadens the sound greatly, but not enough to keep more than ten of the eighteen families from raving. Fortunately our janitor is a "ham," so he keeps all but the most violent in check. As it is, for suffering humanity's sake, no spark transmitting is done after 9:30 p. m. Therefore no spark DX, because it is almost impossible to get out of Chicago before 10 p. m.

The C. W. set employs two 5 watt tubes, using the British aircraft circuit, which meets every expectation. Five hundred volts rectified a. c. supplies the plate current. A separate transformer lights the tubes. Either C. W., chopper, or fone is used. My best distance up to date has been done on fone, when a conversation with 9DHQ (in the next block) was heard in Minneapolis. Since the picture was taken two more meters have been added.

The aerial is a four wire cage, 80 ft. high at the far end and 55 ft. at the near. Seeing as the front yard is a park, it cannot be dug up, so a counterpoise is used, much to the disgust of the non-radio tenants. But as previously stated, THE JANITOR IS A HAM, HI.

## NEW SWEDISH RADIO STATION

The Radio Corporation of America has a contract with the Swedish Government for furnishing apparatus for a high power radio station to handle direct wireless communications between the United States and Sweden. The total cost of the station erected will probably be over $2,000,000. The new station will be near Gothenburgh, which is on the west coast of Sweden. The contract for the installation of two 200 kw. Alexanderson alternator equipments which, when associated with the multiple tuned antenna, will each deliver to the antenna a current of 600 amperes, and is similar to the equipment which is being supplied to Poland by the same company. The receiving equipment will consist of two complete and independent modern sets composed of tuners and the necessary amplifying apparatus and will be used in conjunction with receiving aerials devised for the reduction of static disturbances.


*Station 9BRE*

At the time that the apparatus contract was signed a very important traffic contract was signed which assured the direct communication between Sweden and the United States for a long period of years.

## NEW WORLD RECORD IN RADIO RECEPTION

A record of 55.1 words per minute of perfect copy was made by T. R. McElroy of Boston during the Radio Marathon held at the Pageant of Progress Exposition in Chicago August 6. Mr. McElroy, in another test, copied 58 words per minute with 5 errors.

Radio is like the ouija board in that anybody can work it (see current advertisements) but it works better for some persons than for others, and that's no hallucination, either. When you don't see things at a seance it is because you are not in harmony, but when you don't hear things in radio it is because you are either tuned in or tuned out.

# "The Mystery of VZZ"

By Bernard S. Greensfelder

THE freighter *West Camden* was sailing smoothly through the warm seas of the Pacific a few degrees below the Equator. She was now about three days out from Honolulu bound for Melbourne with $11,500,000 in gold bullion from San Francisco in her hold. The senior radio operator, George Duncan, especially realized his responsibilities because of the valuable cargo.

At nine o'clock in the morning Duncan received the last dot of the noon-time signals from NPL. He adjusted the set to 600 meters to see if he could possibly pick up the NPK weather report on the three-step amplifier he had recently constructed. He patiently listened for a quarter of an hour and then disappointedly raised his hands to remove the phones when a 500 cycle note of an odd, hollow character attracted his attention. It was a spark he had never heard before, therefore he decided to learn the identity of the mysterious station.

Evidently the station was tuning. Suddenly it became very much louder and clearer. Then, in perfect Continental, came "SOS SOS de VZZ VZZ— SS Validas—position 7° 30′ 10″ south lat., 168° 47′ 16″ west long. —forward plates smashed in by derelict pumps working poorly—slowly sinking—may last three hours—comdr—"

*"Then in perfect Continental came 'SOS - SOS de VZZ - VZZ'—"*

Duncan immediately threw the aerial switch to sending position and acknowledged the SOS.

VZZ replied—"only need one ship for aid—can you come?"

By this time the second operator was standing by, ready to assist. He had already summoned the captain.

In a moment the captain entered. Duncan said, "The *Validas,* sixty miles to the north, is sinking. They say they only need us. Shall I reply OK?"

"Are any other ships offering aid?" asked the captain.

"It's queer, but we seem to be the only one who heard him," responded Duncan.

The captain said, "Tell him that we'll be there in three hours, at the most." He then proceeded to the bridge, rang full speed ahead, and changed the course to north.

In the radio room the 5 kw. transmitter flashed the welcome message through the air. A reply came back in a feverish splutter of dots and dashes —"One pump already disabled—crowd on steam—"

Duncan O. K.'d the message and then, after communicating with the captain, stood by for further information. The second operator went to the bridge to help locate the crippled ship.

Fifty miles, forty miles, thirty miles, and yet no sign of a ship. When the expanse of water separating the two ships had been cut down to twenty-five miles a small island appeared to the north. The captain, with a worried look on his face, hurried to the radio room.

"There is an uncharted island, about two miles wide, just where the *Validas* should be," he informed Duncan. "Ask them again for their exact position."

In a minute the message was sent, and VZZ replied, after a moment's hesitation, "Keep on your present course—we're grounded on sand-bar on north side of island." The captain appeared relieved and departed to scan the horizon once more.

A sudden thought came into Duncan's head. He relinquished the apparatus to his assistant and left to find the captain.

"Captain," he said, "do you know anything about this disabled vessel?"

"A little," replied the commander. "She is a 3500-ton freighter on the Honolulu-Australia run. I had imagined that she was out of commission. However, it is our duty to render aid, no matter who the ship is."

"Thank you, sir, that is all I wished to know," said Duncan. He turned and left, but instead of returning to his post, he walked to the rear of the ship to attend to an unfinished job.

THE ship was now within hailing distance of the island, which was seen to be rather heavily wooded; a closer view revealed a number of inlets. Soundings were taken at frequent intervals, and the ship was run at half-speed.

As they were about to round the last promontory on the northwest side of the island a high-powered motorboat came swiftly from one of the inlets and steered directly for the ship. The approach was so rapid that before an alarm could be given the small craft was but a few lengths from the *West Camden.* At that instant a shot rang out, and a projectile from a hidden gun on the island sailed over the bow of the freighter. A second shot followed and the foremast supporting the antenna was severed. Fortunately it fell overboard, nevertheless it carried with it a tangled mass of wire and supports, thereby totally disabling the *West Camden's* radio set.

By this time the crew of the attacked ship was on deck, but the men in the motorboat lost no time. They threw a rope ladder over the side of the ship and were clambering up like lightning. The crew on the *West Camden* tried to resist the attack, but to no avail. They were so surprised that the pirates had little trouble in herding them into the mess-room and locking them up.

Even the officers, whose first thought was of the valuable cargo, realized that resistance would be futile and soon were forced to surrender. The victors immediately took charge of the ship and skilfully maneuvered it into a secluded cove.

There were probably thirty outlaws all told. It could easily be seen that the attack had all been elaborately planned, doubtlessly under the supervision of some master-mind.

After a search had been made of the ship for any remaining members of the *West Camden's* crew, the pirates commenced to haul the treasure on deck.

By nightfall it was ready to be transferred to the shore. Several of the pirates were left on the ship to guard the imprisoned sailors, while the rest departed for the island.

INTO the inky blackness of a tropic night George Duncan raised his head from beneath the canvas covering of a stern lifeboat.

From the stern of the ship he had seen the motorboat come dashing out. In a moment his course of action was decided upon. He had realized in a second the meaning of the unexpected appearance of the launch.

The absence of other responses to the SOS, the unfamiliar spark, the uncharted island! These thoughts flashed through his brain as he leaped into the lifeboat and dived under the cover. There he had escaped detection, and when darkness descended he lowered himself noiselessly to the deck. He grasped a nearby rope and, after fastening it to the railing, slid down the side of the ship into the water. After a few powerful strokes he felt the sand beneath his feet and soon was walking on dry land.

Here and there down the sandy beach small points of light revealed the presence of the pirates who were enjoying a smoke. Duncan warily proceeded to make his way inland. Suddenly a harsh voice exclaimed, "Who's there?"

Duncan's reply was a smashing blow which landed full in the questioner's face, knocking him out. He found the revolver of his victim and also a large flashlight. Guided only by a gleam of light in the interior of the island, he slowly crept along a path he easily found.

Twenty minutes more and Duncan emerged into a cleared space. The moon had now risen and by its light he discerned a well-lighted shack. The sound of the muffled exhaust of a gasoline engine issued from it. To the right of the shack a square frame some sixty feet high rose into space. Approaching it, Duncan noted that it was the support for a number of wires. Then the truth dawned upon him. A directional transmitting loop! Small wonder the signals had so suddenly increased in strength! Small wonder that no other ships had heard the SOS from "VZZ"!

Suddenly a rising, droning purr brought Duncan to a realization of his precarious situation. Stealthily he crept to the door of the shack. He removed his shoes. As he did so, the operator inside commenced to send. From the hiss of the quenched gap Duncan read "SOS SOS de VZZ VZZ——" Duncan opened the door, crept up behind the operator, and without giving him time to even turn around, knocked him unconscious with the butt end of his revolver.

Duncan surveyed the room. In front of him was a standard 15 kw. transmitter panel. A separate semi-enclosed motor-generator was humming away to Duncan's right. He could hear the gasoline engine puffing in the next room. To the left was a two step amplifier on a large table. Secured to the table was a detail map of the South Seas, and projecting through it was a steel rod with a heavy knob and pointer secured to its upper end. The rod pierced the map at the exact location of the uncharted island. The senior operator of KIIK grasped the situation at once, and seating himself at the table he moved the knob until the pointer was in line with Pearl Harbor, T. H. The large transmitter loop outside, he discovered, was electrically geared to the rod and moved in unison with it. Duncan listened in for a moment and heard NPM sign off. He took hold of the key and sent, in a steady hand, "NPM NPM de KIIK KIIK—SOS SOS de KIIK."

NPM checked.

Then—"NPM de KIIK—ss *West Camden* captured and looted by radio pirates—send help quick to uncharted island 7° 10′ 30″ S. lat.—168° 47′ 15″ W. long.—sig—Duncan, op of KIIK—operating outlaw station." NPM came back, "QRX O M." Two minutes later NPM sent "OK—sending revenue cutter from nearby port—will arrive in six hours——"

Just then a sharp report was heard and a bullet from a .44 lodged itself in Duncan's right arm. He knew that it would be useless to resist the desperadoes; a monkey-wrench was lying nearby on the table, so he picked it up and hurled it into the whirring motor-generator. A crash, then the sound of torn and bent metal marked the end of the means of transmission.

The first shot had come through one of the windows of the shanty. The pirates, thinking that they had wounded Duncan more seriously than they had, immediately ran around to the door. Duncan was waiting for them, but he had to shoot with his left hand, and his aim was poor. One of his assailants fired point-blank at him and he fell, shot in the ribs. He saw the bandits standing over him and then he drifted into unconsciousness.

The pirates had no doubts as to the nature of the message Duncan had just sent. They did not know, however, how soon the rescuers would arrive. No time was lost in assembling the band and preparing the launch for immediate service. They had no time to unload the heavy sealed chests of gold from the captured ship. In not more than half an hour the imprisoned crew of the *West Camden* heard the staccato explosions of the departing craft.

EARLY the next morning the cutter arrived. The half-starved sailors on the *West Camden* were released from their confines. Duncan had been missed from the first and a search for him was quickly started. He was found in the shack, nearly dead from the loss of blood. They carefully removed him to the ship and upon reaching Melbourne he was taken ashore and in time fully recovered from his wounds.

Later he was magnificently rewarded for his quick-witted deed of heroism that saved millions and blocked any further attempts by these modern buccaneers.

*Radio Fan (Father of Twins): How This Set Does Howl!*

# Construction and Operation of a Tube Detector

AN electron tube detector, which may be substituted for the crystal detector in the complete tuning and detecting unit shown in April, 1922, RADIO, is described in a recent circular from the U. S. Bureau of Standards. The details of making single circuit and two-circuit tuners may also be found in Circulars 120 and 121, which may be obtained from the Superintendent of Documents at Washington, D. C., for five cents each. Its cost complete with the necessary batteries will be between $23 and $37. Additional electron tube amplifiers which will greatly increase

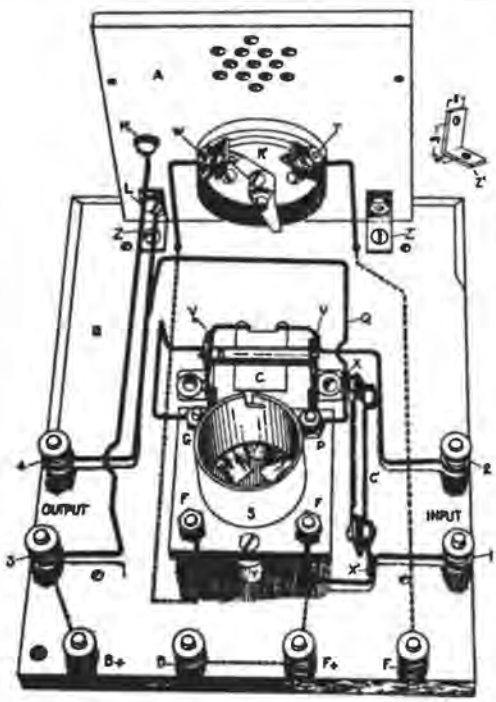



*Fig. 1—Sketch of Detector Unit*

the sensitivity and hence the receiving radius of the receiving set, will not require additional storage batteries. This will make the added cost of the amplifiers small. This publication describes simple apparatus of satisfactory performance without reference to the possible existence of any patents which might cover parts of the apparatus. Apparatus in general similar to that described can be purchased from responsible manufacturers whose announcements can be found in current radio periodicals.

The unit is composed of a baseboard *B* and an upright panel *A*. On the baseboard *B* is mounted an electron tube *E*, an electron tube socket *S*, a resistor (grid leak) *R*, a grid condenser *C*, a by-pass condenser *C'*, and eight binding posts. On the upright panel *A* is mounted a filament rheostat *R'*, and two telephone receiver binding posts *L* and *M*.

Accessories required are a six-volt battery, used for lighting the filament, often called the "A" battery, having about 60 ampere-hour capacity, a 22½ to 45-volt dry battery ("B" battery), binding posts, stiff copper wire, wood boards for the baseboard and upright panel, and two brass angle braces for supporting the panel. The "A" battery will usually be placed on the floor beneath the table upon which the other parts of the equipment are mounted. Its comparative size is much reduced in the drawing. An insulating material panel may be substituted for the wood if desired. The electron tube detector may also be entirely enclosed in a wood cabinet with a hinged cover, if desired.

BASEBOARD. (*B* Figs. 1 and 3.)—The base *B* is any kind of dry wood about 6¼ in. by 8¼ in. by ¾ in. thick. Eight holes are drilled through the base in which the binding posts are fastened. Spacing of these holes is shown in Fig. 3. By the addition of two more binding posts properly connected, this detector may be used in a "regenerative" circuit when the binding posts are externally connected to a "tickler" coil coupled to the tuner. These binding posts are added to the detector baseboard *B* in line with the "input" binding posts Nos. 1 and 2 (see Fig. 1). They are 7/32 in. from the edge of the baseboard, and the four binding posts are arranged in such a manner that they are equally spaced, 1½ in. between centers. Referring to Fig. 1, the wire which leads from the terminal *P* of the electron tube socket is cut at some convenient place *Q* and the two ends thus formed connected to the extra binding posts. The method followed in making these connections corresponds with the style of wiring used in the complete electron tube detector unit. The connection *X* from one terminal of the condenser *C'*, is also removed and a longer wire connected from this terminal to the other side of the point *Q* where the wire was cut. The base is arranged so that the three remaining sides and a hinged cover may be added without changing the relative positions of the binding posts. Under each of the four corners of the base *B*, rubber or wood feet (risers) are fastened in order that the binding post heads and wiring will be protected on the under side of the base.

UPRIGHT PANEL (*A* Figs. 1 and 4).—The panel *A* is any kind of wood about 4½ in. by 5 in. by ⅜ in. thick. In Fig. 4 a back view of the panel is shown which brings the two holes for the telephone receiver binding posts in the lower left-hand corner. If the panel is viewed from the front these two holes will be at the lower right-hand corner. It seems quite desirable that this board present a good appearance, it being the front panel. Four holes are drilled in the panel *A*, one for the bolt which fastens the panel to the brace (see *L*, Fig. 1), two for the telephone receiver binding posts *L* and *M*, and one for the shaft of the filament rheostat *R'* (see Fig. 1). The exact location of the hole for the rheostat shaft is determined from the rheostat itself. It is drilled so that the rheostat will occupy as low a position as possible, allowing room enough to do the necessary wiring.

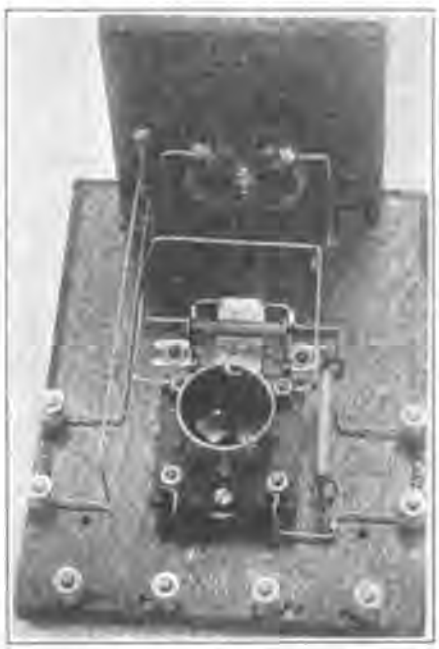


*Fig. 2—View of Completed Unit*

THE ELECTRON TUBE SOCKET *S* is of commercial design. No suggestions are offered as to the particular kind of socket to use. There are many types available and the majority of them will be found satisfactory for this purpose.

GRID LEAK AND GRID CONDENSER.—The grid leak and grid condenser may be purchased together or separately or they may be constructed. If one expects to use a detector type of electron tube (sometimes called "soft" or "gas" tube) it is recommended that these two parts be purchased with the tube, care being taken to select the proper values of resistance and capacity for the grid leak and the grid condenser, as specified by the manufacturer of the tube purchased. The resistance of the grid leak will usually be between 1 and 5 megohms (1,000,000 and 5,000,000 ohms) and the capacity of the grid condenser will be about 0.0003 of a microfarad (300 micromicrofarads). If an amplifier type of electron tube (sometimes called a "hard" tube) is used,

the resistance of the grid leak may generally be anywhere within the resistance limits specified above and the same size of grid condenser used as mentioned above. Experimental grid leaks may be made for such electron tube detectors. This is only suggested for its educational feature. If the two-stage audio-frequency amplifier is used also, it will be quite difficult to make a grid leak that will work satisfactorily. Such an experimental grid leak may be made from a piece of fiber about ⅜ in. wide, 1½ in. long and from 1/32 to ⅛ in. thick. Two ⅛-in. holes are drilled along the center line of the piece, about 1 in. apart. A line is drawn between the two holes, using India or drawing ink. Contact with the ink line may be made by the use of two brass (6/32 or 8/32) machine screws about ½ in. long and each equipped with one nut and two washers. The machine screws are put through the holes in the ends of the fiber strip with

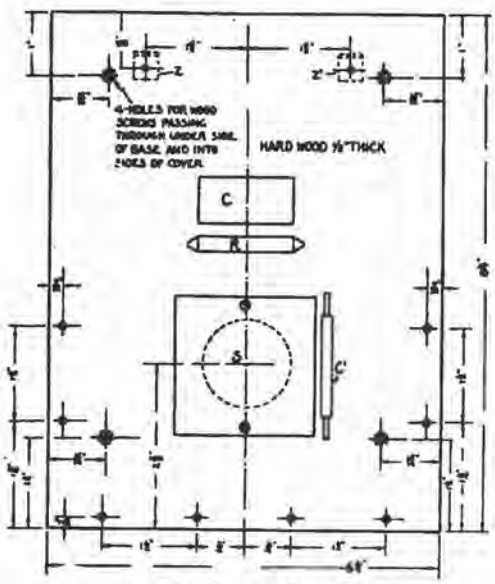



*Fig. 3—Baseboard*

one washer on each side of the fiber strip. A small piece of tin-foil may be rolled up and wound around each machine screw between the fiber and the washer, so that the tin-foil pad will make contact with the ink line. When the nuts are tightened down, the tin-foil pads will flatten out and form a contact between the brass washers and the ends of the ink line. Since the ink line makes a partial electrical conductor of high resistance, the thickness and width of the ink line will determine the resistance of the grid leak to a great extent. The value of resistance may be decreased by inking the line over several times, until the electron tube detector works best. A suitable condenser may be made from tin-foil and paraffined paper after the manner described in Bureau of Standards Letter Circular No. 46, the shape of the condenser being modified to suit the present space requirements, and the total area of each of the tin-foil sheets reduced to six square inches.

BY-PASS CONDENSER *C'* is any small sized fixed condenser having a capacity of from 0.0003 to 0.0015 microfarad (300 to 1500 micromicrofarads) which may be purchased or made according to the description given in Bureau of Standards Letter Circular No. 46. While this condenser is not absolutely necessary, its use is advisable.

THE BINDING POSTS used on the base may be 6/32 or 8/32 brass machine screws each equipped with two nuts and two washers, if regular binding posts are not available. The telephone receiver binding posts *L* and *M* should be of the set-screw type to admit the tips of the telephone receiver cords.

FILAMENT RHEOSTAT *R'*.—The filament rheostat may be constructed, but no details are furnished. If the rheostat is purchased, it is desirable to select one designed for panel mounting as well as one having a neat appearing knob and pointer. The rheostat should have a resistance of about 7 ohms and a current-carrying capacity of about 1½ amperes.

THE ACCESSORY BATTERIES are commercial articles. The purchaser of a storage battery for lighting the filaments should get full instructions from the dealer for testing and re-charging the battery. The dry battery ("B" battery) usually used for the plate circuit cannot be re-charged. The normal life of a battery of reliable manufacture is about six months. Storage batteries for use as "B" batteries are available. Their first cost is greater than that of dry batteries, but they may be re-charged.

## Assembly and Wiring

WOOD FINISH.—It is essential in electron tube sets that the wood be protected from moisture. While the wood base and panel may be treated with paraffin, it was found more satisfactory to first dry the wood and then stain and varnish it, using a good varnish, preferably insulating varnish. Shellac is not recommended. It is rather difficult to give definite suggestions concerning drying and staining of wood. Wood may be put in a warm oven for an hour or so to insure more or less complete drying. A lamp-black or carbon pigment stain is not used ordinarily on such radio parts and it would be well to avoid the use of such. The stain and varnish are thoroughly dried before the apparatus is mounted on the wood baseboard and panel.

BASEBOARD.—The eight brass machine screws or binding posts are put in the holes already drilled in the baseboard. If machine screws were to be used the heads would be put on the under side of the baseboard with a brass washer between the head and the baseboard. A brass washer and two nuts are then fastened to each screw, on the upper side of the baseboard, with the washer next to the baseboard. The tube socket *S*, the grid condenser *C*, the grid leak *R*, and the by-pass condenser *C'*, are next screwed to the baseboard. (Certain types of condensers will be held in position by the wiring only.) The exact location of these parts cannot be stated because the several types of parts commercially available will vary somewhat in dimensions. The tube socket *S* is mounted so that the two terminals marked *G* and *P* (Fig. 1) are nearest the upright panel. Blocks *Y* and *Y'* are put under the socket *S* so that the four terminals of the socket do not touch the wood baseboard. This is done by cutting off two round wood blocks just long enough to raise the socket terminals clear of the base, and mounting them so that the screws

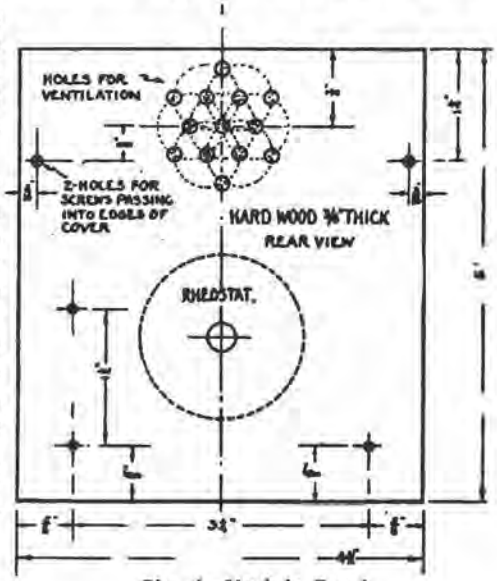



*Fig. 4—Upright Panel*

which hold the socket to the baseboard will pass through holes in the centers of the blocks. After the socket *S*, grid condenser *C*, grid leak *R*, and by-pass condenser *C'* are mounted the parts are wired up.

No. 14 bare tinned copper wire is used in wiring. This makes the connections stiff and self-supporting. This wire is ordinarily furnished in rolls. The wire should be straightened before it is used. It can be straightened by clamping or otherwise fastening one end solidly and pulling on the other end just hard enough to stretch the wire slightly. It is also a good plan in wiring such sets to have all wires run as directly as possible, neatly, and all bends made at right angles. When a wire it attached to a binding post, a loop or eye is formed on the end of the wire and the wire at the eye flattened with a hammer. This gives more contact surface. Special lugs may

also be soldered to the ends of the wire before the connection is made.

A small hole is drilled through the baseboard just back of each of the tube socket terminals marked *F* (see Fig. 1). A short piece of wire is fastened to the right-hand socket terminal marked *F* and is then led through the small hole in the baseboard to the under side of the baseboard. The same wire is led to the binding post $F+$ and fastened between the machine screw head and washer underneath the baseboard. The same wire is further led to the binding post marked $B-$ and fastened between the machine screw head and washer underneath the baseboard. All wires which are run on the under-side of the baseboard are shown by dotted lines.

A short piece of wire is soldered to the wire leading from the right-hand socket terminal marked *F*, just above the baseboard and led to the "input" binding post No. 1, and fastened between the washer and the first nut. This wire is shown as a solid line which means it is on the upper side of the baseboard. The wires do not touch the wood boards except at the terminals and where the wires pass through holes in the baseboard. The wires may be raised more or less to accomplish this. The two terminals of the grid condenser *C* are connected to the two terminals of the grid leak *R*, as shown in Fig. 1. A wire is soldered at *V* and led to the input binding post No. 2.

This wire is kept quite close to the baseboard. Another wire is soldered at *V'* and led to the tube socket terminal marked *G*. The remainder of the wiring is left until the upright panel is assembled and fastened to the baseboard. Notes on soldering are given later.

UPRIGHT PANEL. — The filament rheostat *R'* is mounted on the upright panel *A* so that the two terminals will be in a convenient position for wiring. Two binding posts of set-screw type, *L* and *M*, are inserted in their proper holes, and the upright panel mounted in position by bolting it to the two brass angle pieces *Z* and *Z'*, shown in Figs. 1, 2 and 3. One of the telephone receiver posts *L* serves as a bolt. Two small holes are drilled through the baseboard near the two terminals of the filament rheostat *R'*. A wire is run from the "output" binding post marked 4 (Fig. 1) along the upper side of the baseboard to the back of the telephone receiver binding post marked *L*. A wire is fastened to the tube socket binding post marked *P* and from thence led to the back of the telephone receiver binding post marked *L*, or else soldered to a convenient place on the wire leading from binding post *L*. These wires are shown in Fig. 1. A wire is run from the binding post marked 3 to the back of the telephone receiver binding post marked *M* and also a wire from $B+$ to binding post No. 3, underneath the baseboard. One of the terminals of the by-pass condenser *C'* is connected at the point *X* and the other terminal of the condenser is connected at the point *X'*.

The method of making these connections depends to some extent on the particular type of fixed condenser which is used. If the condenser be provided with flexible leads one of them is soldered at the point *X* and the other is likewise connected at the point *X'*. If the condenser is provided with lugs, connections are made by bending the wires into the proper shape and soldering thereto. A wire is run from the filament rheostat binding post marked *T* through the hole in the baseboard and thence along the under-side of the baseboard to the binding post marked $F-$. This wire is shown in Fig. 1 by a dotted line. Likewise a wire is run from the rheostat binding post *W* underneath the baseboard and up through the left-hand hole in the baseboard at the rear of the electron tube socket *S* and connected to the left-hand binding post marked *F*. This completes the assembling and wiring of the electron tube detector unit.

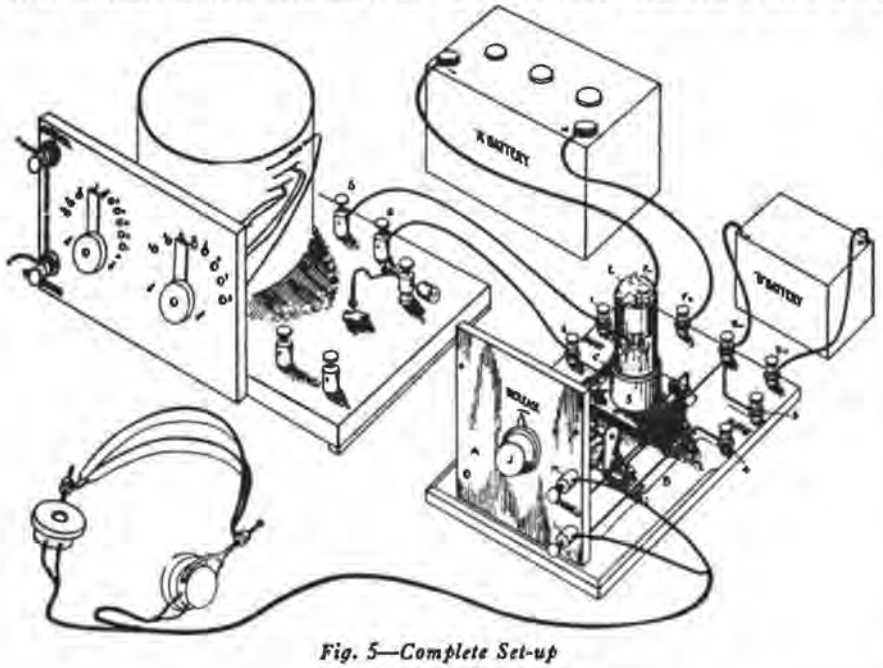



*Fig. 5—Complete Set-up*

### Directions for Operating

CONNECTIONS.—It has already been stated that better results are obtained if the two-circuit tuner described in Bureau of Standards Circular No. 121 is used with the electron tube detector. However, the single-circuit tuner described in Circular No. 120 may be used or the electron tube detector may be connected to any tuner not already supplied with an electron tube detector.

If the single-circuit tuner is used with this electron tube detector the several parts are arranged somewhat as shown in Fig. 5. The single-circuit tuner (shown at extreme left) is fully described in Circular No. 120. The greater portion of the wiring is beneath the baseboard. The wires shown as ---- are those already described in Circular No. 120. The wires shown as .... are the new wires added. Such wiring will not disturb the set for use as a crystal detector receiving set. The second unit to the right is the electron tube detector described in this circular. Accessory parts, such as telephone receivers, "B" battery and "A" storage battery are also shown in Fig. 5. As previously mentioned, the "A" battery is shown here reduced in size, and it is usually placed under the table upon which the rest of the apparatus is mounted.

If the two-circuit tuner is used with this electron tube detector the arrangement of the parts is similar to that shown in Fig. 5, except that the two units consisting of the coupler and the variable condenser with crystal detector replace the single-circuit receiving set shown at the left. Connections between the secondary of the coupler and the terminals of the variable condenser are the same as described in Circular No. 121. Two more binding posts are added at the rear edge of the baseboard supporting the variable condenser and crystal detector (see Fig. 6). The dotted lines clearly indicate the new wiring connections as described for the single-circuit receiving set.

The antenna and ground wires are connected as described in Circular No. 120 and as shown in Fig. 5. Binding post No. 5 is connected to binding post No. 1 and binding post No. 6 is connected to binding post No. 2. The telephone receivers are connected to the binding posts *L* and *M* as shown in Fig. 5. The red (positive,+) wire of the "B" battery is attached to the electron tube detector binding post marked $B+$ and the black (negative,$-$) wire

# Training Broadcast Announcers

WHEN KDKA was first started and popular phonograph records comprised the musical entertainment, the announcers had little difficulty in properly pronouncing the singers' and composers' names. However, it was not long before the Westinghouse company decided to make the greater part of the radio program classical rather than popular, and the difficulties of the announcers really started from this decision.

The first announcers at KDKA were chosen for their voice modulation and the fact that their tones, when heard on the radio receiver, were pleasing and well rounded. The fact that they might not have great success at pronouncing the names of the composers and the additional fact that the French, Italian and German music might be announced in a manner which made it ludicrous, was not taken into account. However, the radio division was not kept in doubt very long as to the manner in which the announcers were fumbling the pronunciation of the foreign names.

For instance, one evening when there was a long list of French names confronting the announcer who boldly called them off one after another in his best Anglo-Saxon intonation and accent, he was interrupted by the strident voice of his manager.

"How do you pronounce 'Berceuse,' by Godard?"

The answer was short and to the point. It sounded something like " 'Berkoos,' by Goddard." The manager's next remarks were lost when they were choked off half-way down his throat, and he promised the announcer that in the morning he would receive some further instruction on pronunciation, adding some extra words that had very little to do with pronunciation.

However, the radio audience had started to object strenuously to the Anglo-Saxon pronunciation of the French and Italian words long before morning. The telephone kept ringing constantly. Many linguists all over the country were anxious to impress the announcers with the fact that their pronunciation was all wrong.

The next afternoon the colleges were heard from. Almost all the colleges in the East sent in protests against the improper pronunciation of these well-known words. The music lovers were even worse. Some of the more temperamental actually shed tears at the manner in which the names of the beloved masters were Anglicized.

So, in the morning, even before the protests began to arrive in great numbers, the announcers went into strict training. They were required to pronounce all the names of the pieces on the program for that evening and rehearse them several times in order to memorize them. This was the beginning of the Westinghouse system of training.

As the program has increased manyfold over the schedules of those early days, the announcers have found it much more difficult to guard against errors creeping into their enunciation. Therefore, before the announcer goes on duty he must rehearse his program in detail before the literary critic of the department of publicity. Every word uttered by the announcer during the entire program is first criticised and corrected, if in error, by the critic. The manner of delivery, the intonation, the pitch of the voice, and all the little details of announcing must first pass the critical ears of the man who sees that no errors are broadcast.

*Rehearsing Program to Literary Critic*

This does not mean that only those announcers whose experience is limited are required to rehearse their programs, but even the ones who have been on duty the longest, almost two years, are required to go through their daily paces just the same. They must have every word correct. If there is the slightest doubt about the pronunciation of a word, it is looked up in the encyclopedia and this authority used. If it is necessary to look up a foreign word whose accent is difficult to the American tongue, one of the linguists employed by the Westinghouse company is also called into consultation.

Even with all this care, an occasional error does crop out in the program, and with an audience of almost a quarter of a million there is bound to be some protests and criticisms. Perhaps the announcer is quite familiar with the proper pronunciation of the word, but a slip of the tongue in an unguarded moment, and he is in for it. Not only his immediate friends in the office in which he works, but also those who know him only remotely, take great delight in phoning him the first opportunity and telling him of his error. Then the returns from outlying districts make mention of it until the announcer feels that everyone in America must know of his error. This outside check, or the criticism of the radio public is the thing which the announcer feels most keenly, even more so than the correction of his manager. He is ever trying his best to improve his diction and to guard against the transmitting of any errors in speech.

So, between his daily training before the literary critic, and the criticism of the radio audience, which is always sincere, the announcer is kept on the *qui vive* to improve himself. It is, therefore, only rarely that a serious mistake is heard in Westinghouse broadcasting, and when this occurs the audience can rest assured that "coals of fire" will be heaped on the offender's head, and that it will have been his first and last offense. Public opinion will see to it that he does not repeat.

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Unable to dispose of a good, but not modern, house in Dallas, Texas, in spite of alluring offers which brought no bidders, an enterprising real estate operator equipped the old mansion with the very latest radio receiving set and so advertised in the leading paper. Replies came immediately and from dozens of offers he was able to dispose of the house with a good profit.

# The Improbability of Radio Power Transmission

By Dr. Charles P. Steinmetz, Chief Consulting Engineer of the General Electric Company

THE successful development of radio communication by telegraph and telephone raises the question of the possibility or impossibility of radio power transmission.

In some respects, radio power transmission exists today, for the message which you receive by radio has been carried by the power of the electromagnetic wave from the sending to the receiving station. However, while the sending station sends out electro-magnetic waves of a power of several kilowatts or even hundreds of kilowatts, this power scatters in all directions, and it may be only a fraction of a milliwatt which we receive, that is, less than a millionth of the power sent out. But this small power is sufficient, when amplified, to give us the message.

The problem of power transmission essentially differs from that of the transmission for communication, that in power transmission most, or at least a large part of the power sent out by the generating station must arrive at the receiving station, to make it economical to transmit the power.

Hence, the problem of radio power transmission is that of directing the radio waves so closely that a large part of their power remains together, so as to be picked up by the receiving station. Much successful work has been done in directing radio waves, and for instance our trans-Atlantic stations send out most of their power eastwards. But still, even as directed, the power scatters over the coasts of Europe from Norway to Spain, so that it is impossible to pick up an appreciable part of it. The limits of impossibility of concentrating a beam of radio waves may be illustrated by comparison with a beam of light. Light is an electromagnetic wave, differing from the radio wave merely by having a wavelength many million times shorter. While usually the light scatters in all directions, like the wireless wave, we can direct it in a concentrated beam by the searchlight. But there is inevitably a scattering of the light in the searchlight beam, and when the beam starts perhaps with a square yard section at the searchlight mirror, at 10 miles distance it has at the very best scattered to a diameter of 2000 ft., and at 100 miles distance the beams cover a section of 16 square miles. If it were a beam of radio power, it would thus require at 100 miles distance a receiving station covering 16 sq. miles—about four miles wide and, what is still more difficult, four miles high, to pick up a large part of the power. The cause of this scattering is twofold. First, the inevitable imperfections of any apparatus. No matter how perfect a reflector, there are slight imperfections, and at 100 miles distance they seriously count. Furthermore, even with an absolutely perfect reflector, the beam of light would stay together only if the light came from a mathematical point. As it must, however, come from a small area, this causes an inevitable scattering, which at best gives an angle of scattering of about two degrees. This is about 100 times as much as would be permissible to economically transmit power a hundred miles by a direct radio beam.

Thus the probability of power transmission by directed radio is very small, except perhaps, in very special cases where the distances are moderate and the efficiency of transmission of secondary importance.

The second possibility of radio power transmission—at least theoretically—is by resonant vibrations or standing waves. Suppose we had a very large sending station sending out electromagnetic waves not of hundreds, but of hundred thousands of millions of kilowatts, and suppose we could find a wavelength where the absorption in the passage of the wave through space is sufficiently small so as to be negligible compared with the amount of power. Assuming first there were no receiving stations. Then the waves issuing from the sending station would circle the globe and return to the sending station, and if the wavelength is adjusted so that the return wave coincides with the outgoing wave, it would return its power, and little power would be required from the sending station to maintain such a system of high power standing waves, only enough to supply the losses—just as little power is required in an electric wire transmission system, to maintain the voltage wave, as long as no current is taken off. Suppose now we erect a second station, tuned for the same wavelength as the sending station. It would resonate with the standing electromagnetic wave issuing from the sending station, thereby stop its passage by absorbing its energy. It would, as we may say, punch a hole in the standing wave sheet coming from the sending station. Power would then flow into this hole; the sending station would begin to send out additional power to maintain the wave sheet, and this power would be received by the receiving station. This would give a real radio power transmission. Any receiving station of suitable design would then be able to pick up power from the universal power supply carried by the standing wave sheet covering the earth. Also several sending stations may send out power. These may either have different wavelengths, then would not interfere, and the receiving station could be tuned to receive power from any of the generating stations. Or — what would be preferable—all the generating stations would be tuned to the same wavelength, that is, the same frequency. Then they would have to be synchronized and operate in synchronism, just as different electric generating stations on the same transmission line are operated in synchronism.

Theoretically, this is an interesting speculation, but whether it could ever become a possibility would depend on the question whether a radio wave of such length could be found as to make the losses of power by absorption, etc., economically permissible, and whether stations for such wavelength and power would be economically feasible. Furthermore, it would have to be an international development. Therefore, even if such radio transmission by a stationary electromagnetic wave sheet were possible, its realization at best is rather distant, so that the present outlook for radio power transmission is very remote. I thought it of interest, however, to bring this before you as an interesting speculation of future possibilities.

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## UNCERTAINTY AS TO BRITISH BROADCASTING PLANS

There is still much uncertainty regarding the conditions under which wireless broadcasting will be carried out in England, according to Electrical Division of the Department of Commerce. Differences have arisen between manufacturers and the Postmaster General, and conferences are now being held, attended by representatives of between 40 and 50 firms, including those which have applied for licenses to broadcast. The vital question is as to the erection of broadcasting stations, one group wishing to have the construction of all of them handled by one organization, and the other, composed of smaller manufacturers, opposing this office, which they characterize as monopolistic. The scheme as outlined calls fo reight stations which are expected to cost approximately £20,000 each. In connection with the cost of the broadcasting program it has been suggested that the Government's "listening in" license fee be increased and that the additional sum thereby obtained be placed in a common fund out of which the program would be provided. At present it is proposed to charge 10/6 ($2.44 at par) for registration of receiving sets.

# Tests with a Portable C. W. Transmitter

By Dr. A. E. Banks

WITH a view to determining the radio possibilities in the mountains inland from San Diego, California, a special portable set was built consisting of a detector and two-step amplifier for receiving, using the CR5 circuit, and a 15-watt C. W. set, incorporated in the unit, using the Heising circuit. While the apparatus when assembled is not as compact as the commercial products, it is very compact, and on test, on a regular antenna, proved as efficient as the ordinary uncrowded C. W. set of the same power. For preliminary tests a special antenna was mounted on the automobile, in this way permitting prospective sites to be felt out tentatively prior to erecting a more efficient antenna.

*Portable Transmitter and Receiver Used in Test*

Laguna Mountain was selected for the first experiment because of its isolation and the practical need of communication. It is in the Cleveland Forest Reserve, rising 6200 feet above sea level. While heavily wooded on one side there is a reasonably large area at the summit fairly clear of timber. This area extends back to what is known as the "rim of the desert," where there is a precipitous drop into the Imperial Valley district, the view from which point forming one of the wonders of Southern California.

The tests were carried out during the week-ends of August 18th, 19th, and August 25th, 26th. During the first tests comparisons were made between the car antenna and a single wire. There was little difference in the efficiency from the receiving standpoint, though from the transmitting the car antenna amounts to little more than a loop, and the addition of a single wire was considered necessary. The body of the car was added as counterpoise in both cases. On the second trip a 2 x 4 was lashed to a pine tree and a two-wire antenna thus elevated 45 ft. at the free end and 15 ft. of 2 x 4 at the lead-in completed the antenna system. During this trip also a four-wire counterpoise spiderweb suspended 5 ft. from the ground was employed. With this, results were better, but it was found that increased efficiency resulted from adding the body of the car as further counterpoise.

During the first tests .5 amp. was the best that could be done on the single wire. During the second tests 1.0+ amp. was put into the antenna with great increase of audibility at the San Diego end. The Forest Ranger, Mr. Edward Miller, very kindly consented to care for the experimental antenna during the absence of the writer, so that further tests may be made with the least possible loss of time in installation. The station site is 61 miles from San Diego.

The receiving characteristics even at this short distance were so remarkably different from those in San Diego as to be almost startling. This has already been noted in a letter by Lee Roy Potter in September RADIO and his remarks coincide with our findings. Owing to heavy static and the presence of electric storms, it was feared that receiving would be next to impossible; at 8:15, however, on the first night the tests were attempted, 5ZA came pounding in louder than we had ever heard him in San Diego and the following stations were copied: 5ZA, 9CJF, 9AMB, 5OL, 9BP, 5QI, 9CJJ, 6ZX, 6APW, 9AJT, 6EPZ, 6AQA, 9ZN, 6RD, 6ARB, 6RU. Unfortunately on both occasions communication was not actually established. Static interference caused us to discontinue on the first Friday without having hooked up with Deputy Radio Inspector D. P. Trim, who was copying us in San Diego. The following night the failure of the storage batteries caused us to discontinue prior to the DX time. This night, however, we copied the following before discontinuing: 9CJF, 9AMB, 9BP, 5QI, 9CJJ, 6ZX, 9ZN, 6BPZ, 6AQA, 6RU, 5OC and others. We got quite a sensation when 9ZM's C. W. was picked up, in spite of heavy static.

The following week most of the time was devoted to the installation of the antenna, and transmission was not attempted until Saturday, though a short test was carried on Friday night. Mr. Trim reported the signals as being received with greatly increased audibility at station 6TW and he endeavored to establish communication. Troubles never come singly and the fusing of a switch point thereby disconnecting the power supply caused us to shut down, this time at the very moment when success was imminent. Owing to darkness and lack of facilities for quick overhauling it was decided to abandon further work until the future.

*Portable Station on Laguna Mountain*

The following additional stations were copied during this trip: 6BQC, 6BPZ, 6ZA, 6ZB, 6TW, 6FT, 6BJY, 6AGR, 6BOE, 7LU, 9CCS, 9CJJ, 9DUG, 5QI. All San Diego stations were copied with greatly decreased audibility. The Los Angeles stations were not nearly so loud as the eastern and more northern ones. 6KA, whose audibility is ordinarily tremendous, was found to

have less audibility than either 5ZA or 7LU, at Laguna.

Peculiarly enough the NPL arc mush was not in evidence though harmonics could be found. All sparks were practically inaudible.

Reception during the whole test was really difficult for the reason that thunder storms were in full swing and the resultant crash in the receiver extremely unpleasant.

*Radio KFI*

A few words may be of interest relative to the apparatus. With the assistance of E. P. Merritt, manager of the Radio Department, Southern Electric Company, standard parts were mounted on a bakelite panel and enclosed in a three-ply oak cabinet. A second oak cabinet of the same light material was arranged as a protective housing during transit. The whole installation is rugged and has proven extremely efficient from the mechanical standpoint. As to the electrical efficiency, when tried out on the regular antenna at Station 6ZB using a storage battery and dynamotor, the same as in the field, communication was easily established with Los Angeles and Long Beach, audibility being favorably commented on.

Laguna is isolated, having no direct communication with the outside world except by heliograph, which is uncertain. The Forest Ranger, Mr. Edward Miller, is intensely interested in the experiments and has done everything possible to arrange for our comfort during the week-end trips.

# News of the Broadcasters

## WLW AT CINCINNATI

WLW, the new and powerful radio broadcasting station of the Crosley Manufacturing Company, Cincinnati, Ohio, has been constructed under the supervision of Charles E. Kilgour and Dorman Isreal in the company's new factory.

Four 250 watt radiotron tubes are used, two as oscillators and two as modulators, with the Heising system of modulation used in connection with speech amplifier. This speech amplifier is composed of three Western Electric No. 216A amplifying tubes, arranged with one connected to the microphone circuit, with its output impressed upon the other two, which will be arranged as a push-pull circuit.

Their output is impressed on two 50 watt radiotrons, operated back to back, or as the push-pull system, while the output of the entire amplifier is impressed upon the grids of the modulator tubes. Normal radiation will be nine amperes.

This set also can be operated as a master oscillator-modulating outfit, using one 50 watt tube as a master oscillator, modulated by another 50 watt tube. The high frequency output of this unit will be amplified by one 250 watt tube, and its output, in turn, amplified by three 250 watt radiotrons. Sufficient tests have not yet been made to determine which will be the better method of transmission.

The antenna is 140 ft. long, with an average height of 125 ft. This is composed of twelve wires on 23 ft. spreaders. The four outside wires are doubled and the lead-in is a cage 1 in. in diameter and made up of 768 strands of No. 30 wire. The counterpoise is 60 ft. below the antenna at the lead-in end and 90 ft. at the other end. This contains 15 wires on 34 ft. spreaders, the four outside wires being doubled as in the case of the antenna proper.

The high voltage supply is obtained from a Glow Electric motor-generator composed of two 1000 volt, 1½ kw. generators coupled to a 5 h. p. three phase 220 volt squirrel cage motor. One ¾ kw. exciter is belted to the set and supplies 220 volts for the field excitation.

## RADIO KFI

RADIO KFI, owned and operated by Earle C. Anthony, Inc., of Los Angeles, is equipped with a 100 watt transmitter, consisting of two 50 watt oscillators, two 50 watt modulators, one 50 watt speech amplifier, and one 3 tube input line repeater. The announcing is done from the panel, and phonograph, piano and any other entertainment is all picked up from one microphone located in center of broadcasting station.

A ½ kw. 1000 volt motor-generator set is used to supply plate voltage. Filaments are lit off storage batteries with mercury arc charging unit for charging the batteries.

The room is draped with heavy velour on walls and a canopy over the ceiling in addition makes the room practically sound proof and free from echo.

Antenna current, no modulation, is 4 amperes. Modulation on voice and music and tone test runs between ¼ and 1 ampere increase in the antenna circuit. A tuned counterpoise and ground system is used.

The antenna consists of two 65 ft. steel masts located on top of the Packard building, which is four stories, approximately 100 ft. high, with six wires, No. 7-18 phosphor bronze antenna wire, separated 3 ft. apart, 100 ft. long; T type antenna. The counterpoise is located directly under the main transmitting antenna, approximately 100 ft. long.

Special filters, reactors and inductances were designed and made specially for this installation under the direction of A. MacDonald, operator. It has an approximate daylight range of 300 to 500 miles and on the 510 meter wavelength from 7 to 9 p. m. it has been heard over distances of 1500 miles.

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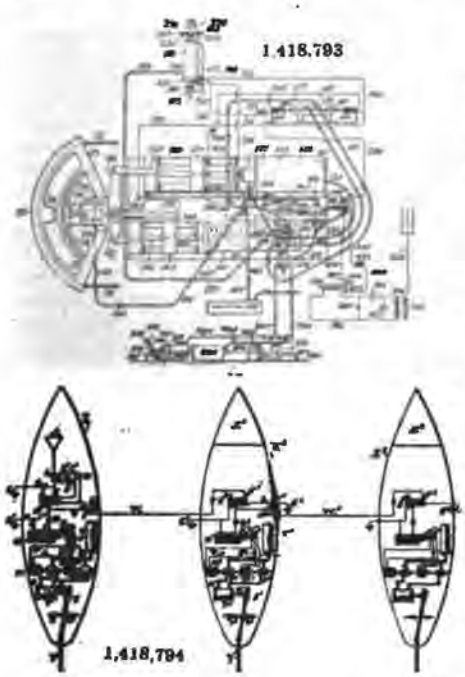
Wiley Winsor, physical director of the Y. M. C. A. at San Francisco, is broadcasting setting-up exercises at 10 a. m. Monday, Wednesday and Friday from KSL, The Emporium broadcasting station. This has been arranged for by Major A. H. Hutchinson of the Junior Signal Corps.

*Studio and 150-watt Transmitter Operated by E. J. Martineau for Hale Bros., San Francisco. KPO*


**Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.**

**John H. Hammond, Jr., Pat. No. 1,418,793; June 6, 1922. System of teledynamic control for dirigible bodies.**

A radio receiving circuit 505, 506 is arranged to energize solenoid 500 upon receipt of radio impulses. This in turn causes actuation of solenoid 490 which moves a piston valve in cylinder 471, so that the main control valve 425 may be rotated. Corresponding to various positions of this valve, the steering wheel 70 may be affected to cause the vessel to move to the right or left. The arrangement is such that a gyroscope normally prevents deviation by the aid of mechanism 181, to the shaft 175 of which the gyroscope may be connected. The control valve 425, however, may cause the control to pass temporarily to the distant operator. By prolonging the radiant impulse, fluid may also be admitted to pipe 451 which causes actuation of the piston in cylinder 330. This may be utilized for such purposes as varying the throttle opening of the engine or for controlling a searchlight, or both.




**John H. Hammond, Jr., Pat. No. 1,418,794; June 6, 1922. System of teledynamic control.**

A plurality of bodies to be steered, such as X, $X^1$ and $X^2$ are connected to each other by variable conductors W, $W^1$, which are reeled on spring drums H to permit variations in length of the conductors. The main vessel X is equipped with a receiving system A, L, C, E, so that relay F may be operated when radiations are received. This relay actuates rudder Y and also causes simultaneous actuation of relays $F^1$ and $F^2$ on the auxiliary vessels $X^1$ and $X^2$. These latter relays in turn cause the corresponding rudders to be actuated.

## SIGNIFICANT RADIO DEVELOPMENTS FROM THE PATENT OFFICE VIEWPOINT

*By* S. R. WINTERS

When any art or science has progressed with such surprising swiftness as is true of radio-telephony and radio-telegraphy within recent months, it is not an unseemly procedure to lift the curtain and bare to the spotlight the personalities whose respective contributions have made remarkable achievements possible. The United States Patent Office is the logical source to consult when an appraisement of "Who's Who" in the significant developments of wireless communication is being made.

The files of voluminous letters of patent (approximately two thousand having been granted since Guglielmo Marconi first transmitted a commercial wireless message) of Uncle Sam's inventive-appraising bureau yield the protective papers whose discoveries have proven epochal in hastening the realization of radio-communication. The writer is indebted to Dr. Wm. A. Kinnan, First Assistant Patent Commissioner, for his generous co-operation in supplying data as to the notable steps.

Five names are inseparably identified with radio-communication: Guglielmo Marconi, J. A. Fleming, Lee De Forest, Edwin H. Armstrong and Edwin H. Colpitts. Their respective contributions, in agreement with the order of their names just cited, were: The application of the first complete radio-telegraph set in the transmission of a message by electromagnetic waves; the vacuum-valve detector for receiving wireless communications; the audion tube or bulb for the reception of radio messages; the regenerative feed-back circuit for the audion receiver; and the audion oscillator for generating modulated high-frequency waves.

Of historical interest and in respect to the claims of friends of the inventor, reference should be made to a patent granted Mahlon Loomis, a dentist of Washington, D. C., which bears the title "Improvement in Telegraphy." The date of its issuance was July 30, 1872—a half-century ago—or 25 years before Guglielmo Marconi accomplished his feat of the transmission of a communication in the absence of wires. Undoubtedly this was the earliest patent granted by the Patent Office regarding radio-communication. From the viewpoint of Uncle Sam's appraiser of inventions, however, the Loomis discovery was lacking in the essential particular of a means of generating high-frequency electromagnetic waves. Radio-signaling, obviously, involves the use of some system of generating the Hertzian waves, and for this reason writers of textbooks and radio engineers are prone to discount the invention as disclosed in the Loomis patent, No. 129,971. His priority in the direction of radio-communication, however, merits consideration.

Among the earliest of experiments with electromagnetic waves, without having established their identity, were conducted in England in 1879, when a Professor Hughes employed a kind of generator of sparks, the device taking the form of a trembler bell. By the use of a telephone receiver and a coil of wire acting as an antenna, he was enabled to produce sounds while pacing to and fro in front of his home. The ridicule of his friends who were invited to observe the experiments, served to put a damper on his activities. He was signaling by electromagnetic waves, but the disconcerting comments of his neighbors stifled his discovery a-borning. Professor Joseph Henry of Princeton University, in 1842, indicated that the discharge of a Leyden jar was, under certain conditions, capable of oscillating—that is, the current proceeded first one way and then the other over the circuit connecting the inner and outer coatings of the jar. Sir William Thompson, afterwards Lord Kelvin, in 1853, demonstrated mathematically the soundness of this theory. The oscillations of the current from the Leyden jar bear similarity to those employed to produce electromagnetic waves used in radio-telegraphy and -telephony. James Clerk-Maxwell, professor of physics at Edinburgh University, in 1865, was responsible for the expressed conclusion that electric oscillations in a circuit produce electric waves in the surrounding space which travel with the velocity of light.

It was, however, in 1888, that the notable scientific stroke of Professor Heinrich Hertz of Karlsruhe was accomplished, namely, establishment of proof of the existence of these waves. Hence the use of the term "Hertzian waves," which is synonymous with the designation "electromagnetic waves." He produced, detected and measured them. Likewise, he indicated that they were polarized and could, not unlike waves of light, be reflected and bent. The instrument employed has been since identified as the "Hertz oscillator." Structurally, it consisted of two flat metallic plates, 16 in. square, each connected to a rod approximately 1 ft. in length and terminating in a small knob. These rods were buttressed end to end with the knobs adjacent and ¼ in. apart. They were connected in a circuit with the secondary winding of an induction coil, thus making it necessary for the current to span this space between the knobs in order to complete the circuit. Within the primary of the coil was placed a make and break unit. Once the primary circuit was broken, these plates became charged and then they discharged back and forth across the gap between the knobs and produced sparks. Each of the latter dispatched a train of electromagnetic waves. The detection of the presence of these elusive particles was made possible by use of a so-called "resonator." This device consisted of a metallic wire bent into form of a hoop, 14 in. in diameter, with its ends divorced by a slight gap. The precise dimensions of this hoop-like apparatus, so that it would be in "tune" with the oscillator, was determined by prearranged tests. By installing a piece of sheet zinc, 6 ft. wide and 12 ft. high as a reflector and causing the waves striking the latter to be forced back toward the os-

*Continued on page 40*

## LETTERS TO THE EDITOR

### Antenna Height

Sir:—This communication is regarding the article by Dr. Banks about the height of antenna.

First, as regards his practical instances Dr. Banks assumes that the same set uses the antennæ listed in his table. Might not these results be due to the fact that in the city the height of an antenna is limited, due to limited space for guying, but also that in a city a large amount of money is available to the amateur for apparatus, and due to the greater efficiency of his apparatus he reaches out in spite of, rather than because of, the low antenna? Even in the table given, the higher antennæ have the greater ranges listed.

Dr. Banks states that "the current squared multiplied by the resistance of our antenna will then indicate the watts we are radiating."

This means that the *power output* is equal to the current squared times the resistance for *D. C.* In alternating current this statement is not exact, the error increasing with the frequency. This also does not include the capacity of the antenna. If the capacity is high enough the antenna may be charged within its capacity and discharge through the antenna inductance on the reverse oscillation, the energy radiated depending only on the radiation resistance which is low in a low and small antenna.

In this formula "radiation resistance" should be substituted for "resistance." The radiation resistance, according to *QST* in "Letters to the Editor," cannot be computed, but it may be supposed that the radiation resistance increases as the radiation surface with a certain increase for effective height increase, and an inverse increase as the wavelength. The problem resolves itself as to whether or not the radiation resistance varies faster with the increase in height than does the square of the current decrease. If some engineer with the "dope" will enlighten us on that point, our problem is solved. The following is from an article in the August *QST* by Mr. A. M. Young, who has certainly had a considerable amount of experience:

"The most important thing about the antenna is to have the center of capacity as high as possible. * * * I have tried many times lowering or raising the antenna * * * with the result that, although the antenna current is often lowered by raising the antenna, my signals were reported much more QSA when it was at the greatest height."

When 8XV was testing for the trans-Atlantics he installed a receiver four miles away and put in a galvonometer in place of the phones for audibility meter. By raising his transmitter antenna 22 ft. his radiation dropped from 22 amps. to 15.2 amps., but the galvonometer reading increased from 51 to 72 divisions, showing what some additional height can do. (*QST* March No. 14.)

If you average the heights of the antennæ used by the successful trans-Atlantic stations you will find as follows: C. W. stations, 70 ft.; spark, 77 ft. These averages were pulled down by two stations with heights under 30 ft.

The whole trouble seems to lie in the fact that not enough accurate information is available. Won't some amateur with a lot of money hook a 50-watt tube onto a 50-ft. eight-wire cage and try every five feet from 20 to 120 ft. of height, using cage lead-in and counterpoise 10 ft. above ground, and prepare graphs showing variations of total resistance, fundamental wavelength, current (T. C.), and audibility measured by galvanometer in receiver one mile away? Then we could get some dope to go by and could settle the question once and for all. We can't tell anything by individual station performance because of the varying powers, locations, and efficiencies of various sets.

Yours truly,

A READER.

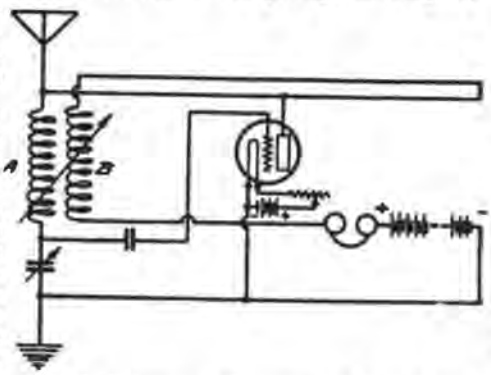
Claremont, Calif.

### The Gibbons Receiver

Sir: Here is just a little hint that some amateurs like to know about. It is about an article in the August RADIO, on page 22, by D. P. Gibbons. Before I tell of this hint of mine, I will say that the set he describes is some peach. It is all that he says it is—and more.

By my own experience, and that of others, I find that a Pen Brand grid condenser is best, because this set is hard on them. When trouble comes, it can most always be traced to the grid condenser.

Now, if you already have one of these wonders you know how well it works, and probably are willing to make it work better. Try this: Get a 400 turn coil and put it in as shown below. Couple it at about 20 degrees, then go to work as usual. This coil greatly improves the clearness of music and at the same time amplifies. If it does not amplify the local stations, don't worry, because it doesn't. In getting Los Angeles,




though, it increases the strength a very great deal.

This coil also helps in tuning the set, and greatly reduced interference.

For the benefit of those who may not have seen Mr. Gibbons' article, the following instruments are required:

1 70 turn honeycomb coil—*A*.
1 400 turn coil—*B*.
1 grid condenser.
1 .001 mfd. variable condenser.
1 rheostat (plain).
1 18 volt B battery.
1 6 volt A battery.
1 socket.
1 soft tube.

And, of course, aerial, ground and phones.

It is very important to connect coil *B* just where it is shown and *not* between the plate and aerial. This decreases the wavelength of the set a very little bit.

I will be glad to hear from other experimenters on this line. Yours truly,

GILBERT EARLE.

149 Parkside Drive, Berkeley, Calif.

### Effect of Mountains on Radio

Sir:—I saw Mr. Potter's letter in RADIO for September and thought it might interest him as well as others to learn just what effect the mountains seem to have on reception in Reno.

This city is almost completely surrounded by mountains—the highest range being on the west. Broadcasting stations in San Francisco and vicinity have always been difficult to pick up here. Aside from a few instances, the Rockridge (KZY) and Presidio (AGI) stations have never been heard here satisfactorily, although they have been heard with great clarity many miles east of here. Amateur spark and C. W. stations in the same vicinity with these broadcasting stations are very little affected by the intervening mountain range, although they seem to be more subject to fading than stations located in other directions. At the same time there are other broadcasting stations west of Reno which push through in spite of the mountains, using less power than the previously mentioned stations. The best of these is the Kennedy station at Los Altos (KLP). So it seems, on second consideration, that there must be some cause other than the mountains to produce this peculiar condition. A strong argument in favor of this is the fact that the reception from coast stations directly west is very noticeably better in Carson City than here, and Carson City is so close to the range on the west as to be in what is popularly believed to be the radio "dead zone."

Broadcasting stations as far south as San Diego, north to Portland, and east to Denver are received with great distinctness and very little fading. On one occasion last winter a broadcasting station in Winnipeg, Canada, was heard here with plenty of "punch," although the feat has never been duplicated.

All considered, it apparently still remains to be proven that it is the mountains and not the atmospheric conditions that so noticeably affects radio transmission and reception.

Very truly yours,

B. W. CASSELBERRY.

620 Plumas St.,
Reno, Nev.

## NEW LIST OF RADIO STATIONS OF THE U. S.

Copies of the new list of Commercial and Government Radio Stations of the United States, edition June 30, 1922, will be ready for distribution about the 15th of October and may be procured from the Superintendent of Documents, Government Printing Office, Washington D. C., at 15 cents per copy. The new list of Amateur Radio Stations of the United States will be ready for distribution about the same time or a few weeks later. The price of this publication is 15 cents per copy. A list of the broadcasting stations in operation on June 30 last will be included in the first-named publication. The list of experimental stations, technical and training school stations, and special amateur stations (special land stations) will be in both publications.

## NEWS OF THE OPERATORS

6FZ has moved from 2436 Dwight Way, Berkeley, to 1463 76th Avenue, Oakland.

KDN, operated by Leo J. Meyberg in connection with the *San Francisco Bulletin* at the Fairmont Hotel, announces that jazz music has been entirely eliminated from its programs.

Midwest Radio Company of Cincinnati, Ohio, announces that their Mirage radio frequency broadcast receiver is now ready. This instrument was designed to meet the demand for a moderately priced long distance vacuum tube receiving outfit with the added feature of a radio frequency amplifier which makes for sharp tuning and the elimination of static to a large degree. Under average conditions stations up to 300 miles may be heard and much longer distances under favorable conditions.

A. H. Grebe & Co., Inc., have established a western branch at 451 East Third Street, Los Angeles, Calif., for the distribution of products throughout the territory west of the Rocky Mountains. Factory shipments arrive weekly by boat, via the Panama Canal, and will be distributed from this point to the dealers.

# Queries & Replies on C.W. practice by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

**What are the correct physical and electrical values of the Western Electric amplifying transformers mentioned in the article on page 17 of July RADIO?**

2CNB, New York.

As these transformers you mention are an integral part of the Western Electric 7-A amplifier, and are not sold separately for amateur use, no information as to their characteristics has been issued by the manufacturer up to the present time.

**Please show where to add a potentiometer to the radio set shown on page 24 of March RADIO. Also indicate where to place a second stage of amplification.** F. W. U., Trenton, N. J.

This information is shown in Fig. 1.

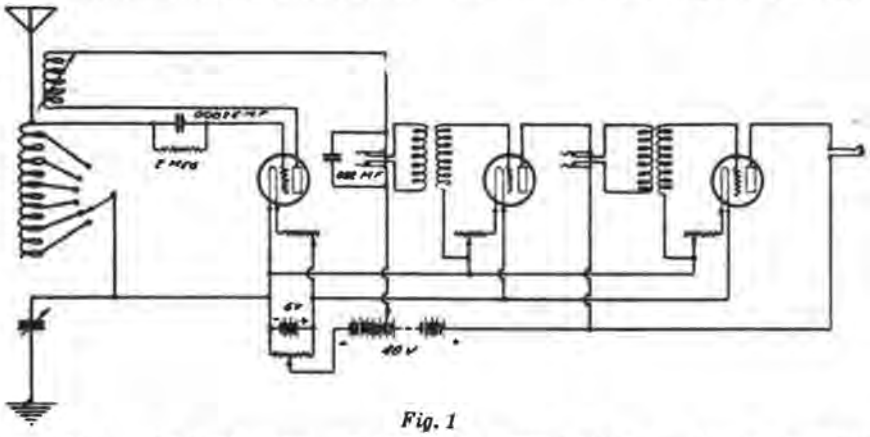


*Fig. 1*

**Is capacitive feedback more efficient than tickler feedback for C. W. reception? What are the advantages of audio frequency amplification using choke coils instead of transformers? What circuit does Mr. Dow, 6ZAC, use for reception?**

B. B. S., Brooklyn, N. Y.

Tickler feedback is the most universally used, although both have their good points. Audio frequency amplification with choke coils usually gives a better frequency characteristic than with transformers. Mr. Dow uses a regenerative receiver with the Armstrong tickler feedback and two stages of audio frequency amplification.

**Which C. W. transmitter should give the best results (a) one using two 5-watt tubes on pre-rectified (using Kenotrons) A. C., or (b) one using two 5-watt tubes in a self-rectifying circuit similar to that used by C. J. Dow's transmitter?**

A. E. W., Watsonville, Cal.

The latter type is the least expensive and unless you wish to experiment with telephony, the latter is the easiest to operate.

**Please publish the formula for computing the wavelength of aerials.**

R. I. N., St. Paul, Minn.

There are no simple formulas that do not involve considerable mathematics. Suggest that you obtain a copy of Bureau of Standards circular No. 74 from the Government Printing Office, Washington, D. C. wherein you will find considerable information on the subject.

**Given size of wire, diameter of tube, capacity of condenser to be shunted around the finished coil, please indicate a simple formula for determining the number of turns on the coil for various wavelengths.**

C. H. C., Pasadena, Cal.

See answer to previous question. The space devoted to this column is insufficient to explain formulae.

**What would be the natural wavelength of an antenna 65 ft. high, 60 ft. long, of six wires? What would the size of the counterpoise be for this antenna? What would be the resistance of the antenna with or without counterpoise?**

L. M. N., Los Angeles, Cal.

Approximately 150 meters. A counterpoise of twelve wires, six or eight feet above the ground, directly under the antenna, and of the same length, would be adequate. A counterpoise will generally reduce the antenna resistance to from one-half to one-third the resistance with the ground connection. It would be difficult to determine the resistance of your antenna system without making direct measurements.

**What kind of tube and what capacity of grid condenser was used in the set shown on page 22 of August RADIO? What size of wire should be used in wiring this set?**

J. H. T., Victoria, B. C.

The tube used was a Cunningham C-300 and the grid condenser was .00025 M. F. No. 20 wire should be large enough for this set.

**I intend to install a 50-ft. "T" type cage antenna. Would a cage type counterpoise be practical for this antenna?**

A. K. C., San Francisco, Cal.

A cage type would not be necessary if you have the room for a flat counterpoise, suspended a few feet above the earth. If you are cramped for room, a cage type of counterpoise would work, although I do not believe it would serve as well as one of the flat types.

**Please publish a circuit for a two-stage amplifier using two circuit jacks, to add to a single coil circuit.**

C. R., Santa Ana, Cal.

This circuit is shown in Fig. 1.

## CLASS "B" RADIOTELEPHONE BROADCASTING STATIONS

A new class of radiotelephone broadcasting station license has been established to be known as Class "B." A wavelength of 400 meters has been assigned for the use of stations of this class which must be reasonably free from harmonics. The power supply must be dependable and non-fluctuating. The minimum required will be 500 watts in the antenna and the maximum shall not exceed 1000 watts.

The modulation system must be so arranged as to cause the generated radio frequency current to vary accurately according to the sound impressed upon the microphone system. Sufficient tubes and other material must be readily available to insure continuity and reliability of the announced schedule of service. The antenna must be so constructed as to prevent swinging. Some dependable system must be provided for communication between the operating room and the studio. The radio equipment in the studio must be limited to that essential for use in the room. The room shall be so arranged as to avoid sound reverberation and to exclude external and unnecessary noises.

The programs must be carefully supervised and maintained to insure satisfactory service to the public. Mechanically operated musical instruments may be used only in an emergency and during intermission periods in regular program. Where two or more stations of Class "B" are licensed in the same city or locality a division of time will be required if necessary.

Licenses issued for the use of the 400 meters wavelength shall specifically provide that any failure to maintain the standards prescribed for such stations may result in the cancellation of the license and requiring the station to use the 360 meters wavelength.

## RADIO TELEPHONE RANGE TESTS

The Bureau of Standards is planning to conduct comprehensive tests to determine the effective working ranges of radio telephone communication when using various kinds of transmitting and receiving sets. Preliminary plans have been outlined for this work, and some correspondence conducted in regard to it.

For a plain, untechnical definition, static is that thing in radio that sometimes sounds like frying eggs and sometimes like the cat's meow. It's what you hear when you can't hear anything.

# NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS

## NEW DICTOGRAPH RADIO LOUD SPEAKER

The Dictograph Products Corporation, of New York City, has produced a radio loud speaker constructed on the principles of the "Acousticon," through which deaf people have been enabled to hear lectures, the voices of their loved ones, music, sermons, etc. It is obvious how sensitive and finely constructed this instrument must be to perform its delicate work. One of the chief essentials is the transmission of sound in its natural tones, free from distortion, and this

*Dictograph Radio Loud Speaker*

quality of the Acousticon has been incorporated in the Dictograph loud speaker. No attempt has been made to develop volume at the expense of clearness or articulation, but tonal quality and musical reproduction in volume sufficient for the home is now within the reach of all radio users.

The design and construction is such as to permit of maximum amplification and the elimination of side tones, distortion, mechanical vibration and the metallic sound common in the phonograph.

It is adapted for use in all types of radio receiving sets in which a detector unit is employed and also two stages of amplification. It is not recommended for use with crystal receiving sets unless these sets are located close to a broadcasting station and the volume of the sound received through a head set is quite strong.

In using the Dictograph radio loud speaker all that is necessary is to tune the receiving set so that the maximum volume it is capable of receiving is had in the head set. The cord, which is attached as standard equipment, is then plugged in to the receiving set in place of the head set. No other wiring is necessary. It is not essential that a head set should be used before using the loud speaker, as good results are secured by plugging the loud speaker directly to the receiving unit and tuning in directly.

## THE AEROVOX INTERTUBE COUPLER

A new device that is rapidly making enthusiastic boosters is the "Aerovox" Intertube Coupler. While it serves, as its name indicates, as a coupling from the output circuit of one tube to the input of the next, regardless of frequency, its special field of usefulness is in radio frequency amplification.

The designers of this instrument are D. K. Lippincott, of the Aerovox Corporation,

*Aerovox Intertube Coupler*

and B. F. McNamee, of the Radio Devices Co. of San Francisco. They have avoided the mistake of attempting untuned radio frequency amplification for short wave work. Realizing that a broadening out of the waveband to the extent necessary in untuned work can only be done by introducing losses into the circuit, they have provided a method for sharply tuning the coupler on short wavelengths.

## ACOUSTIC PROPERTIES OF "MADERAWARE" DIE CAST WOOD

The American Art Mache Company, Chicago, some time ago developed a process of die-casting wood fiber into any desired form. Their earlier products included a wide range of wood castings to replace hand-carved wood, as for instance in interior trim for fine homes, for statuary, etc.

But their discovery that "Maderaware" had remarkable acoustic properties for horns for radio has led them to abandon practically every other line of manufacture and to concentrate their large producing facilities upon the manufacture of radio horns.

They have adopted the term "Clearspeakers" for the Maderaware horns, to typify the clear voice-like messages that they deliver.

In presenting their claims to the radio public they contrast the metallic reproductions of early table-top talking machines with the full, sweet resonance of the modern wood cabinet machines; and prophesy that "Maderaware" die cast wood will render as great a service to radio-telephony as the cabinet makers did to the talking machine industry.

The violin-like resonance of "Maderaware" wood is ascribed to the fact that the die casting process compresses the wood-fiber

*Maderaware Radio Horn*

to a density 200 per cent greater than that of seasoned hardwood, and that this density is uniform thruout the structure.

It seems also to have the effect of amplifying the sounds by adding to the electric vibrations the vibrance of the wood itself. Yet, however loud the message, it is stated to be uniformly clear, pure, musical and free from metallic discord.

## DIFFERENCE BETWEEN RADIO AND AUTOMOBILE STORAGE BATTERIES

"How does the radio 'A' storage battery differ from the ordinary six volt automobile starting and lighting battery?" This question is asked about as often as any other propounded to the radio equipment dealer who supplies the correct answer: "It has thicker plates and fewer of them per cell." According to the Willard Battery Company, there is a need for a uniform delivery of current at a constant voltage over as long a period of time between recharges as it is possible to obtain. The immediate demand for a great flood of current, such as is required in starting a car, is absent here. Thin plates with much exposed plate surface produces the current required for car starting, but thick plates give more uniform current over a longer period between recharges, and what's more, contribute to longer life of the battery.

## NEW RADIO CATALOGS

Northern Radio and Electric Co. of Seattle, Wash., has issued a price list of standard radio equipment for which they are distributors.

The Radio Electric Co. of Pittsburgh, Pa., has issued a circular illustrating and describing their type CA concert receiver, 175-800 meters. This consists of one compact unit 18 x 12 x 11 in., containing tuner, detector, 3 stages of amplification and loud speaker.

## LOUD SPEAKER INSTALLED IN HIGH SCHOOL

A most interesting installation has recently been completed for the Piedmont High School, Piedmont, Calif., involving a distinct improvement over present methods of interclassroom communication.

Developed by The Magnavox Company, pioneers in the field of devices for sound amplification, the installation consists of a central or master station and twenty-five receiving stations, each equipped with a No. LS-2 Magnavox Telemegaphone, the motor generator and battery being installed in a steel cabinet in the basement.

*Talking to the pupils of 25 classrooms at one time by means of a Magnavox Telemegaphone installation equipped with radio hook-up.*

The master station is operated like an ordinary telephone (as illustrated). Talking into the Magnavox in ordinary tones, the speech is amplified in any or all of the twenty-five classrooms as desired, in sufficient volume to be distinctly audible to all the students.

While similar Magnavox installations have already been developed for hotel, railroad terminal and similar commercial uses, this is its first application to school service. A distinctly novel feature of this installation also is the fact that, by means of a special switch, broadcasted radio lectures and concerts may be connected so as to be reproduced in any or all the classrooms by the same instrument.

## THORKITE

An extremely rare bismuth-copper-silver-sulphide mineral, thorkensonite, has been placed on the market under the trade name "Thorkite." This mineral is claimed to be one of the most efficient detectors for crystal radiophones so far discovered.

This mineral is known to occur in but one mine in America. Its value as a rectifier was unknown until recently, as few specimens of the mineral exist, and for this reason very little experimental work could be conducted on this ore. The mineral as first broken from its silicious lime matrix is only an indifferent detector crystal, but after the surface has been exposed to the atmosphere, or artificially aged by means of an electric current, it becomes extremely sensitive as a rectifier for the high frequency radio waves; continued exposure to the atmosphere tends to increased sensitiveness, the result being that this crystal lasts almost indefinitely and actually improves with use. This distinguishes it from most other detector minerals as they are most efficient with a freshly broken surface and deteriorate to a greater or less extent when exposed to the atmosphere.

The extreme ease of adjustment and constantly increasing sensitiveness makes this crystal a very efficient rectifier for radio receivers where vacuum tubes and transformers are used for radio-frequency amplification.

## NEW JEWELL CATALOG

The Jewell Electrical Instrument Company of Chicago have recently added so extensively to their line of electrical measuring instruments that it became necessary for them to issue an entirely new catalog. This new catalog is now off the press and in addition to being an attractive piece of advertising and printing matter, it is indeed a most complete and valuable addition to electrical engineering literature. Each instrument is clearly illustrated and its applications, size, scale length, accuracy and general characteristics described in detail. In the back of the catalog detailed dimensional drawings are shown of each instrument together with full size scales and complete listing of readings and prices.

The sales department of the Jewell Electrical Instrument Company is revising their entire mailing list, and it is their wish that every electrical engineer and user of electrical measuring instruments send their names asking for a catalog. They are also preparing to send out their 1922-23 leather vest pocket "Jot-book" covers. The Jewell "Jot-book" or vest pocket memorandum pad with monthly calendars and filler pads has become an established and permanent feature of Jewell publicity.

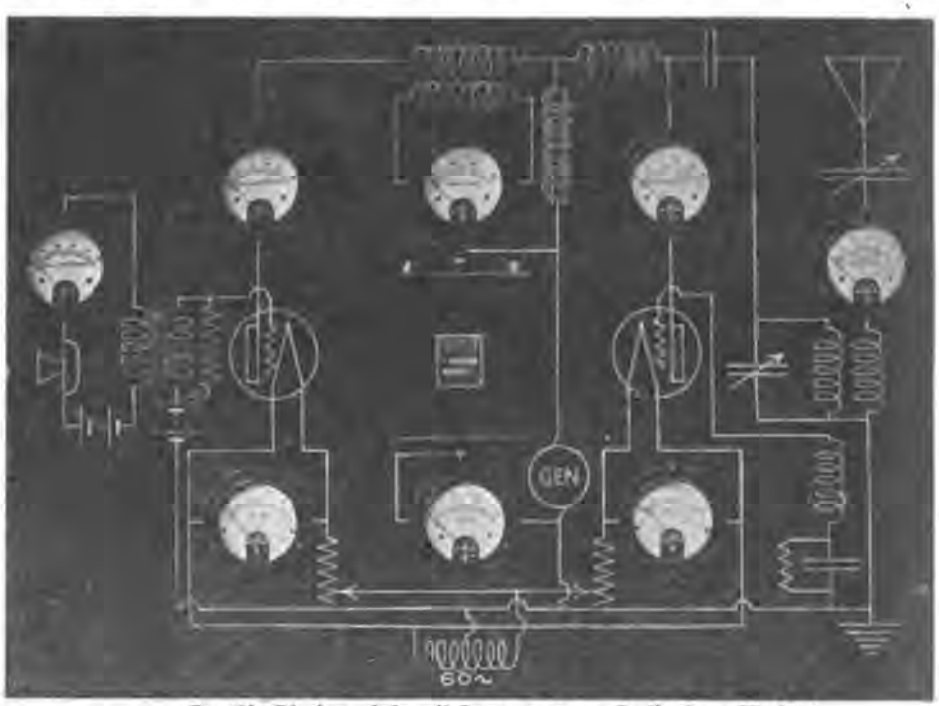
Probably the most important addition to the Jewell line has been their new miniature movements for A. C. and D. C. instruments, both switchboard and portable. They are very urgent in their solicitation that instruments in which these two movements are used be tested and compared with those of other manufacturers of high-grade instruments, both foreign and domestic. Their new poly-phase watt-meter development also deserves much creditable comment. In the radio field, in addition to their widely known and recognized line of uniform size instruments, they have developed several special instruments, such as their Triplex filament meters, wavemeters, and A-B battery testers.

The Jewell Electrical Instrument Company have been adding new representatives and making changes in several of their territories. Their line has developed and grown to such an extent that a more intensive selling program has been possible and many of the changes made were to enable their representatives to devote more time to the sale of Jewell instruments. Briefly enumerated the territories and representatives affected by recent changes are as follows: New York by John Forshay, 45 Vesey Street; Philadelphia by L. B. Underwood, 139 N. Fourth Street; Buffalo by J. H. Burroughs, 70 Bloomfield Avenue; Cleveland by P. J. Burrill, 517 Bangor Bldg.; Dallas by F. T. Morrissey, 305-306 Slaughter Bldg.; Seattle by Messrs. Eicher & Bratt, 2107 L. C. Smith Bldg. All other territories and representatives remain as before.

## THE VARIO-ANTENNA

One of the most novel of the many plugs now available for converting the electric wiring system in a home into an antenna for receiving radio signals is the Vario-Antenna invented by George C. Clark, president of the Clark Radio Manufacturing Corporation of Oakland, Calif. As indicated by its name, the essential part of this device is the variable capacity, whereby the wiring system can be tuned to any given wavelength by simply rotating an adjusting knob provided for the purpose. It is claimed that this device eliminates any a. c. hum and reduces static. By its use, of course, an outside aerial and lightning protective device is unnecessary. It is also claimed that by reason of its variable adjustment several sets may be connected to the same lighting system throughout a hotel or an apartment house. The variation also properly balances the ground wire.

Mr. Clark, the inventor, has had wide experience in electrical work, having been associated with the Thompson Houston Electric Co., the Western Electric Co., Peter Cooper Hewitt, and A. Frederick Collins in various capacities since 1890. In the course of his experience he patented many well-known electrical devices, particularly as applied to X-ray and electro-medical equipment.




*Graphic Placing of Jewell Instruments on Radiophone Hook-up*




# CALLS HEARD

*Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.*

**BY 6AWT, 653 UNION ST., SAN FRANCISCO, CALIF.**

C. W.—4cb can, (5br can), 5za, (6bf), (6cu), (6ea), (6eb), (6en), (6ft), (6gd), (6gh), (6jd), (6ka), (6pi), 6za, 6zg, 6zn, (6zs), (6zz), (6aeh), (6agh), (6alu), (6avd), (6awp), (6bed), (6beg), (6bes), (6bfp), (6bko), (6bqc), (6bqq), 6xad, 6xaq, 6zac, (7dp), 7go, 7iw, 7lu, (7mf), 7mw, (7na), 7nf, (7nn), 7nx, (7ox), (7pb), (7qe), 7qw, 7rn, (7sc), 7xg, 7aaw, (7aea), (9bd Can.), 9no, 9wd, 9wu, 9amb, 9ayu, 9zaf, cl8, kfc concert, kfi concert.

Spark—(6ea), (6eb), (6gi), (6gt), (6iv), (6ke), (6mh), (6od), (6ol), (6up), (6aak), (6acy), (6ahp), (6alu), (6ald), (6amn), (6asc), (6avr), (6awi), (6awx), (6baj), (6bjx), (6box), (7bb), (7bc), 7bh, (7bk), 7cu, 7ed, 7fj, (7fr), 7fq, 7ga, (7ge), 7gi, 7jd, 7jw, (7kj), 7kp, 7nf, 7mp, 7mu, 7mw, 7nn, 7nw, 7oh, 7ot, (7oz), 7qq, 7sg, 7sr, 7tc, (7to), (7tj), 7xz, 7ve, (7vf), (7ya), 7yg, 7zj, 7zm, 7zu, 7aab, 7aea, (9bd Can.), (cl8).

**BY 2LJ, WEEHAWKEN, N. J.**

6xad on July 15 with two stages audio while at Sugar Loaf, N. Y.

**BY 6BNT, 226 N. WILLARD ST., SAN FRANCISCO**

Spark—6cc, 6gf, 6gt, 6gr, 6gp, 6ic, 6on, 6oc, 6ke, 6no, 6wa, 6aak, 6aci, 6agf, 6ahf, 6ajh, 6ajr, 6amn, 6atj, 6ali, 6ars, 7mf, 7ot.

C. W.—6ea, 6eb, 6en, 6ff, 6ka, 6gr, 6ku, 6cu, 6aat, 6aak, 6apn, 6awp, 6aqu, 6aqa, 62b, 6bes, 6beg, 6bqc, 6bqp, 7mf.

**BY 7AFH, MONROE, WASH.**

Spark—6abx, 6ajr, 6ala, 6alu, 6aqa, 6ark, 6ars, 6atu, 6oc, 6gf, 6gr, 6rr, 6tu, 7aea, 7bh, 7cu, 7ey, 7fi, 7fq, 7gf, 7hd, 7ic, 7ih, 7iw, 7jd, 7jf, 7jw, 7mf, 7mu, 7of, 7oh, 7ow, 7ro, 7sa, 7tj, 7to, 7tw, 7ve, 7vf, 7vs, 7wg, 7wr, 7zk.

C. W.—6la, 6aat, 6aiy, 6ak, 6alu, 6ams, 6arb, 6arc, 6asj, 6aw, 6awt, 6bod, 6bcj, 6beg, 6boe, 6bqc, 6bag, 6cj, 6en, 6fh, 6ft, 6gr, 6ka, 6ku, 6lf, 6nx, 6pi, 6rd, 6rm, 6rr, 6tv, 6vm, 6xad, 6xb, 6se, 6sf, 6zi, 6so, 6zz, 7ack, 7aea, 7afw, 7agx, 7dp, 7fl, 7ha, 7lr, 7lu, 7mf, 7na, 7ot, 7os, 7qe, 7qw, 7sy, 7tn, 7zb, 7zu, 9aja, 9ayu, 9dtm, kvq. Canadians—4bv, 5ct.

Fone—7na, 7sy, kyg, kfv, klp, kwg, kdys, cbcq.

**BY 6BJE—300 ELEVADO DRIVE, PASADENA, CAL., AT EVERETT, WASH.**

5br, 5ct, 6bk, 6oc, 6ft, 6fh, 6gr, 6ka, 6nn, 6nx, 6rr, 6tu, 6xh, 6zx, 6abw, 6apw, 6aqu, 6arc, 6ark, 6awe, 6beg, 6bqc, 7iw, 7lu, 7mf, 7tw, 7vf, and others.

**BY 6CU, 2010 SIXTH AVE., LOS ANGELES, CALIF.**

Spark—5xd, 5xu, 6aak, (6aau), 6abm, 6abu, (6abw), 6abx, 6acr, (6ada), (6aeh), 6aci, (6afp), 6agf, 6ah, (6ahf), 6ahu, 6aih, 6ain, (6ajh), (6ajr), 6ajw, (6akl), 6ala, (6alv), 6amk, 6aol, (6aor), (6aqu), 6ar, 6ark, (6as), 6asv, 6atu, (6auc), 6aud, 6avm, (6avx), 6awh, 6awx, (6bak), 6bgl, 6bip, (6biu), 6bjh, (6bjv), 6blv, (6cc), (6ez), 6fk, 6gf, 6gr, 6gt, 6hc, 6hp, 6ib, (6ic), 6im, 6kc, 6km, (6lo), 6ms, 6ng, 6oh, 6pj, 6po, 6qk, (6qr), 6tf, 6tu, 6uo, 6vk, 6vz, 6wg, 6xh, 6xam, 6xd, 6zi, 6zq, (6zu), 6zx, 6zz, 7fj, 7gq, 7jd, (7mf), 7oh, (7ot), (7os), 7ya, (7yj), 7zm, 7zz, cl8.

C. W.—5za, 6agp, 6aif, 6ak, 6alv, (6ams), 6arb, (6asj), (6asv), (6awt), 6bod, (6bcr), 6bla, (6gy), 6kc, 6ku, (6pt), (6ti), 6vm fone, 6xad, 6xaf, 6xc, 6za, 6zac, 6zad, (6zb dalite), 6ze, (6zf), 6zi, 6zq, 6zx, (6zz), 7dp, 7ha, 7nf, (7os), 7qt, 8ags, 8zv, 9amb, (9ayu), 9dva, 9wd, 9xaq, 9zm, 9zaf, Can. 9bd, kdpw, ksl, ksz.

**6BQH, 2507 E 1ST ST., LOS ANGELES, CAL.**

C. W.—5za, 6cu, 6ea, 6eb, 6en, 6rr, 6ka, 6aag-v, 6aat, 6apo-v, 6aeh, 6baj, 6bbc, 6bes, 6beg, 6bfp-v, 6bjc, 6bjo-v, 6bjq, (6bjr-v), 6bjt, 6bjy, 6bmd, 6bpc, 6bps, 6bqe, (6bqd), 6bqg, 6bqq-v, 6bqt, 6bqs, 6brf-v, (6xas-v), 6xad, 6sb, 6zac, 7nf, 7sc, 9ayu.

Spk.—6cc, (6od), 6ex, (6du), 6gr, 6mh, 6tu, 6aak, 6abw, 6abu, 6acy, 6aic, 6ajh, (6apy), 6ark, 6atf, 6avd, (6avr), (6bae), (6bbv), (6bea), (6bee), (6bem), 6bfh, (6bjx), (6bms), (6bqa), (6bqe), (6bra), (6brb), 6brs, 6su, 6zal, 7ya, cl8.

**BY 6AWT, 653 UNION ST., SAN FRANCISCO, CALIF.**

C. W.—4bv, Can. (6bf), (6ea), (6eb), (6ft), (6jd), (6ka), (6alu), (6apw), (6awp), (6bes), (6bfp), (6bko), (6bps), (6bqe), (7lu), (7mf), (7na), (7nn), (7ot), (7os), (7qe), 7sb, (7zea), 9aja, kfc concert.

Spark—6gt, (6ke), (6od), (6ol), 6up, (6aak), 6ahp, 6apy, (7bk), (7ge), 7jw, 7kj, (7nn), 7oh, 7zea, (9bd-Can).

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**SAN FRANCISCO** **U.S.A.** **SAINT LOUIS**

## CALLS HEARD

**BY 6BPZ, 2114 CRENSHAW BLVD, L. A.**

C. W.—(6bf), (6fh), 6gf, 6gr, (6gx), 6ik, 6nx, 6oh, (6rd), (6zb), (6zf), (6zx), (6aat), 6aos, (6aqw), (6arb), 6asi, 6atp, (6awt), (6bcr), 6bhk, (6bjy), 7na, 7lu, (7mf), (7ot), 7os, 7sc, 7su, (7sea), 9aja, 9amb, 9asc.

Spark—6ar, (6cc), 6fh, 6gf, (6gr), (6gt), 6hc, 6jf, 6tc, 6tu, 6aak, 6abw, (6ahf), (6ajh), (6akl), (6ams), (6avd), (6bjv).

**BY 7VF, 793 MICHIGAN, AVE., PORTLAND, ORE.**

Spark—6ex, (6fh), (6gf), (6gr), 6hc, (6ic), 6lu, 6oh, (6tu), 6up, 6vx, (6zq), (6abu), 6abw, (6abx), 6akt, 6alv, 6ams, (6aqu), (6ark), 6avb, 7fi, 7fq, (7ks), (7ot).

C. W.—6ea, 6en, 6fh, 6ft, 6gr, 6gx, 6ka, 6jd, 6km, 6nn, 6oo, 6pi, 6rd, 6rr, (6zf), 6aeh, 6alu, 6aot, 6aqw, 6arb, 6ark, (6asj), 6ats, 6avo, 6awp, (6awt), 6bod, 6bea, 6bfp, 6bhk, 6bps, 6bqc, 6brk, 6bsa, 7lu, 7ot, (7qw), (7th).

**BY 6BQC, 1629 VINEYARD AVE., LOS ANGELES, CAL.**

C. W.—(6ak), (6bf), (6fh), (6gr), (6gx), (6gy), (6ik), (6ku), (6lo), 6nx, 6oh, (6rd), (6sa), (6zb), (6zf), (6zo), (6zs), (6zx), (6zz), (6aat, (6abq), (6acj), (6aok), (6aos), (6aqw), (6arb), (6asl), (6awt), 6bc), (6bhk), (6bjy), 6bqf, (6bql), 6bum, (7lu), (7mf), (7na), (7ot), (7os), 7sc, (7sea) qra, (9aja) qra, 9amb,

Spark—(6bc), 6gr, 6ic, 6tu, 6zu, (6aak), 6akl, 6amk, (6aud), (6bju).

**BY 6BQR, J. F. MOSS, 843 WEST 7TH ST., LOS ANGELES, CALIF.**

Spark—5xd, 6cc, 6dk, 6eu, 6go, 6gf, 6gr, 6gy, 6hc, 6ic, 6km, 6no, 6po, 6qr, 6tu, 6aei, 6afy, 6agh, 6abd, 6ahy, 6ajr, 6amk, 6ans, 6aog, 6ark, 6ars, 6arz, 6atu, 6auu, 6avb, 6xh, 6zx, 7jd, 7mf, 7ya, 7zm.

C. W.—6fh, 6gx, 6ku, 6nx, 6rd, 6vg, 6zf, 6zx, 6aat, 6aos, 6arb, 6awt, 6bcj, 6bea, 7lu, 7me, 7mf, 7ot, 7sea, 9amb, 9ayu, 9dtm, 9zaf.

**BY 6TI, 414 FAIRMOUNT AVE., OAKLAND, CALIF.**

(6gr), (6fh), (6ea), (6ke), (6aak), (7bb), (7sea). 6ti's 5-watter was heard by 6ax on kkai 2,000 miles on one tube and honey-combe.

**BY 9BD, BARRON HOTEL, VANCOUVER, B. C.**

C. W. Canadian—(4bv), (5ct), (cfcn—Calgary, Alta.). U. S.—5qi, 5jl, 6aat, (6asj), (6awt), 6apw, 6abx, 6ak, (6bea), 6bum, (6fh), (6gr), 6it, 6ka, 6ku, 6qx, 6oh, 6nx, 6bea, 6boe, 6rd, 6bcj, 6zx, 6zf, (7agf), (7sea), (7iy), 7qe, (7lu), (7na), (7sc), 7tw, (7qw), (7os), 7wm, 7zb, (bt3), 8yr, 9axr, 9aou, 9pi, 9nc, 9da, 9zaf.

Spark—(6ang), (6gr), 6ams, 6ic, 6vx, (6tu), (7bb), (7bk), (7sea), (7ve), 7kj, 7km, (7vx), 7to, (7sk). All above heard on detector tube alone—during August.

**BY 6BQY, 2101 S. GRAND, LOS ANGELES**

C. W.—5sa, 6bf, 6gr, 6gy, 6nx, 6rd, 6tw, 6vs, 6xh, 6zb, 6zf, 6zs, 6zx, 6aos, 6aqw, 6arb, 6avb, 6awt, 6bic, 6bjy, 6bjs, 6bum, 6buq, 7lu, 7mf, 7na, 7ot, 7os, 9aja, 9amb, 9zaf.

Spark—6ar, 6gr, 6tu, 6ahf, 6ahp, 6akl, 6bju.

**BY 7SG, ABERDEEN, WASH.**

C. W.—5di, 5qi, 5zz, 6aat, 6abx, 6aga, 6agr, 6ak, 6amu, 6aot, 6apw, 6aqw, 6arb, 6asj, 6awp, 6awt, 6bed, 6bcj, 6bcr, 6beg, 6bea, 6bf, 6bfp, 6bhk, 6bla, 6bir, 6bjl, 6bjy, 6bmd, 6bmn, 6boe, 6boo, 6bpf, 6bps, 6bqc, 6bqe, 6bqq, 6bql, 6bqs, 6brg, 6bsa, 6btb, 6bve, 6cu, 6ea, 6eb, 6en, 6fh, 6ft, 6gr, 6gx, 6ik, 6jd, 6ka, 6km, 6ku, 6lv, 6nl, 6nn, 6nx, 6rd, 6rr, 6ti, 6vf, 6wk, 6xh, 6zac, 6zf, 6zg, 6zx, 7aea, 7agf, 7agx, 7fr, 7iy, 7lr, 7lu, 7mf, 7na, 7nl, 7ny, 7oe, 7ot, 7os, 7qb, 7qe, 7qw, 7rn, 7sy, 7th, 7to, 7wm, 7xi, 7zb, 8wr, 9aja, 9amb, 9aps, 9beg, 9eb, 9dr, 9dtm, 9dug, 9in, 9zaf. Canadian—4bv, 5ct, cfcn. All heard on home-made short wave set one step.

**BY 6BQL, 575 21ST AVE., SAN FRANCISCO**

C. W.—6bf, 6cu, 6df, 6ea, 6eb, 6ec, 6en, 6fh, 6ft, 6gi, 6gr, (6gx), (6ka), 6ku, 6oh, 6rr, (6zf), 6zo, (6zx), 6aat, 6abx, 6ake, 6akw, 6ale, 6alu, 6aok, 6aos, (6apw), 6aqa, (6aqw), 6arc, 6atg, 6awp, 6baj, 6baw, 6bbc, 6bcj, 6bea, 6bjc, 6bjq, 6bjy, 6bkb, 6bla, 6bmn, 6boe, 6boo, 6bpy, 6bps, (6bqc), 6bqd, 6bqg, 6bqp, 6bqx, 6brs, 6brg, 6brk, 6bum, 6bzg, 7lu, (7mf), 7na, 7ot, (7ox), 7sc, 7sea, 9aja, 9zaf.

Spark—6cc, 6dd, 6ec, 6gt, 6ic, 6ke, 6ol, 6qr, 6zu, 6aak, 6aau, 6abw, 6abx, 6ajh, 6akl, 6ald, 6ali, 6ark, 6ars, 6asc, 6asq, 6avm, 6avr, 7kj, 7nw, 9bd.

**BY 8AUU—1611 SHORB AVE. N. W., CANTON, OHIO**

Spark—1aly, 1akg, 1ask, 1nf, 2aje, 2fp, 2gp, 2om, 2rm, 3acy, 3bnu, 3gu, 3hj, 4fd, 5bl, 5io, 5py, 8afg, 8aiy, 8apm, 8anw, 8asl, 8aib, 8aqo, 8azf, 8axt, 8aux, 8axn, 8ax, 8bds, 8bay, 8bas, 8bnh, 8bno, 8bnv, 8bda, 8bri, 8bqf, 8clo, 8cdv, 8cpx, 8cct, 8csd, 8ea, 8eb, 8ek, 8eo, 8ew, 8jpk, 8jx, 8oi, 8rk, 8se, 8tc, 8tt, 8uc, 8ud, 8oe, 8xo, 8zo, 8zy, 9aiw, 9air, 9amk, 9aix, 9aar, 9aph, 9aja, 9aaw, 9acb, 9aza, 9bxc, 9bax, 9bct, 9cfp, 9ccj, 9wa, 9wd, 9zn.

# Finest Filament Control We Have Ever Used, *Says Radio Guild, Inc.*

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Graphite discs (not loose carbon grains) provide the delicate control for vacuum tubes. A single knob, without vernier, gradually applies or removes pressure from the discs, thereby changing the filament current more smoothly and noiselessly than any vernier rheostat.

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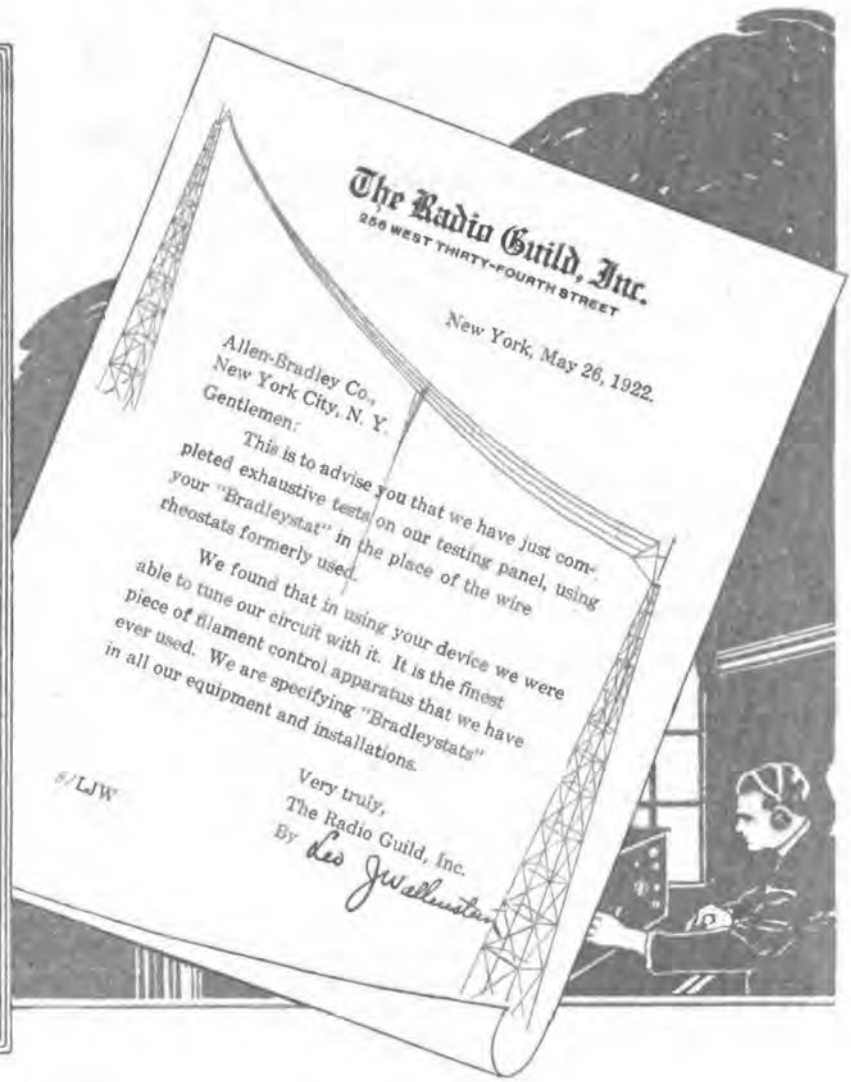



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# Bradleystat

REGISTERED U. S. PAT. OFF.

## PERFECT FILAMENT CONTROL

## RADIO DEVELOPMENT

*Continued from page 31*

cillator in the path of fresh, oncoming, unreflected waves, reinforcing occurred at some points and interference at others. The effort was not dissimilar to the fact that sound waves reinforce or interfere. A shifting of this "resonator" to and fro between the oscillating device and the reflector made it possible to detect these points. The sparking across the tiny gaps in the hoop-like device increased until it reached a maximum at the point of greatest reinforcement. Subsequently, the spark expired as the "resonator" attained the point of complete interference. Harmonizing with the modern conception, this German inventor indicated that electromagnetic waves advanced in ever-widening circles. The example of the effect of a rock thrown on the surface of a pond of water is a favorite characterization. Similarly, he reasoned that they were capable of casting an electric shadow by a metal plate or screen, comparable to the ability of rays of light throwing a shadow by interposing an opaque object.

That loose iron filings, when subjected to an electric current, would cohere and their resistance forthwith fall to an extremely low value—only to have their original resistance restored instantly by tapping them—was a discovery of S. A. Varley, in 1866. He made a lightning arrester from iron filings. A scientist of the Catholic University of Paris inserted iron filings in a glass tube and placed a metal plug in each end, by which the device could be connected in a circuit. The filings, according to observation, would cohere when electric discharges were admitted passage in their neighborhood and that the tapping of the tube restored the filings to their original condition. He called his device a "radio-conductor." Sir Oliver Lodge, at a later date, dubbed the invention a "coherer," and in 1893 linked it up with a battery and galvanometer. He was thus enabled to employ it as a detector of electric waves. Professor Papoff of Kronstadt, in 1895, installed a real radio receiving system for the purpose of detecting atmospheric electric disturbances. A rod was extended above the roof of a building and its other end connected through a coherer to the earth. The coherer had a relay and battery connected in its circuit, the former being energized whenever atmospheric discharges passed through the coherer. The relay closed the circuit of a tiny electric trembler bell, the clapper of which, on being drawn up, struck the bell, to give a signal of disturbance, and when retracted tapped the coherer to restore it.

"The foregoing shows the preliminary work, the stage setting, for Marconi's masterly act," says Dr. W. A. Kinnan. "The materials with which he was to build had been created. The oscillator, including the key, the interrupter, the transformer, the spark gap apparatus, and the radiating plate; the receiver including the receiving plate, the coherer, the tapper, and galvanometer, had all been created and their use had been indicated. Other actors were hard upon him, stood ready to step upon the stage. Clerk-Maxwell and Hertz had pointed the way, Branly, Lodge and Papoff had traveled in the direction thus indicated to them and were in 1896-7 standing in the wings of the stage. But even so, they never entered and light never fell upon them until Marconi had given commercial telegraphy by Hertzian waves to the world. It was a noble gift and the reward and the glory are justly due this remarkable young Italian." The patents granted Marconi,

*Continued on page 86*


The Willard Radio "B" Battery with glass jars and Threaded Rubber Insulation is the most practical insurance against leakage *noises* and leakage *losses*.

# Why Gamble on "B" Batteries?

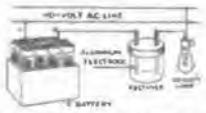
You're careful in soldering connections. You spend good money for additional stages of amplification. You give special attention to insulation of aerial and lead-in.

If you've gone that far, you simply can't afford to take a chance on having a leaky "B" Battery spoil it all with a bombardment of leakage noises. *You can't afford anything less than a leak-proof Willard "B" Battery.*

Every cell of a Willard "B" Battery is an individual glass jar. Jars are well-spaced to prevent leakage from cell to cell. Threaded Rubber Insulation protects the plates and thus guards against inside leaks.

Because of the leakproof feature Willard "B" Batteries are unusually quiet and hold their charge for long periods.

Ask your radio dealer or the nearest Willard Service Station to show you the Willard 6-volt Radio "A" Battery and the Willard 24-volt Radio "B" Battery.



This rectifier will keep your "B" Battery charged at a cost of a few cents a month.

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THREADED RUBBER BATTERY

# Willard

## PROFESSIONAL RADIO OPERATOR

*Continued from page 18*

the future method of taking radio-compass bearings, regardless of whether the radio telephone is ever utilized aboard ship or not. The advantage in having the compass aboard the ship instead of in the shore station is obvious; bearings may then be taken upon any radio station, anywhere, instead of at only a few specially arranged points, as at present.

But now, lest the shellback brass-pounder who may chance to read this goes into a blue funk and decides to will his uniform insignia to his home town museum and jump overboard with the ship's spare anchor draped around his neck, it is time to take up the more encouraging side of the question.

Whatever the ultimate development of the wireless telephone, it does not seem probable that it can ever supplant the wireless telegraph—at least not to any great extent. The perfection of the wire telephone has not put the wire telegraph out of business; in fact, the volume of telegraph business is perhaps ten times what it was when the telephone was first introduced—though it would undeniably be still greater were there no telephones. The removal of the radio operator from any class of ship is doubtful; it cannot come to pass for many years yet, and in the case of the passenger liner, never.

Even when the vacuum tube telegraph transmitter has become standard all over the world, the radiophone will still have its drawbacks. On the ship plying in foreign trade, its use will require the ability of some one aboard to speak the many different languages of the countries to which the various coastal stations belong, or *vice-versa;* whereas the telegraph handles with equal ease traffic in any language, and in cipher.

The ship-owner possibly may not strenuously resist the passage of legislation which will force him to discard his present radio equipment, since this equipment is, comparatively speaking, not expensive; but unless the radio apparatus of the future is to be unbelievably simplified, it will always be liable to derangement, and the steamship companies that demand service will hesitate to send their ships to sea with the radio equipment in charge of some one who has no knowledge of the apparatus further than the mere ability to use it. Besides, it is quite probable that the maintenance of a continuous radio watch aboard all vessels carrying more than twenty-five persons will eventually be required by law, and when such legislation is passed the operator's position will be permanently secure, no matter what perfection time may bring in wireless telephone apparatus.

In the case of the passenger ship,

*Continued on page 44*

# MASTER RADIO PRODUCTS


Master Dials 75c

Master Rheostats with knob $1.25 without knob $1.10

Potentiometers $2.50

Master Sockets $1.25

MASTER

The very highest engineering skill and best quality materials combine to make MASTER RADIO PRODUCTS worthy of your attention. Made by an organization which always has been noted for its reliability and integrity MASTER RADIO PRODUCTS everywhere have been accorded that prestige which usually comes only after years and years of effort. You can depend upon MASTER RADIO PRODUCTS for Service and Efficiency in every way.

**MASTER DIALS**—An exquisite product, made of highly polished, genuine Bakelite, moulded in one piece and heavily reinforced to prevent warping. Extra large knobs, deeply grooved and tapered to fit the fingers. Graduations are clearly defined and deeply etched into the solid Bakelite. Diameter 3 inches; depth 1⅝ inches. Shaft ¼ or ⅛ inch.

**MASTER RHEOSTATS**—Suitable for back or front panel mounting as well as for portable use. When mounted as back of panel instrument the shaft projects through the panel. A knob and pointer, or dial can be used equally well as means of resistance control. Shaft may be adjusted for any thickness of panel up to ½ inch. MASTER RHEOSTATS are made for two classes of service: for regulation of filament current in receiving tubes, with a resistance of 6 ohms and a current carrying capacity of 1.6 amperes. Also for regulation of filament current in 5-watt transmitting tubes, with a resistance of 2.5 ohms and a current carrying capacity of 2.5 amperes.

**MASTER POTENTIOMETERS**—Similar in general construction to MASTER RHEOSTATS. EQUIPPED with third binding post, with connection to switch blade for biasing the grid on tubes used in radio frequency circuits. Resistance 300 ohms: current carrying capacity 50 milli-amperes.

**MASTER V. T. SOCKETS**—Incorporate many features absolutely new. Base is genuine Bakelite. Binding posts permit quick and positive connections. Side-contacts of heavy spring brass insure a quarter inch rigid contact with each prong of vacuum tube. These side contacts cannot be bent or forced out of position. In addition side contacts hold tube absolutely stationary so that no other support is necessary. MASTER V. T. SOCKETS *are a splendid improvement.*

**MASTER SELECTOR JACKS**—Make receiving as simple as turning on electric lights. Eliminates old-fashioned plugs and jack in amplifier sets, as well as annoying panel cords and wires. To obtain range of selectivity, detection and amplification you simply press a button. MASTER JACKS improve and simplify any set.

**MASTER TRANSFORMERS**—Amplify without howling or distortion. Core is staggered laminations of highest quality silicon steel. Both electrically and mechanically MASTER TRANSFORMERS are RIGHT. MASTER RADIO FREQUENCY TRANSFORMERS increase range and selectivity and enable the operator to obtain greater service from his receiving set.

Master Jacks Double Circuit $1.50

Single Filament Control, $1.60

Double Filament Control, $1.75

Master Transformers $5.00

All MASTER RADIO PRODUCTS are designed by skilled engineers and are fully guaranteed to be free from all defects of any kind. The MASTER trademark is an assurance of quality. Ask your dealer to show you MASTER RADIO PRODUCTS—or write us direct for descriptive bulletins.

# UNION CONSTRUCTION CO.

## OAKLAND, CALIFORNIA

*Continued from page 42*

which since 1912 has been required by law to carry two radio operators and maintain a continuous watch at sea, the wireless telegraph will never be supplanted. The volume of traffic is too great; formal telegrams can be transmitted more rapidly and accurately by telegraph than by the use of the human voice, and the effective working range of the telegraph will for the same transmitting power always be much greater than that of the telephone. Even when present difficulties in regard to modulation, articulation, static and interference have all been overcome, a trained expert will almost certainly be required to manipulate and care for the apparatus, because every improvement in a device of this kind generally brings an added complication; and since in any case some one must be employed to stand the listening watches, the elimination of the radio operator is neither desirable nor possible.

As an auxiliary, however, the radiophone is perhaps destined to fill an important and a unique place on the passenger liner. It is not improbable that the wire telephone companies will in due time establish "linking stations" at various points along the coasts, whereby passengers aboard ship will be enabled to converse with subscribers to ordinary wire telephone service anywhere. From his stateroom phone the business man a thousand miles out to sea will be brought within speaking range of his office; and the moony lover and the girl he left behind him will provide huge diversion for countless thousands of eavesdropping young radio bugs—and old ones, too!

In conclusion, it seems probable that the employment, if ever, of the wireless telephone aboard ship without a licensed operator in charge of it, will be confined to yachts, river steamers and possibly small freighters and oil-tankers operating on short coastwise runs. The wireless telephone will not encroach upon the telegraphic field; it will find its own. It will be used for point to point communication in isolated districts, as for instance by large mining and development companies; and with perfected control of high power vacuum tubes will come commercial trans-oceanic telephony. Its greatest service of all, it seems to me, however, is foreshadowed in its wide utilization this early for broadcasting musical programs. The perfectly modulated transmitter and the distortionless receiver of the future will have its finest application in this field. We shall have the gist of the news, the market reports on produce peculiar to the locality, and magnificent concerts broadcasted the country over—broadcasted not so much for the entertainment of the blasé urban class, but especially for the country dweller, linking the man of the soil and the man of the city in closer bonds of community

*Continued on page 46*

# The Radio Public Is Ready to Buy

## Are You Ready to Sell Them the Standard, Nationally Advertised Merchandise They Insist Upon ?

A new radio buying public, made up of the great majority who "waited to see what would become of radio," are already buying well and will buy more and more as the season progresses. These cautious folks, however, are insisting upon well-known products of established quality.

You can satisfy this new demand for quality merchandise most profitably and conveniently through the services of WHOLESALE RADIO EQUIPMENT. Products of sixteen or more of the most important, nationally popular manufacturers are always obtainable at attractive prices. Prompt, careful shipment. Credit facilities that lift you over the rough spots. Let us tell you more about this service. **A postal will do the trick!**

Fall and Christmas Trade Will Flow to the Best-Stocked Store
Establish Your Source of Supply NOW. Place Your Order TODAY!

**Sample Our Service**

## TWO FAST-SELLING ITEMS

## Thordarson

**Amplifying Transformers—Shell Type**

Low distributed capacity. The core of special 7 mil high silicon steel is twice the cross section of the ordinary core. Coils wound with silk covered wire, in separate sections, and placed side by side on the core. Mounted on brass or nickel-plated frame. Bakelite terminal board.

LIST $4.50

## Bradleystat

REGISTERED U.S. PAT. OFF.

PERFECT FILAMENT CONTROL

A graphite compression rheostat that gives absolutely even control of filament current. For ¼ or 1 ampere detector and amplifier tubes and 5-watt power tubes.

LIST $1.85

**DISTRIBUTORS FOR**

Acme
Baldwin
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Magnavox
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Paragon
Thordarson
Tuska
Western Electric

***Wholesale Only***

*Write For Attractive Discounts and Helpful Credit Arrangements*

# Wholesale Radio Equipment Co.

## 24 WILLIAM STREET, NEWARK, N. J.

*Continued from page 44*

feeling and bringing a little step nearer that ultimate harmony to which the universe is destined.

### Will We Ever Have Women Radio Operators?

Every so often I hear some young miss turned radio fan, or—I have a sort of suspicion—ambitious to vamp a bold sea-rover, ingenuously inquiring why there are no "lady wireless operators" on the "boats," and to please tell her, will there ever be any?

Without in the least wishing to dash the secret aspirations of any adventuresome member of the unfairer sex, I venture to reply, regretfully, but firmly —no. The suggestion that there ever will be any such is highly irritating to the average shellback operator; in fact, the merest insinuation that anything of the kind is even remotely possible is to rub all his fur the wrong way. I was once informed by one brass-pounder, though, that any such talk didn't bother him; he most emphatically knew that no "dames" could ever be wireless operators because they couldn't climb up the masts and grease the antenna insulators. In view of the way I have been climbed by some of them, I am rather doubtful about the correctness of this statement; but, all pleasantry aside, women operators in the marine service are out of the question, and any one who knows anything about life aboard ship will not need to be told why.

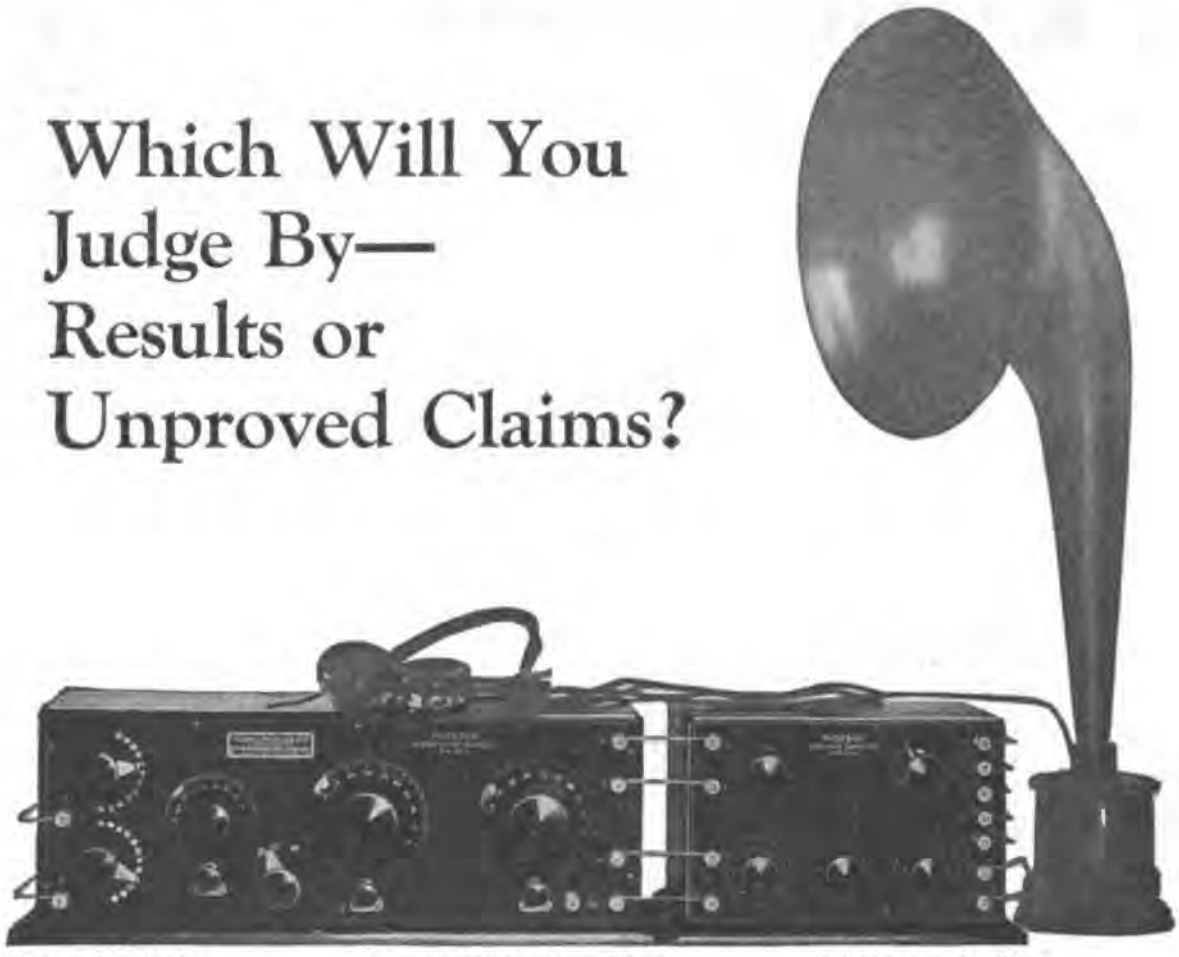
The reasons cannot be discussed very far in these pages; but it may be pointed out that the conditions aboard a ship are not similar to those in, for instance, an office or a store. The relations of the officers are very intimate and personal, quite like those of a close family, or a small bachelors' club. No apple of discord among the gods of Olympus ever created strife comparable to that which would ensue from the placing of a girl radio operator aboard a ship, especially a freight ship. It is a fact—we know it—that this would only lead some flirtatious young persons to aspire all the more eagerly; but the shipowners, who are operating their ships for business purposes, understand the situation well enough.

The fact that a few stewardesses are employed on the larger passenger steamers has nothing to do with the matter; these are almost invariably anything but good-looking, and old enough to be the grandmothers of the oldest men on the ship; and even so, I know from personal observation that it is not always well that they are aboard.

In the case of the land radio stations, the foregoing, of course, would not apply; but, as has already been explained, since there is sharp competition among the best shipboard operators for these berths, there is little chance for a beginner of either sex to get them.

*Continued on page 48*

# Which Will You Judge By— Results or Unproved Claims?



Type R-A-10 Receiver — Licensed Under Armstrong Patents — D-A-2 Detector-Amplifier

*Also Manufacturers of*
**PARAGON**

Radio Telephone Transmitters
V. T. Control Units
Rheostats
Potentiometers
V. T. Sockets
Amplifier Transformers
Detectors
Control Dials
Amplifiers
Receivers
Switches
Variometers

## *Paragon Stands on its Record*

In 1915 the *first* regenerative receiver, Paragon, was manufactured.

In 1916 Paragon effected the *first* transcontinental reception (not prearranged) from New York to California.

In 1917-18 Paragon receivers, due to greater sensitivity and selectivity, proved superior to all others in interception of enemy signals by the U. S. Army and Navy.

In 1921 Paragon effected the *first* transatlantic amateur reception, registering signals from 27 American amateur stations at Ardrossan, Scotland, a distance of 3500 miles.

In 1922 Paragon Products are a safe investment in a market in which it is difficult to judge values.

Paragon needs no extravagant claims; but we guarantee our customers this:—that Paragon Products are reasonable in price, sound in design and thorough in workmanship.

If your dealer does not sell Paragon Products, send for our catalogue (free) and we will see that you are promptly supplied.

**ADAMS-MORGAN CO., 2 Alvin Ave., Upper Montclair, N. J.**

# PARAGON

Reg. U. S. Pat. Off.

# *RADIO PRODUCTS*

Tell them that you saw it in RADIO

*Continued from page 46*

To return to the ships again. If it be argued that there actually have been three or four girl wireless operators, it may be replied that these were, in two cases, daughters of the captains of the ships upon which they sailed—they made only a few short voyages merely for the novelty of the thing—while the other one or two enjoyed advantages similarly unusual, and were duly chaperoned.

The radio operator is carried primarily to serve in the emergency when death comes near; and there is something incongruous in the idea of a girl sticking at the key on a sinking ship—chivalry would not permit it; and I think, too, there would be something no less incongruous in the sight of "Sparksie's" weekly wash hung out to dry with the rest of the family's on the ship's rail.

### Some Final Points

That a great many radio amateurs take up commercial wireless operating with a mistaken idea as to its possibilities seems to be indicated by the fact that so few stay with the game or advance to anything higher in the radio field. If recruited from the amateurs' ranks, the operator, after perhaps two or three years of commercial experience, returns whence he came—that is, back ashore and to the status of an amateur radio enthusiast again; but he earns his living at something else. Not one in ten of those who wore the phones ten years ago are engaged in any sort of radio work today.

Whether commercial radio offers anything worth while to the prospective operator depends entirely upon his own particular circumstances and inclinations. While every professional operator likes his work, more or less, the amateur will never experience the joy in attending strictly to business with a commercial set that he finds in experimenting with that conglomeration of beloved junk in the woodshed. To hover all night in an attic over a fizzly vacuum tube and a wobbly-spined condenser in order to relay a piffling love note across seventeen states is immensely enjoyable; but when we commercialize our pleasures we find them not half so zestful.

It is sometimes asked whether it were not well for the radio amateur, before entering upon some other ultimate line of work, to become a commercial operator for a year or two, for the sake of the educational value, and to broaden his knowledge of the world. It is, possibly, but to become a wireless operator is getting to be a good deal of an undertaking in itself, and in this rapidly moving age, every day counts.

There is one class of persons for whom, it seems to me, radio operating would be a very desirable employment—cripples. For these unfortunates, if

*Continued on page 50*


# Red Seal Battery Contest

## Starts Nov. 1st. Closes Nov. 15th


**All Radio Sets installed FREE in the homes of the winners anywhere in the U. S. A.**

Cabinet Closed

***1st Prize***

This cabinet type complete Radio Receiving Set is one of the finest and most complete sets on the market. It is designed and manufactured by the Colin B. Kennedy Company of San Francisco, makers of the finest type of radio receiving sets. The cabinet is walnut and stands 58 inches high—a masterpiece of cabinet making. The receiving set is regenerative, having an effective range from 175 to 25,000 meters—400 to 600 miles on "broadcasting." Contained within the cabinet are all batteries, and a most efficient loud speaker. Value complete, $725.00.

***2nd Prize***

It consists of the Westinghouse R. C. Receiving Set and the famous distortionless Western Electric Loud Speaker, "Tungar" Battery Charger, Storage Battery, 9 "B" Batteries, one Manhattan 3,000 ohm Headset, 3 vacuum tubes, 2 telephone plugs, and complete antenna equipment—a total value of $408.50.

***3rd Prize***

A complete receiving outfit made up of the well known Grebe CR No. 9 Regenerative Receiver and 2 stage amplifier, Magnavox Loud Speaker, Storage Battery, "Homecharger" Battery Charger, "B" Batteries, one Manhattan 2,000 ohm Headset, 3 vacuum tubes, 2 telephone plugs, and complete antenna equipment—a total value of $256.50.

***50 Other Prizes***

To 50 other contestants, whose answers the judges decide are most meritorious, will be given one of the famous Manhattan 2,000 ohm Radio Headsets. These headsets are built with the precision of a watch and have great sensitiveness and high amplifying qualities

# Win this $725.00 Radio Set FREE

## *Only a rich man could buy it but a poor man may win it FREE*

SIMPLY obtain a free "Red Seal Battery" contest blank between November 1st and November 15th from stores that show the Window Display pictured below. Each contest blank gives full simple instructions to help you write your answer and full rules of the Contest.

### *"Finish-the-Sentence" Contest*

The prizes will be awarded for the most appropriate answers for completing *in your own way* in not more than ten words, the following sentence:

"The Red Seal Dry Battery is best
(1.) because it is the All-Purpose Battery and
(2.) because.....

### *Examples*

Your answer may be descriptive of the Red Seal Dry Battery or it may describe some use. For example: "It never fails on land, air or sea." Another: "It never starts what it can't finish." Another: "It rings bells and buzzes buzzers."

### *Judges*

The judges of the Contest are: Mr. Llew Soule, Editor of "Hardware Age," New York; Mr. Howard A. Lewis, Manager of "Electrical Merchandising," New York, and Mr. Joseph A. Richards, President, Joseph Richards Co., Inc., Advertising Agents, New York.

### *Awarding the Prizes*

Prizes will be awarded to those who conform to the rules of the Contest and whose answers, in the opinion of the judges, are most appropriate. In case two or more persons submit winning answers, prizes identical in character with those offered will be given to each successful contestant.

### *Announcing the Winners*

As soon as possible after the judges have rendered their decision, the names of the prize winning contestants, will be announced in the Saturday Evening Post.


*Look for this Window Display in Dealers' Windows Nov. 1 to 15. It identifies all stores that have free contest blanks.*

### *Contest Opens Nov. 1—Closes Midnight Nov. 15.*

All answers must be written *only on contest blanks* supplied by dealers displaying Red Seal Battery Contest window display. Send as many answers as you like to:

**Red Seal Battery Contest**
**Manhattan Electrical Supply Co., Inc.**
**17 Park Place**
**New York City, N. Y.**

MANHATTAN
ELECTRICAL SUPPLY CO., INC. NEW YORK
*Makers of the Famous Red Seal Dry Batteries and Manhattan Head Sets*

Tell them that you saw it in RADIO

*Continued from page 48*

not too helpless, radio, with its light work and health-giving surroundings, is an almost ideal vocation.

It should not be necessary to say that the youth going to college, or who intends to go there, should aspire to something higher than radio operating.

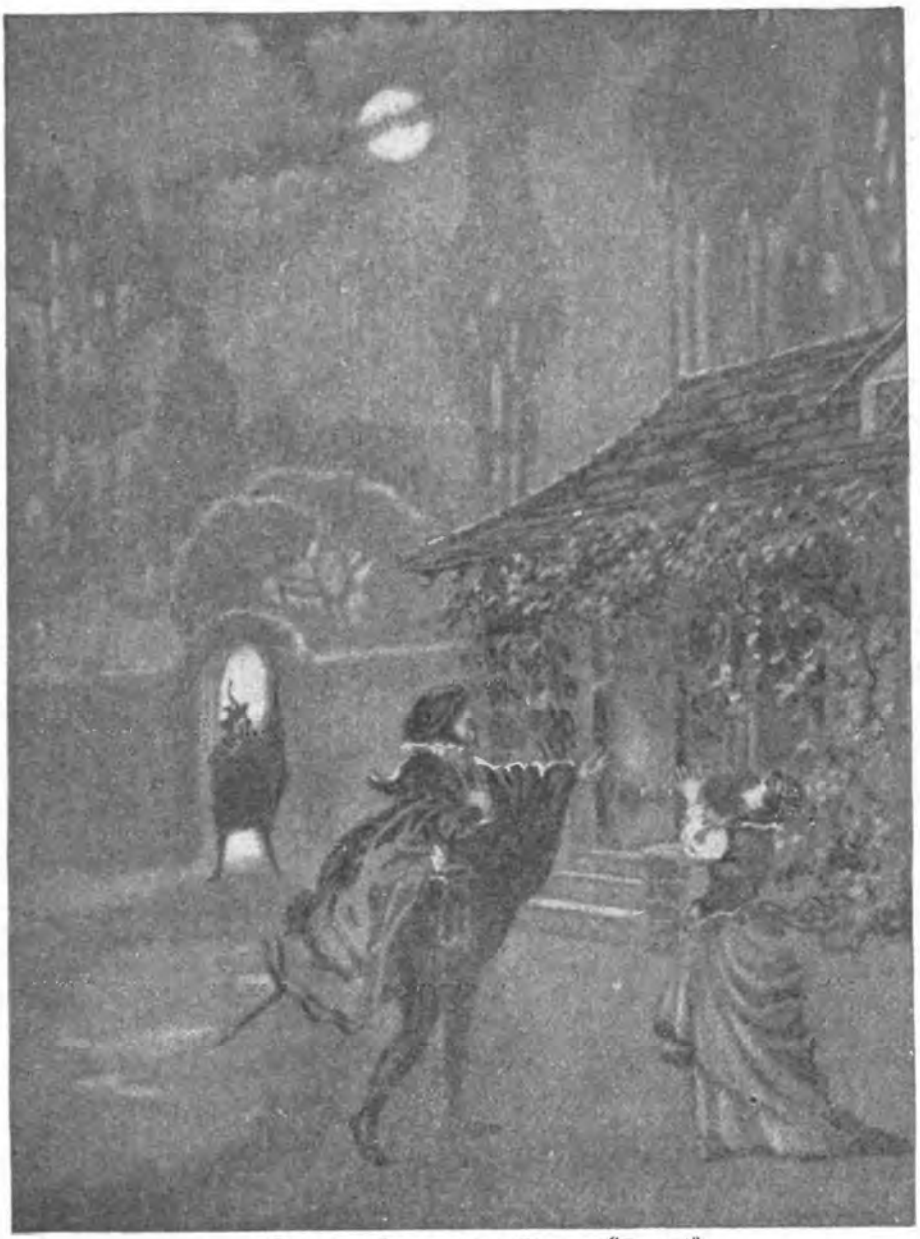
On the other hand, for the youth weighing up coffee and beans at ten dollars a week in a small grocery; for the lad hoeing in a hot and dusty cornfield for twenty dollars a month; for the unhappy boy become a slave to an automatic machine-god in one of our huge modern industrial plants; for any such as these, commercial radio operating certainly offers at least breathing room and an opportunity to work for better things.

---

One thousand vacuum tubes, type VT-11, manufactured by the General Electric Company, have been declared surplus, and are offered for sale to the public at $5.50 each; not more than three to any one person; licensed only for *amateur, experimental or entertainment use;* at Signal Section, San Francisco General Intermediate Depot, Polk and North Point Streets, San Francisco, California.

---

The Radio Marketing Corporation has been formed to supply the needs of amateurs at Oakland, Calif., by F. J. Hill, Jos. J. Rosborough, Oliver Kehrlein, Robert Thomas, and J. N. Borroughs. Mr. Thomas is acting as manager of the store at 329 Fourteenth Street. Business is done under the name of "Ramarco."

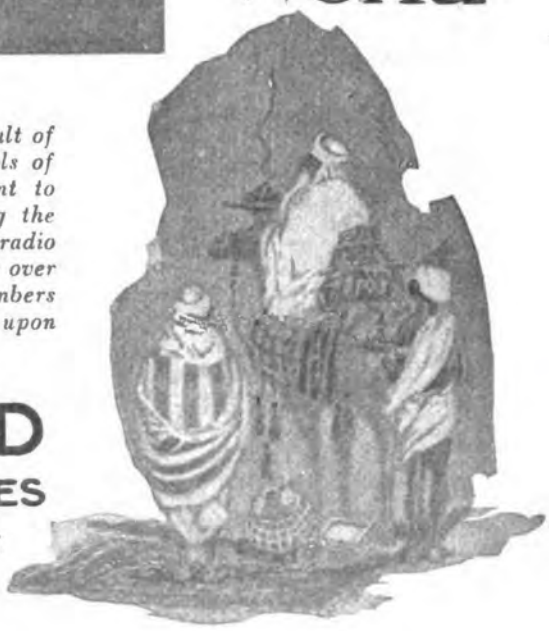


Scene from the Opera "Faust"

# The New Star in the Radio World

*MOMENTOUS events in the arts and sciences are the result of rising above out-worn principles, independent of the tools of mediocrity. Beginning where others have been content to finish, a forward-looking group of radio engineers, comprising the Mu-Rad Laboratories, have designed and successfully constructed radio apparatus which is as advanced as the twenty-one-jewel watch is over the key-winder. Prices of this apparatus insure that great numbers will benefit from their achievements. Descriptive literature upon request.*

**MU-RAD**
**LABORATORIES**
INCORPORATED
ASBURY PARK
NEW JERSEY



## ELECTRONIC THEORY

*Continued from page 14*

should reverse the charges at these two points, however, so that the point at high potential is now at a low charge, and *vice-versâ,* the electrons will reverse the direction of their flow back toward the new point of higher potential. If we continue to reverse the charges of the two points, first from low to high and back again, the current flowing between the two points will reverse its direction as often as we switch the respective charges at these two points. Such a reversing current is called an alternating current.

Either type of current when flowing in a wire is accompanied by four effects: 1, heating; 2, electrostatic; 3, electromagnetic; and 4, radiation. Let us examine these different phenomena in order.

1. We have seen that the electrical current encounters resistance in the conductor in which it is flowing, and that this resistance is due to friction between the electrons and the atoms or molecules of which the conductor is composed. Just as the friction between two pieces of wood being rubbed together gives rise to heat, so the friction in the conductor between the electrons and the atoms, if the conductor is an element, also sets up heat therein.

The more electrons there are flowing in a wire and the higher its resistance, the greater will be the total amount of friction set up by the electrons, and hence the greater the heating effect.

In an electric lamp the resistance of the fine filament wire is so great that enough heat is generated to maintain the filament at white heat.

2. Due to the electrostatic effect, a negatively charged body is one having more than its normal number of negative electrons and a positively charged body is one having less. Thus, when a piece of sealing wax is rubbed with flannel, the wax becomes negatively charged and the flannel positively so, because the friction rubs some of the negative charges off the flannel and deposits them on the wax.

Due to the fact that the flannel and the wax now have opposite or unlike electrical charges, an attraction or electrostatic strain is set up between them if they are brought close to each other. This electrostatic strain represents stored up electrical energy.

A convenient device for practically storing electrostatic energy is the *condenser,* the first type of which was the Leyden jar, devised by Musschenbroek of Leyden in 1746. As shown in Fig. 3, the Leyden jar condenser consists of a glass tumbler or jar, coated on both sides with metal, either foil or sheet metal—usually copper. The essential feature of a condenser is that it must consist of an insulator coated on both

*Continued on page 54*


# Charge Your Battery at Home

KEEP pep in the battery for your vacuum tube receiving set by using the Rectigon Battery Charger.

The Rectigon is a small, inexpensive device that will charge your radio battery over night. It is entirely automatic in operation and needs no attention after it is started.

The Rectigon is portable—it can be placed wherever desired. The absence of oil or grease assures you of no damage to your floor or rugs.

It is as indispensable to your vacuum tube wireless equipment as the battery itself.

For details regarding the various sizes of this type of battery charger, write for our Folder F-4491, "Charging the Radio Battery at Home."

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.
Sales Offices in All Principal American Cities

# Westinghouse
## RECTIGON BATTERY CHARGING

Tell them that you saw it in RADIO

Continued from page 52

sides with a conductor. It is immaterial whether the insulator, or *dielectric,* as it is sometimes called, is in the form of a jar or simply a plate or sheet.

A condenser is charged by connecting the two metallic coatings to a source of electricity so that one coating acquires a positive charge and the other a negative one. It is discharged by connecting the two coatings through a conducting wire.

The ability of a condenser to store electrostatic energy is termed its *capacitance* or *capacity* and is measured in *farads.* (After Michael Faraday, an

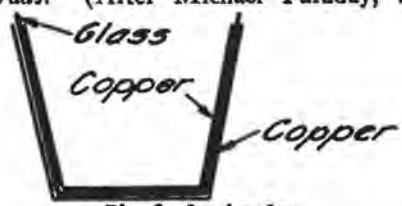



*Fig. 3—Leyden Jar*

English professor of the nineteenth century.) Since the farad is too large a unit, however, to be used practically, condensers are commonly rated in *microfarads, i. e.,* millionths of a farad.

The capacity of a condenser is increased by enlarging the size of its metallic coatings and by decreasing the distance between them. The capacity also depends upon the nature of the substance used as the dielectric. If mica or isinglass is employed, the condenser will have four times the capacity it would have if paraffine were used, and about eight times the capacity which would be obtained with air as the dielectric.

Condensers are used in both the transmitting and the receiving sets of radio stations. On account of the high voltages to which transmitting condensers must be charged, it is customary to employ glass or mica as the dielectric because of their greater insulating qualities, but for the low potentials encountered in receiving sets, air may be used. The latter is particularly advantageous where it is desired to change the capacity of a condenser at will. Condensers of changing capacities are called *variable condensers* and they usually employ air as the dielectric.

3. Due to the electromagnetic effect, the positive or north pole of a magnet is attracted and the negative or south pole repelled by a wire carrying a direct current flowing in the proper direction.

If the wire is wound in the form of a coil around a cylinder of insulating material, and a direct current is passed through it, one end becomes magnetically positive and the other end negative, according to the direction in which the current is flowing. The magnitude of this effect is increased by increasing either the number of turns of the wire, or electrical current, or both.

Continued on page 58

# FREE RADIO APPARATUS

## Genuine Standard Apparatus Given Positively Free of Charge for Securing Subscriptions to RADIO

***This Startling Offer is Being Made by Popular Request of Many of Our Readers***

**You do not have to be a subscriber in order to receive these premiums**

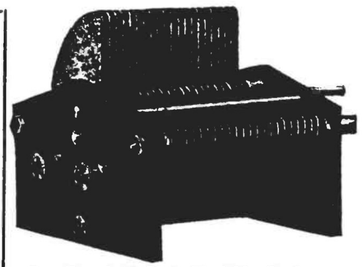
*All subscriptions must be for a period of one year. The subscription rate is $2.50 in the U. S., and $3.00 in Canada or foreign countries. If you are already a subscriber, you may extend your own subscription for one year.*

### OUR GUARANTEE!

The publishers of RADIO hereby guarantee all apparatus on these pages to be exactly as represented. No rejected or used equipment will be supplied. These various premiums have been supplied to us by a number of the most prominent manufacturers of radio equipment and we fully guarantee that shipments of any and all premiums will be made from the offices of the Pacific Radio Publishing Co. on the same day that orders are received. This offer will be withdrawn on November 1st. No premiums will be awarded for subscriptions received after that date. Any number of premiums will be sent to an individual in return for subscriptions, but we cannot accept subscriptions for a period of more than one year for any subscriber.

### Free Detector and Amplifier Tubes

We have just received a big shipment of Cunningham Type C-300 Detector Tubes and Cunningham Type C-301 Amplifier Tubes. These Tubes are the standard, tested General Electric-Cunningham product. Every tube is fully guaranteed by the Publishers of RADIO to be in perfect operating condition. We will send you one of the Detector Tubes for three subscriptions to RADIO. If you send us four subscriptions, you will receive one of the Amplifier Tubes. Remember that we guarantee to ship these tubes on the same day that your order is received. 25c must be included for mailing charges.

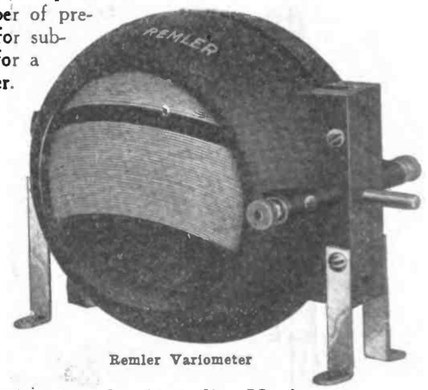



Pen Brand 43 Plate Variable Condenser

### Improved Type, Highly Efficient Condenser

The 43 plate Variable Condenser illustrated above will be given to you for securing three subscriptions to RADIO. This Condenser is equipped with binding posts and a novel adjusting device for regulating the tension of the movable plates. We have a good supply of these Condensers on hand, ready for immediate delivery. Do not forget to include 25c for mailing charges when you send us the order.

**Moulded Remler Variometer or 43 plate "Pen" Condenser given free with three subscriptions to RADIO**

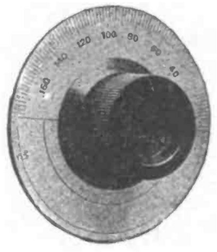



Remler Variometer

### The Popular Bakelite Variometer

This instrument needs no introduction. It is one of the best constructed and most efficient pieces of radio apparatus on the market. We have a limited supply on hand, ready for delivery on the same day that we receive your order. Send us three subscriptions to RADIO and the Variometer is yours. Be sure to include 25c for mailing charges. This Variometer retails at $6.50.

**23 Plate "Pen" Variable Condenser Free With Two Subscriptions**



Radio Frequency Amplifying Transformer

**Aerovox Inter-tube Coupler free with three subscriptions**

This Transformer has just recently been placed on the market by the Radio Devices Company, San Francisco, and has already met with the approval of numerous radio manufacturers and experimenters. The retail price of the instrument is $4.50. We will send you one of these Transformers upon receipt of two subscriptions to RADIO. Include 25c for mailing charges when you send us the order.

### Silver-Plated Dials Free

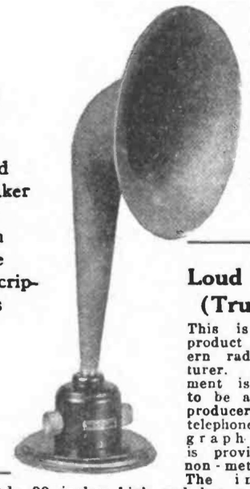
The standard 3" Somerville Silver-Plated Navy Dial, with large knob, as illustrated above, will be given to you for securing one subscription to RADIO. The Remler 3" Bakelite Dial, white engraved, with bakelite knob, will also be given free with one subscription. The mailing charges on either Dial are 12c, and this amount must be sent with your order.

## ALL APPARATUS GUARANTEED TO BE AS REPRESENTED

## ALL PREMIUMS WILL BE MAILED ON SAME DAY THAT SUBSCRIPTIONS ARE RECEIVED

**Tell your friends about this remarkable offer. Show them this advertisement. It is an easy matter to secure subscriptions for RADIO. Try it and be convinced.**

**You get this Loud Speaker free with three subscriptions**



This Transformer FREE WITH ONLY TWO subscriptions

### Loud Speaker (True-Tone)

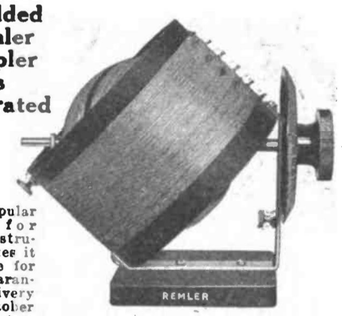
This is the latest product of a Western radio manufacturer. The instrument is guaranteed to be a perfect reproducer of radio telephone and telegraph signals. It is provided with a non-metallic horn. The instrument stands 22 inches high and has a twelve inch bell horn. It retails for $6.50, and will be sent to you free of charge for securing three subscriptions to RADIO. It will be necessary for you to include 60c for mailing charges, due to the heavy weight of the shipping carton.


### Bryant Transformer

You get one of these Transformers for securing only two subscriptions to RADIO. The retail price is $5.00. It has a ratio of 3½ to 1, and the insulation resistance is above 10 megohms. The mounting is beautifully finished in blued steel. Mailing charges of 25c must accompany your order.

This Remler Vario-coupler given free with three subscriptions to RADIO

**Bakelite Moulded Remler Coupler as Illustrated**



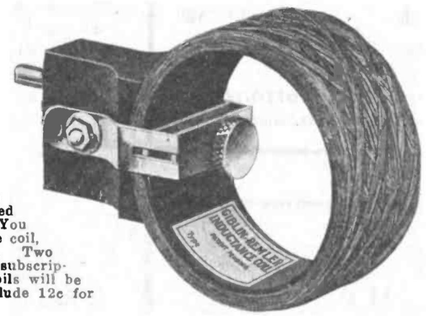

The popular demand for this instrument makes it impossible for us to guarantee delivery after October 15th. Better get your three subscriptions in our hands immediately, and we will send you one of these Couplers on the same day that we receive your order. The Coupler is furnished without dial. Mailing charges are 25c.

### FROST FONES FREE with three subscriptions

We have only a limited supply of these quality receivers on hand, and you will have to act quickly if you want to receive a pair of these fones. They will be shipped directly from our office immediately upon receipt of your subscriptions. The usual 25c must be included for mailing charges.

### REMLER-GIBLIN COILS

This latest type of inductance will be given to you free of charge for securing one subscription to RADIO. The usual Remler-Giblin plug will be supplied with each coil. This plug is illustrated in the accompanying half-tone. You may have your choice of any size coil, varying from 25 to 150 turns. Two coils will be given with two subscriptions, but no more than three coils will be supplied to one subscriber. Include 12c for postage.

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Mailing charges of 12c must accompany orders for apparatus, but the C. W. Manual will be sent to you postpaid.

***Send us your own subscription and get one of these premiums***

**THIS BIG OFFER EXPIRES ON NOVEMBER FIRST!**

*Continued from page 54*

The property of a coil of wire by virtue of which it stores up electromagnetic energy, manifested as we have just seen, is termed its *inductance.*

In the pioneer days of electricity it was discovered that a difference of potential would be set up or induced across the terminals of a coil if the coil were subjected to a changing magnetic field. This magnetic field might be that from an ordinary, permanent steel magnet in the form of a bar, or it might be the magnetic field generated within a coil carrying a direct or alternating current.

This phenomenon is termed *electromagnetic induction,* its essential feature being that the magnetic field inducing the electrical potential must be *changing,* not constant. With a permanent steel magnet, this condition can be obtained by thrusting the magnet into the coil and withdrawing it. If a coil carrying direct current is used, the effect is obtained by turning the current on and off. This latter condition may be realized by employing an alternating current in the coil, since, as we have seen, an alternating current is one in which the electrons flow first in one direction, stop, and then flow in the opposite direction. (The reversals of current are called *alternations,* and one-half the number of alternations per second is termed the *frequency* of the alternating current.)

The amount of potential generated by electromagnetic induction across the terminals of a coil depends upon the number of turns of wire in the coil, the strength of the magnetic field, and the frequency with which the magnetic field is changed. To double any one of these factors will double the induced potential.

If an alternating current is sent through a coil or inductance, the changing magnetic field which it sets up within and around the coil will induce a potential not only across the terminals of another coil brought near it, but also across the terminals of the first coil. This induced potential is not added to the original alternating potential, but is opposite in polarity and therefore opposes it. This opposing, induced E. M. F. is called "back" E. M. F. The effect of this back E. M. F. is to cut down the amount of alternating current flowing through the coil.

We have seen that the amount of induced potential depends upon the frequency of the magnetic change. With alternating current in a coil, the frequency of its magnetic field and hence the amount of the back E. M. F. depends upon the frequency of the current.

The property of a coil by virtue of which it tends to limit the passage of alternating current through it due to the back E. M. F. generated within it is termed its *reactance.* Reactance, like resistance, is measured in ohms. A coil offers no reactance to direct current be-

*Continued on page 60*

*"The Peak of Perfection"*

# 3 big advantages


## The Parkin dial type Rheostat

*(Patented August 1, 1922)*

In the *Parkin-Dial Type Rheostat* the resistance element is placed *outside the cabinet* in a recessed groove in the back of a three-inch moulded Bakelite dial. This *patented* construction gives the *Parkin Dial-Type Rheostat* three big exclusive advantages found in absolutely no other rheostat—

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An off position is provided, and a stop on the dial engages stationary contacts at the extreme positions.

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THE DIAL is moulded of black Bakelite, beautifully polished, and graduated from 0° to 180° for fine adjustment. Graduations read from right to left for clockwise rotation, and are filled with brilliant white enamel for easy reading. The knob is of moulded Bakelite.

THE RESISTANCE ELEMENT consists of a flat semi-circular core wound radially with non-corrosive resistance wire, and recessed in the back of the dial. Adjacent turns are slightly spaced, allowing single turn adjustment. Resistance 5 ohms, carrying capacity 1½ amperes.

TO MOUNT the *Parkin Dial-Type Rheostat* is extremely easy. Fasten the stationary contact to the panel with screw and nut furnished. Loosen the set screw behind the knob, remove the shaft, insert it through the hole in the panel, replace the dial on the shaft, and tighten set screw. That is all. Only two small holes are necessary in the panel; a 3/16 inch hole for the shaft, and directly below this, ⅝ inch from the center, a ⅛ inch hole for the screw which fastens the stationary contact to the panel.

*Parkin Dial-Type Rheostat* Order No. 100, price complete *$1.50* at your dealer. Write for *"Radio Buyers Guide"* No. 9, listing other Parkin *Peak of Perfection* Parts.

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Parkin Parts

SINCE 1914

*Continued from page 58*

cause the magnetic field set up by such current is constant; it does not change, except at the instant when the current is turned on or off.

When an alternating current flows through a coil it is thus subjected to the resistance of the wire itself and the reactance of the coil. The total limiting factor is called the *impedance,* being a combination of both resistance and reactance.

A condenser also offers reactance to an alternating current, but of a different type. We have seen that a coil offers no reactance to direct current. A condenser, however, offers tremendous reactance to direct current, so much so that no direct current can flow through it. A condenser, then, is really an insulator to direct current.

Since a condenser acts in exactly opposite fashion to an inductance, the reactance of a coil to alternating current may be reduced if a condenser is inserted into the circuit. In fact, if the condenser is properly designed for the particular coil in use, the reactance of the condenser can be made to neutralize or annul exactly that of the coil, so that the only impedance offered the alternating current is that of resistance, as if direct current were flowing through the coil. Such a condition is called *resonance;* the coil and condenser are said to be in resonance with each other, and the circuit is called a resonant one.

4. We shall discuss the phenomenon of radiation in the next assignment.

Before completing this assignment, we give in Fig. 4 some conventional symbols used in drawing electrical and radio diagrams.

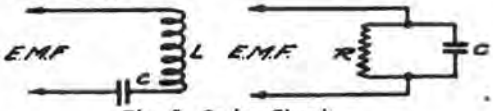


*Fig. 5—Series Circuit*
*Fig. 6—Parallel Circuit*

When current flows through one electrical device before passing through another in the same circuit, the devices are said to be in *series* with each other and the circuit is called a series one. If the current flows through both devices at the same time, they are said to be in *parallel,* or *shunt,* and the circuit is termed a parallel circuit. Thus, Fig. 5 represents a series circuit and Fig. 6 a parallel one.

*Continued on page 62*

# Broadcasting a Message of Radio Reliability

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COTO-COIL CO. is not a mushroom growth in the Radio field. We originated Honeycomb Coils long before the radio boom. We are here to stay. Our products are right to hold their own in any comparison for quality. Electrically correct and mechanically accurate. Even the Cotoco Dial is a better product—practically unbreakable, with metal insert to make it run true.

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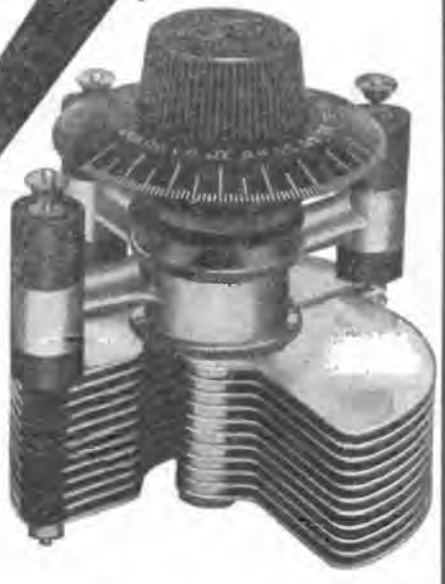

Above, the COTOCO VARIABLE AIR CONDENSER, scientifically correct for minimum of electrical losses. A fine machine product that is as superior as it looks. At left, below, the COTOCO AMPLIFYING TRANSFORMER FOR AUDIO FREQUENCY. Allows you to forget distortion. Whether through head phones or loud speaker, music or speech comes clear and true. At right, below, the COTOCO HONEY-COMB COIL, yet to find its equal as a compact, neat and remarkably efficient inductance unit. We made the first one.

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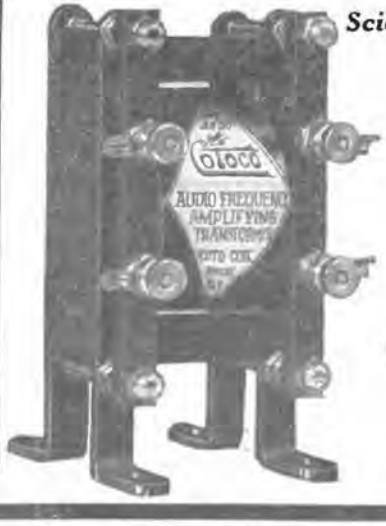


Mounts on Either Fixed or Trunnion Brackets

*Continued from page 60*

## RADIATION

WE observed in the first assignment that there are four phenomena accompanying the flow of a stream of electrons, or the electrical current in a wire, *i. e.*, the generation of heat in the conductor, the production of both electromagnetic and electrostatic fields around the wire, and radiation.

What do we mean by radiation? We mean the emanation or propagation of electrical waves away from the conductor, just as we say that an electric lamp radiates light waves and a hot iron radiates heat waves.

These waves are sent off from the conductor as a result of the building up and collapsing of the electromagnetic and electrostatic fields around the wire when the direct current flowing therein is started and stopped. In this respect, the radiation of electrical waves is similar to the electromagnetic induction of potentials from a direct current flowing in a coil, which we studied in the last assignment, in that this phenomenon is not observed unless the current is thrown on or cut off in the circuit. We also observed in the last assignment that an alternating current fills the requirement of an intermittent current in a coil for the electromagnetic induction of potentials in that coil, or in an adjacent one, in that the stoppages and reversals of the electronic flow within a wire are equivalent to a direct current which is thrown on and off by means of a switch in the circuit.

So it is with the phenomenon of radiation. Electrical waves are not radiated from a wire unless the direct current within the conductor is started and stopped or unless an alternating current is flowing within the wire. As in electromagnetic induction, this prerequisite of an intermittent or alternating current is very important.

Electrical waves are very similar to other types of waves, such as sound waves and waves on the surface of water, and in order that you may have a thorough understanding of them, we shall examine the latter type first.

If a stone is dropped into a pool of still water, ripples or waves spread out over the surface of the water in ever-increasing, concentric circles, the center of these circles being the spot where the stone struck the water and where the splash or disturbance occurred. It is significant that a *disturbance* of the water—the medium which conducts or transmits the waves, just as the ether which was mentioned in the last assignment, conducts electrical waves—is

*Continued on page 64*

# REMLER Cunningham

# Giblin-Remler Inductance Coils

## Ideal For Reception On All Wave Lengths

It is well known among radio engineers that the most efficient receiving sets are those designed so that all of the turns of wire in their inductance coils are in constant use, regardless of the wave length being received. This factor limits the wave length range of the most efficient sets for Radiophone reception.

Maximum efficiency is obtained for any given range of wave lengths in either single circuit or coupled circuit receivers by using Giblin-Remler Coils, shunted by variable condensers. Any desired range of wave lengths is at the operator's disposal by merely changing the size of the coils used in the coil mounting.

This operation does not require the connecting of any wires and is as simple and quick as inserting a telephone plug in a jack. If variable condensers of .001 micro-farads capacity are used, four sets of Giblin-Remler Coils (of sizes determined from the table) will cover the entire range of wave lengths between 128 and 23,800 meters.

## Maximum Inductance and Minimum Distributed Capacity

| Type and Number of Turns, Mounted | Price, Mounted | Type and Number of Turns, Unmounted | Price, Unmounted | Inductance in Millihenrys at 1000 cycles, Accuracy ½% | Natural Wave Length in Meters, Accuracy ½% | Distributed Capacity, in micro-microfarads, Accuracy 1% | Wave Length Range in Meters using Condenser of .001 max. and .00034 mfd. min. | | High Frequency Resistance in Ohms at Wave Length shown | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min. | Max. | 200 | 500 | 1000 | 2000 |
| RG 25M | 1.50 | RG 25U | .70 | .030 | 39 | 14.3 | 63 | 334 | | 1.1 | | |
| RG 25M | 1.50 | RG 25U | .70 | .041 | 47 | 15.2 | 75 | 389 | | 1.5 | | |
| RG 35M | 1.50 | RG 35U | .70 | .083 | 87 | 25.4 | 128 | 550 | | 3.5 | | |
| RG 50M | 1.60 | RG 50U | .80 | .169 | 114 | 21.6 | 185 | 785 | | 5.5 | 4.4 | |
| RG 75M | 1.65 | RG 75U | .85 | .377 | 163 | 19.8 | 266 | 1170 | | 28.3 | 12.1 | 6.2 |
| RG 150M | 1.70 | RG 100U | .90 | .666 | 217 | 19.9 | 358 | 1550 | | 80.3 | 26.5 | 12.6 |
| | | | | | | | | | 1000 | 2000 | 5000 | 10000 |
| RG 150M | 1.75 | RG 150U | .95 | 1.503 | 281 | 14.8 | 512 | 2320 | 69.5 | 23.5 | 7.1 | |
| RG 200M | 1.50 | RG 200U | 1.00 | 2.68 | 374 | 14.7 | 690 | 3110 | | 50.6 | 12.5 | |
| RG 250M | 1.50 | RG 250U | 1.10 | 4.20 | 424 | 12.1 | 860 | 3880 | | 87.5 | 19.9 | |
| RG 300M | 2.00 | RG 300U | 1.20 | 6.11 | 494 | 11.2 | 1030 | 4650 | | 141 | 29.3 | 13.8 |
| RG 400M | 2.10 | RG 400U | 1.30 | 11.04 | 618 | 9.7 | 1380 | 6300 | | | 54.6 | 22.3 |
| RG 500M | 2.30 | RG 500U | 1.50 | 17.50 | 747 | 9.0 | 1730 | 7900 | | | 93.1 | 34.9 |
| | | | | | | | | | 2000 | 5000 | 10000 | 20000 |
| RG 800M | 2.40 | RG 800U | 1.60 | 29.2 | 1024 | 10.1 | 2260 | 10250 | | 111 | 43.8 | |
| RG 750M | 2.85 | RG 750U | 1.85 | 39.0 | 1249 | 11.3 | 2660 | 11850 | | | 64 | |
| RG1000M | 3.40 | RG1000U | 2.50 | 71.6 | 1620 | 10.3 | 3570 | 16000 | | | 123 | |
| RG1250M | 3.80 | RG1250U | 2.90 | 108.0 | 1930 | 9.7 | 4380 | 19700 | | | | |
| RG1500M | 4.40 | RG1500U | 3.50 | 159.8 | 2300 | 9.3 | 5300 | 23800 | | | | |

This table compiled by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

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**REMLER RADIO MANUFACTURING COMPANY**

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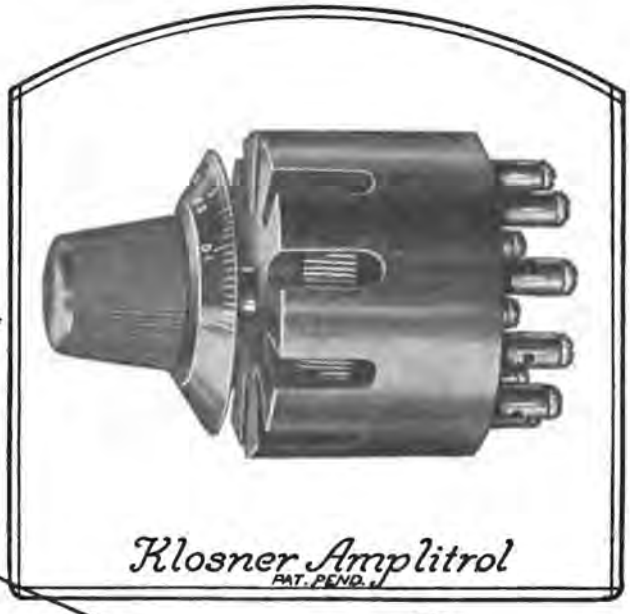
Continued from page 62

necessary for the radiation of these water waves. If the stone were simply suspended on a string so that it touched the surface of the water, and no motion were imparted to it, no waves would be set up. This stationary or non-disturbing condition is similar to a flow of *direct* current in a wire. It is only when a disturbance in the transmitting wave medium occurs that waves are radiated. The effect of a direct current in a wire is to produce an electromagnetic and electrostatic strain in the ether surrounding it, but this strain is only a passive or potential one (in the non-electrical sense), and a disturbance in the ether is not caused until the electromagnetic and electrostatic fields are built up or collapsed, due to the

Continued on page 66

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*We are the inventors and sole manufacturers of the famous Klosner Vernier Rheostat Model 100, still being sold for $1.50.*

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The "Amplitrol" and the Rheostat do not employ the graphite-disc principle, but that of wire wound. This feature insures perfect contact at all times, making tuning quicker and louder and giving greater range. Why buy an ordinary rheostat when the Klosner costs no more? See them at your dealer's or write for literature.

## Klosner Improved Apparatus Co.,

2024 Boston Road New York City

*Continued from page 64*

turning on or shutting off of the direct current or the employment of an alternating one.

Water waves consist of crests and troughs—the crests constituting the uppermost portions of the waves and the troughs, as their name implies, being the lower or depressed recesses between the crests. The crests are raised as much above the surface of the water as the troughs are depressed below it.

It should be noted that the entire body or bulk of the water around the scene of disturbance does not move outward in the form of waves. The only part of the water which actually moves outward in the circular fashion described is that part constituting the ripple or crest.

If a disturbance or noise is produced in the air, the air in the immediate vicinity of the point of disturbance is compressed and circular waves of compression travel outward in all directions from the center of disturbance, just as did the waves on water. There is one difference, however, between air waves and waves on water in that while the latter are limited to the surface of the water, except for the small amount by which they are raised above or depressed below the surface, as we have just seen, the waves in air, or sound waves, travel in gradually rising or mounting *spherical waves.*

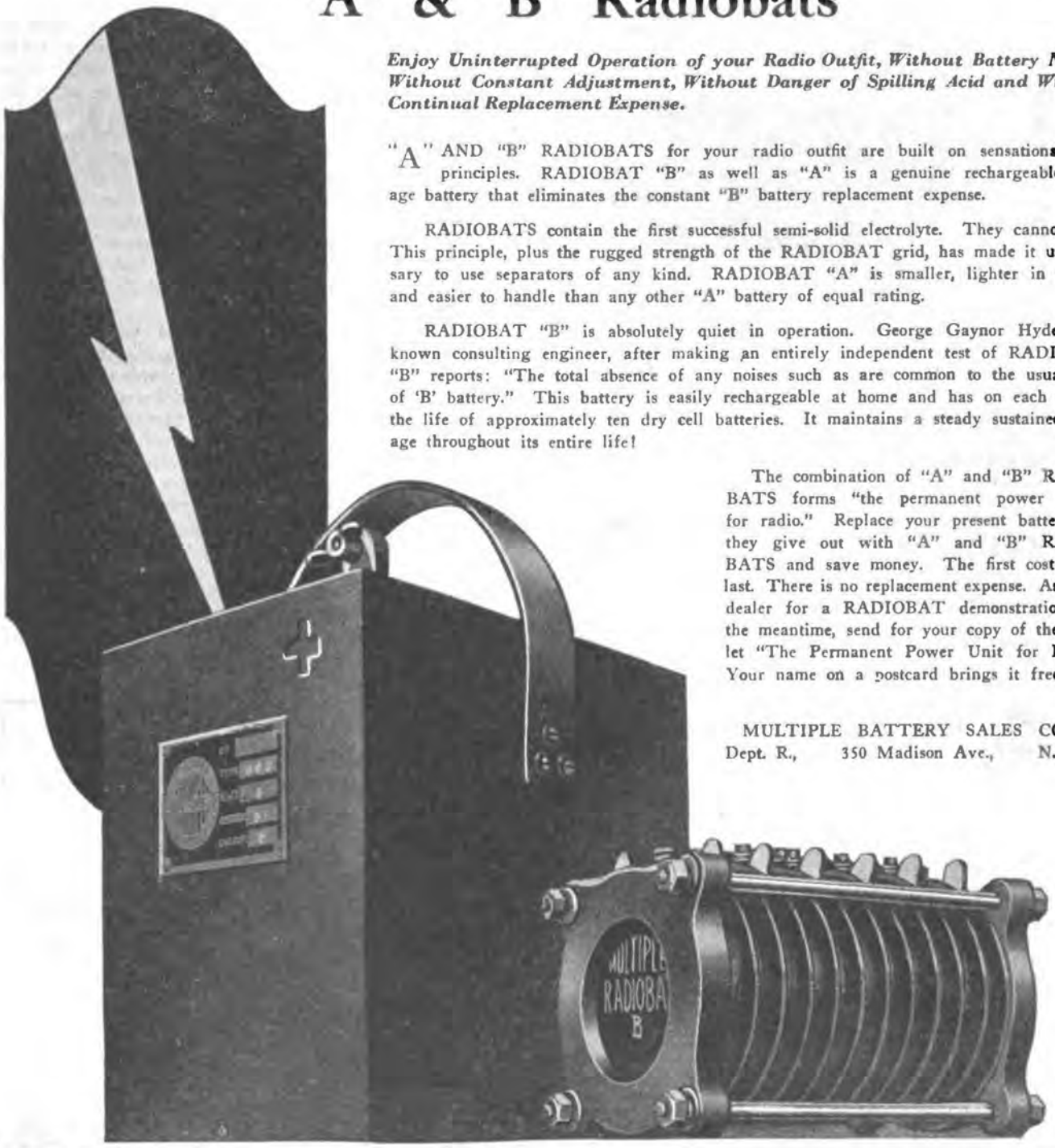
The Greek Theatre at the University is semicircular in shape, but if we should imagine it to be fully circular and should picture ourselves to be at some point above the center of our imaginary circular theatre, the view we should have of the circular, rising tiers of seats would be roughly similar to that which we should have of sound waves sent out in air—that is, assuming that sound waves were visible and were emanating from some point below us.

Radio waves—which, as we shall see later, are one form of electrical waves—are similar to air or sound waves in that they are not only circular but also spherical.

The distance between the crest of one

*Continued on page 68*

# Hook your radio set to these sensational "A" & "B" Radiobats

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MULTIPLE BATTERY SALES CORP.
Dept. R., 350 Madison Ave., N. Y. C.

# "A" and "B" RADIOBATS

## The Permanent Radio Power-UNIT

*Continued from page 66*

wave—whether it be electrical, air, or water—and the crest of the next succeeding or preceding wave is termed the *wavelength*. Obviously, this distance is the same whether it is measured between crests or troughs.

One of the most common types of sound waves is that of speech, set up by the vibration of the human vocal cords. The oftener the surrounding air is disturbed due to the rapidity of vibration or the frequency of the vocal cords, the more waves will be radiated from the mouth in a given length of time. A complete wave consists of one crest and one trough and the number of complete waves or cycles (compare with the definition of *cycle* in the last assignment) which occur in one second of time is termed the frequency.

The frequency of waves—whether they are sent up in air from the vibration of the vocal cords or of a piano string, or on water due to the imparting of regular or periodic disturbances to its surface—is exactly the same as that of the disturbing or vibrating source of such waves. As we increase the frequency of vibration of the generating or disturbing source, as we have just seen, we cause more waves to be radiated in a given length of time. Since these waves follow each other with increased rapidity or frequency, it follows that they are more closely

*Continued on page 70*

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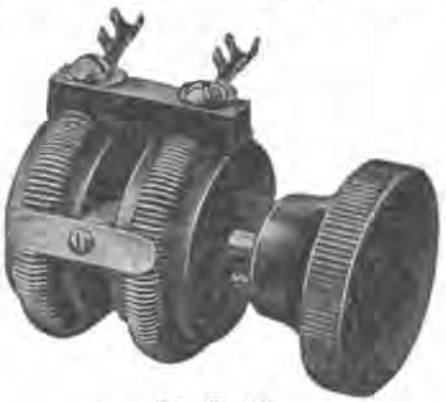

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Pen Brand 43 Plate Variable Condenser

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| 3 plate Vernier | Approx. .00005 mf | | $2.10 |
| 7 plate Variable | Approx. .0001 mf | | 2.25 |
| 11 plate Variable | Approx. .0002 mf | | 2.60 |
| 17 plate Variable | Approx. .0003 mf | | 3.00 |
| 23 plate Variable | Approx. .0005 mf | | 3.60 |
| 33 plate Variable | Approx. .00075 mf | | 4.20 |
| 43 plate Variable | Approx. .001 | mf | 4.70 |
| 63 plate Variable | Approx. .0015 | mf | 7.20 |

**Manufacturers**

We are in position to supply you with U and T punchings for transformer iron cores, also brackets. If you are contemplating manufacturing transformers, write us, stating your requirements, and let us quote you.

Attractive discounts to dealers and jobbers. Write for folder on PEN BRAND PRODUCTS

**THE RADIO TELEPHONE SHOP**
175 STEUART STREET SAN FRANCISCO, CAL.

# Radio Frequency
## Amplifying Transformers

*What is Radio Frequency Amplification?*

Radio Frequency Amplification is the increasing of the strength of radio signals or waves before they are applied to the detector tube, where they are made audible.

*What results will I get by adding Radio Frequency Amplification to my set?*

Louder signals with less noise in your set; distant stations which your detector alone cannot pick up. Less interference and less static disturbance, particularly if you use a loop indoor aerial.

*Can Radio Frequency Amplification be added to any standard make of tube set to advantage?*

Yes.

*What must I add to my set to use Radio Frequency Amplification?*

One radio transformer, one tube socket and one amplifier tube must be added for each stage desired. A 200 ohm potentiometer, irrespective of the number of stages, is an advantage, although not necessary.

*How should a Radio Frequency Transformer be constructed to insure maximum efficiency?*

An efficient radio frequency transformer is preferably built with a closed magnetic circuit to prevent undesirable oscillations or whistling sounds and should, therefore, employ an iron circuit and iron shielding to eliminate stray magnetic fields.

*What Radio Frequency Transformer is built that way?*

The transformer manufactured by the Radio Service Laboratories, Inc., is built on this engineering principle. The comminuted iron closed core (a special form of divided magnetic material) completely encloses the bobbin or transformer windings thus broadening the wave-length range, increasing the amplification per stage, shielding from stray magnetic fields, and eliminating capacity and leakage effects.

*Where can I obtain this transformer?*

At any electrical shop or store where Radio supplies are sold. If your nearest dealer does not carry it, write to the Rasla Sales Corporation, national distributors, 10 E. 43rd St., New York City, giving us the dealer's name and we will see that you are promptly supplied.

*Continued from page 68*

crowded together. The distance between any two waves is thus decreased; so we say that *as we increase the frequency of waves, we decrease their wavelength.*

The frequency of sound waves plays a very important part in our sense of hearing. Those sound waves which have a very low frequency of vibration are the low notes of the musical scale; or they have a low pitch, as we say. Those of higher frequency have a higher pitch. The ear can respond only to sound waves whose frequencies lie between certain limits. For example, the human ear cannot detect sounds of less than twenty complete swings or cycles per second. This is called the lower limit of audibility. Similarly, we cannot usually hear sounds of a frequency of more than ten thousand cycles per second. The upper limit of audibility, being in the higher frequencies, is not so clearly defined for different persons as is the lower, and as a consequence, there are some persons who cannot hear a cricket chirping, because some of the cricket's notes are above their limits of audibility.

In radio engineering those frequencies lying between 20 and 10,000 cycles per second have been termed *audio* frequencies, while those above 10,000 per second have been arbitrarily termed *radio* frequencies, since the frequencies of radio waves in common use fall in the region above the upper limit of audibility.

The speed or velocity of waves varies according to the media which conduct them. Sound waves travel in air at a speed of about one-fifth of a mile per second. Light waves—like the rest of

the electrical waves of which they are but one type, as we shall later observe—travel at a much higher speed, approximately 186,000 miles per second. This great difference between the speeds of light and sound waves can be readily observed by watching a distant pile driver, for example. One sees, by means of the high speed light wave, the hammer strike the pile long before the sound of the blow, carried by the sound waves, is heard. The same phenomena are observed in watching and hearing the whistle of a steamer or locomotive some distance away.

The significant point about all waves, whether they be mechanical waves—such as sound waves or water waves—or electrical waves—such as radio or light waves—is that they are set up by some vibrating source. With sound

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waves, we have mentioned as examples the vibrating vocal cords and a vibrating piano string. With radio waves, a vibrating electrical circuit is required, or a circuit carrying a vibrating electrical current. Such a current, as we have seen, is termed an alternating current.

### THE FAMILY OF ELECTROMAGNETIC WAVES

If we take an iron poker and commence to heat it in a flame we shall find that it will radiate heat waves even before it begins to turn red from the applied heat. This radiation of heat waves, while invisible at first to the eye, can be detected by holding the poker near the face or hand. As a matter of fact, all bodies are continually radiating heat waves since all bodies are at *some* temperature, but their heat is not apparent to us until the temperature rises somewhat above that of the human body, which, as you know, is just a little below 100 degrees on the Fahrenheit scale.

As we learned in the last assignment, all substances are composed of atoms or molecules depending upon whether they are elements, mechanical mixtures, or compounds. These atoms or molecules, as the case may be, are constantly in a state of vibration or unrest. Due to the vibration of these electrical particles or charges, electrical waves or radiations are constantly being given off from all bodies and we call these radiations *heat* waves. Heat radiation, then, is a form

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of electrical wave just as are light and radio waves.

If the atoms or molecules of which a substance is composed were not vibrating constantly, no radiations or heat would be given off and we should say that the body was at absolute zero temperature—not the zero of any of the thermometer scales with which we are familiar, but a temperature infinitely lower. Needless to say, such a condition does not exist, but it is approached, and even then only by a wide margin, by bodies or gases at extremely low temperatures, such as liquid air.

The amount of heat which a body contains and gives off in the form of heat radiations or waves is determined largely by the rapidity or frequency of its atomic or molecular vibration. If we apply external heat to a body, as we are doing in the case of the poker, this external heat energy, which is really a form of electrical energy, causes the atoms or molecules to vibrate more rapidly and its heat content increases and the temperature rises. As more and more heat is applied, the atoms and molecules vibrate at increasing frequencies and the frequency of the heat or electrical waves which the poker radiates is also increased. When enough heat is applied, the frequency of the electrical waves becomes sufficiently high so that we can *see* them and we say the poker is now red hot. These electrical waves have thus been converted from invisible heat waves to visible light waves.

As still more heat is applied to the poker, the increasing frequencies of its electrical radiations cause the poker to assume simultaneously, one after the other, the colors orange, yellow, green, blue and violet—in fact, all the colors of the rainbow. Now, as you may know, these colors are called the primary colors of light and the combination of all of them gives us white light. So we see that the reason why a poker becomes white hot when we apply enough heat to it is because it is emitting light waves of all the colors of the rainbow.

All the colors with which we are familiar are simply light or electrical waves of different frequencies. Just as we have seen that the ear can only detect sound waves of certain frequencies, so also the eye has certain limits of responsiveness called its limits of visibility as distinguished from the limits of audibility of the ear. And just as there are certain sounds above the ear's upper limit of audibility which the ear cannot always detect, such as the notes of the cricket, so there are electrical waves of frequencies higher than that which produces the color violet and which are invisible to the eye. These are called ultra-violet waves or rays and can be obtained from bodies at extremely high temperatures—our poker

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will give off ultra-violet waves or rays if we heat it sufficiently—from the X-ray, from radium, and from other radio-active substances.

While these ultra-violet rays cannot be detected by the eye, they can be registered on a photographic plate, as is done in the making of an X-ray picture. Heat or infra-red waves, as we have seen, while not visible to the eye, can be detected by our sense of touch.

Below the infra-red waves is a great band of additional electrical waves which are also invisible to the eye. These are the radio waves with which we are especially concerned. Their frequencies are lower than those of any of the other electrical waves and they can be detected only by special electrical circuits called radio receivers, which transform their feeble electrical currents, sometimes only after they have been amplified many times at the receiver, into sound.

Starting with the waves of lowest frequency, there is reproduced below a

*Continued on page 80*

## RADIOADS

**A CLASSIFIED ADVERTISING SECTION READ BY 60,000 BUYERS**

The rate per word is five cents, net. Remittance must accompany all advertisements. Include name and address when counting words.

Ads for November issue must reach us by October 1st

**GENUINE BARGAIN**—DETECTOR AND TWO STAGE AMPLIFIER with two guaranteed amplifying transformers, three rheostats, three sockets, grid condenser, Formica panel, jacks, binding posts and bus-bar wiring. Sell for $24.00. Used only one week. First money order takes it. Radio Designing Co., 515 4th Ave., San Francisco.

**Bank** wound tuning inductance for panel mounting. Range 17y to 3000 meters. Only three holes in panel are necessary for mounting and those are covered by dial. Price with bakelite dial, $10.00. Without dial, $9.00. W. S. Levin, 137 6th Ave., San Francisco, Cal.

**WESTON VOLTMETER**, Model 1, D. C., range 0-15V, 0-150V, fitted with reversing key, carrying case, condition like new. Cost $100.00. Sell for $50.00. W. S. Levin, 137 6th Ave., San Francisco.

**RADIO BATTERIES**, 50 A. H. 2 V. $3.25 each. Write Howard Hunt, Box 108, Macedonia, Ohio.

**LIGHTNING-STRANGE BATTERY COMPOUND** startles the world. Better than sulphuric acid. Charges discharged batteries instantly. Gallon free to agents. LIGHTNING CO., St. Paul, Minn.

**FOR SALE**—¼kw. Spark set, $19.00. Write Eugene Champion, 2507 East 1st St., Los Angeles, Cal.

**FOR SALE**—Cunningham Detector (new) $4; Radiotron amplifier (new) $5.50. Key ⅛" silver contacts $1.25; Signal socket (new) 75c; pair W. E. phones $10; 2 variometers (new), $4 each; 1 kw. protective device, $2.50; 2 sets variometer forms, $1.50 per set; 2 General Radio radiation ammeters, 0-1, $4 each. R. S. CLAYTON, 1404 66th St., Berkeley, Cal.

**ARMSTRONG SUPER-REGENERATIVE CIRCUIT** constants for immediate delivery: 5 millihenrie, $1.00; 10 millihenrie, $1.00; 100 millihenrie (iron core), $1.35; 1 henry (iron core), $1.35; 12,000 ohm non-inductive resistance, $1.75. All constants high grade. We offer without additional charge as premium with each order complete description and blue print of this circuit. HENRY I. LEVITON, 138 North La Salle St., Chicago, Illinois.

**ONE Magnavox Power Amplifier**, 20% off. New R-2 Magnavox without horn, $65. Henry Chapelle, Woodburn, Ore.

**MAGNAVOX SPECIAL**—The well-known Type R-3 Radio Magnavox with fourteen inch horn, $89.50. Cunningham or Radiotron Detector Tubes, $4.50. Amplifier Tubes, $6.00. Highly polished 3-inch composition dials with ¼-inch brass bushing, 50c. Genuine bakelite V. T. sockets, red, molded, 50c. HENRY I. LEVITON, 138 North La Salle St., Chicago, Illinois.

**CLARION LOUD SPEAKER UNIT**—For horn or phonograph attachment, Type 3-C, five dollars. Few Brandes Trans-Atlantic type head sets. List twelve dollars, our price to you, six-fifty. Enclose check and address: Citizen Wireless Service, Hornell, New York.

**DON'T MISS THIS** — With every pair of Superior Phones, $8.00; Murdock 8000 ohm Phones, $6.00; or Murdock 2000 ohm Phones, $5.00, you will receive an Amateur Radio Call Book FREE. Immediate shipment Postpaid. Wright Electric Co., Scottdale, Pa.

**KELLOGG RECEIVERS** No. 69-B, 2400 ohms, with 25 years of telephone construction behind them, super-sensitive, light weight, simple adjustment. Regularly sold at $12.00. October special at $7.50 each. HENRY I. LEVITON, 138 North La Salle St., Chicago, Illinois.

**BARGAIN**—Ten new guaranteed tubular detectors, six volt with double filament. Will sell one or the lot at $4.75 each. Cash with order. F. W. RICHARD, 5574 Broadway, Oakland, Cal.

**WANTED**—"PACIFIC RADIO" and "RADIO," volumes one, two, three and numbers one, two, three, four, five, six and seven of volume four, or any of them. ERNEST E. FORD, Alhambra, California.

**RADIOTRON UV 200 Detector Tube**, $4.50; Radiotron or Cunningham Amplifying Tubes, $5.85; 90 ampere hour Storage Battery, $14.75; $5.00 Transformer, $4.25; $1.50 Socket, 75c; $8.00 Phones, $6.75; R-3 Magnavox, $40.00; $1.00 Dials, 3"-3¼", 65c; Bakelite Panels cut to size, 2¼c per square inch; $1.50 Vernier Rheostat, $1.20; Nickel Binding Posts, 7c; Taps, 2½c; Stops, 2½c; Variometer, Mahogany or Spanish Cedar, assembled, $3.00; Variocouplers, assembled, $3.00; Bank Wound Inductance, 200-2500 meters, $8.00; $3.50 Condensers, 23 plate, $2.60; $4.75 Condensers, 43 plate, $3.70; "B" Battery, 45 volt (variable), $4.00; Homecharger, $17.50; $5.00 Murdock Phones, $4.50; $6.00 Murdock Phones, $5.50. EAST WEST RADIO CO., 81 Pleasant Street, San Jose, Calif.

*Continued from page 76*

table of the most important of the electrical waves:

Radio waves
Infra-red or heat waves
Red light
Orange light
Yellow light
Green light
Blue light
Violet light
Ultra-violet rays or waves
X-rays and radium emanations.

It should be noted, that while no gap exists between the frequencies of the electrical waves in the range from infra-red waves to X-rays, there is a considerable interval between the radio waves of highest frequency and the infra-red waves of lowest frequency. In this gap lie electrical waves of frequencies much higher than are encountered in radio practice, some of which have been produced in the laboratory but which to date have been put to no practical use. The rest have never been produced by man and so far, at least, have not been discovered to exist in nature.

You should clearly understand that the only difference between all the various types of electrical waves lies simply in their respective frequencies of vibration. It is this difference in frequency which determines whether the electrical wave shall be visible as in the case of light, and if visible, whether it shall be the color red or blue; whether it shall produce marked heating effects as in the case of infra-red waves; or whether it may be used to transmit intelligence by telephone or telegraph, as in the case of radio waves.

We have seen that air may be used as the conducting medium for the transmission of sound waves. The medium which serves to transmit or conduct the great family of electrical waves is shrouded in mystery. Formerly, it was considered to be the *luminiferous ether*, or simply the ether, a mysterious medium—neither liquid, gaseous nor solid—which fills all space. Light and radio waves certainly require no tangible medium on which to travel, because both can be sent with ease through a vacuum. A common example of this is the electric lamp in which the filament which radiates the light waves is completely surrounded by a vacuum.

As we learned in the last assignment, however, the publication and partial acceptance of the Einstein Theory of Relativity has led scientists to question the necessity for our conception of this mysterious ether. This phase of the subject is far from clearly understood by anyone and you need only concern yourself with those facts and phenomena in connection with electrical waves which have been indisputably proved.

For example, the velocity of all electrical waves has been definitely proved

to be 300,000,000 meters per second. (A meter is about three inches longer than a yard.) This velocity is equal to 186,000 miles per second. It is this very high velocity of the light wave which explains why we can see distant occurrences long before the sound connected with them reaches our ears.

It is interesting to note that a light wave, or a radio wave, if the transmitting station be sufficiently powerful, will travel seven and one-half times around the earth in one second.

It is known that all forms of electrical waves exhibit both electrostatic and electromagnetic characteristics, as does the electrical current in a conductor. It is because of this that electrical waves are often called electromagnetic waves.

In the reception of radio waves we make use of the electrostatic and electromagnetic properties as well as the actual flow of electrons from one station to another through the earth. These phenomena we shall study in the next assignment.

In summing up this assignment remember that all vibrating bodies emit waves and that by means of vibrating (alternating) electrical currents or vibrating electrons, electromagnetic waves may be radiated. The frequencies of these waves vary according to the frequencies of their radiating sources. The frequencies of electrical waves determine whether they are radio, heat, light or ultra-violet waves.

The waves of lowest frequency, ranging from 12,000 to 1,500,000 cycles per second, are used for radio purposes; those of very much higher frequency comprise the heat and light waves occurring in nature.

## LINKING THE AMERICAS BY RADIO

The Radio Corporation of America announces that it has received orders from the United Fruit Company and the Tropical Radio Telegraph Company for five radio stations, three for Central America and two for the United States, each with a sending radius of more than 2000 miles. The erection of these five stations will fill an important and essential gap in the radio communication system of the Americas.

The three Central American stations will be located on the corners of the triangle embracing Honduras, Nicaragua and Panama. The Tropical Radio Telegraph's stations will be located at Managua, the capital of Nicaragua, and at Tegucigalpa, the capital of Honduras, the city designated as the capital of the new Central American Union. These stations will connect with the United Fruit Company's station at Almirante, Panama.

The United States terminals of this communication system will be at New Orleans, La., where the present station of the Tropical Radio Telegraph Company is to be enlarged and new apparatus installed, and at a new station which the Tropical Radio Telegraph Company will erect in the vicinity of Miami, Fla.

## ARMSTRONG CIRCUIT

*Continued from page 15*

amplification will probably do better work on distant signals than would be possible with the Armstrong circuit.

The principle of this circuit, put briefly in simple words, is this: Ordinarily, the coupling between coils *A* and *B* can only go so far when oscillations start and signals can no longer be heard. If coil *A* is then removed a certain distance, oscillations will stop and regeneration take place. With the new circuit coils *A* and *B* can be very closely coupled and the tube is prevented from oscillating continuously by the action of the second tube. This second tube is not used directly for detecting or amplifying the signals, but simply generates an alternating current of 15,000 to 20,000 cycles per second. This is applied to the first tube in such a way as to paralyze it 15,000 or 20,000 times per second and thus prevent it from continuing in the oscillating condition.

Since the tickler coil *A* is now coupled very closely to coil *B*, the regeneration is much greater than in the simple circuit.

This principle is not entirely new. The writer had a demonstration of such a circuit two years ago by Mr. Charles V. Logwood. Where Armstrong paralyzes the tube and thus prevents it from continuing in oscillation by an electrical means, Logwood did it by a mechanical means. Logwood's circuit was intended primarily for the reception of long wave arc stations and was probably better adapted to that particular purpose than the new Armstrong circuit.

## BOOK REVIEW

"Elements of Radio Telephony," by William C. Ballard, 132 pages, 5 x 7, flexible cover. Published by McGraw-Hill Book Co., New York City, and for sale by RADIO, Pacific Bldg, San Francisco. Price, $1.50.

'Tis a relief for the reviewer who has been flooded with books on popular radio to read this book by Professor Ballard of Cornell University. The author knows what he is writing about and knows how to impart his knowledge to the reader. The book is intended to inform a novice what happens when messages are sent and received by radio. There is a minimum of mathematics, and that of the simplest. The treatment is confined almost entirely to the vacuum tube and its use as a generator, detector and amplifier of radio waves. The concluding chapter gives practical information for the experimenter who desires certain results but who does not know what apparatus is necessary.

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The Radio Pathfinder, by Richard H. Ranger, with line drawings by Thomas E. Monroe; 155 pages, 5x7½. Published by Doubleday, Page & Co., New York City. Price, $1.50.

The how and why of radio, in the abstract, is difficult for the layman to understand. As a crutch to the understanding, the author of this interesting book employs an animated electron to explain what is taking place in a radio transmitting and receiving set. He does this in such simple language that any twelve-year-old should find it easy to understand what is actually going on in the set. The action of each part is explained in detail, the description of vacuum tube detector and amplifier action being especially clear. This book is highly recommended to anyone who wishes to gain a qualitative understanding of radio intricacies.


NOW that the problems of Radio broadcasting have been solved, the real pleasure and usefulness of wireless telephony is dependent on possessing the only perfected loud speaker—the Magnavox Radio.

Your receiving set only brings the message, while Magnavox Radio tells it clearly and in full volume to all within reach of its voice.

### R-2 Magnavox Radio with 18-inch horn

This instrument is constructed on the electro-dynamic principle ("the reproducer with the movable coil") making it a most efficient converter of electrical energy into sound waves.

Type R-2 has very great amplifying power, yet requires only .6 of an ampere for the field.

R-2 serves the requirements of professional use for large audiences, dance halls, etc.

### R-3 Magnavox Radio with 14-inch horn

Same in principle and construction throughout as Type R-2, but possessing silghtly less amplifying power. Requires one ampere field current from your filament battery.

R-3 Magnavox Radio is ideal for use in homes, offices, amateur stations, etc.

With either type Magnavox Radio the hookup is simple and no extras or adjustments are required.

Attached to any commercial receiving set, the Magnavox Radio makes it possible for you to hear all that is in the air as if it were being played by your phonograph.

Whatever your previous experience (if any) with Radio has been, a new world of enjoyment awaits you in the service of the Magnavox Radio.

### Magnavox Power Amplifier—Model C

The Magnavox Power Amplifiers insure getting the largest possible power input for your Magnavox Radio. They can be used with any "B" battery voltage the power tube may require for best amplification.

Switching from stage to stage is made easy by master switches, as illustrated. *2 and 3-stage.*

More wonderful day by day grows the range of entertainment, recreation and information supplied by central broadcasting stations in all parts of the country.

It is the development of Magnavox Radio which has made these wireless programs fully enjoyable—removing the restrictions and limitations imposed by the telephone headset.

### Full Information—Send For It

Every radio user (present or prospective) will be interested in reading this new folder on the Magnavox Radio.

It contains full information about this wonderful reproducer, with illustration, description and list price of the various instruments.

Even if you do not now own a receiving set you should learn how the possibilities of wireless telephony have been revolutionized by the development of Magnavox Radio.


*On receipt of request we shall be pleased to send you free copy by return mail.*

## THE MAGNAVOX COMPANY

*Home Office and Factory:* Oakland, California

**New York Office: 370 Seventh Avenue**

## RADIO DEVELOPMENT

*Continued from page 40*

both in the United States and Great Britain, indicate that his first triumph of communicating by electromagnetic waves was accomplished by an arrangement of two metal plates, elevated on poles in the picturesque fashion common to country tavern signs, the transmitting plate being connected through a spark gap to earth. This device consisted of insulated balls that were divorced by small air space which could include a vacuum compressed air or gas, or a liquid. To the terminals of the gap the leads from the secondary of an induction coil were

connected, the primary winding having the common battery, key and interrupter, connected in its circuit. The interrupter functioned in making and breaking the circuit one hundred times a second. The receiving circuit passed from the plate, through the coherer, to the ground. The terminals of the coherer were connected to a relay which controlled the tapper, but in the absence of a bell, a sounder in parallel to the tapper coil, was employed. Departing from the experience of the vanguard of scientists who supplied him with his working materials, Marconi placed the circuits vertically instead of horizontally, and employed longer waves, more energy, larger radiating and receiving

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antennae. He also designed an improved coherer.

J. A. Fleming discovered that rarified gas was an effective conductor of electric current. The U. S. Patent Office granted him protective right to a device bearing striking similarity to an incandescent electric lamp.

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A metal cylinder surrounded the filament and the invention was employed in detecting wireless waves. His procedure in adapting this device to service was to employ the transformer coupling between the antenna and local circuit, connecting the metal cylinder to one terminal of the secondary winding and the filament to the other. Since, in the use of a device of this sort, the filament, when heated, gives off negative electrons which pass to the cylinder and out to render the space between the filament and the cylinder conductive, current can pass from the cylinder to the filament. The current will not readily pass the other way. Therefore, the Fleming progeny acts as a rectifier, and he dubbed it a "valve."

Lee De Forest, in 1905, made a notable contribution to the progress of wireless communication by introducing the "audion." It is a rectifier and a sensitive detector. It is a modification of the Fleming "valve." A metal plate, placed at one side of the filament, was substituted for the Fleming cylinder, and a third electrode of a perforated or grid-like design placed between the filament and plate. The universal popularity of this device and the reams upon reams of paper already devoted to describing and expatiating the virtues of this rectifier and detector render superfluous any attempts of elaboration in this article. May it be said, however, the modified audion, sometimes styled the thermionic amplifier, is the "heart and soul" of the modern radio outfit.

Edwin H. Armstrong and his regenerative

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feed-back circuit for the audion receiver, and Edwin H. Colpitts and his audion oscillator for generating modulated high-frequency waves, are inventors of more recent years than the ones previously treated in this manuscript. The luster of their contributions, however, is destined to be none the less brilliant than that of their predecessors. Already Armstrong is being heralded as the genius who made broadcasting of music and vocal speech by radio-telephony possible over the entire United States. The invention of Colpitts, for which a patent was granted in 1915, is designed to simplify the mechanism and strengthen the effectiveness of the apparatus required for the production of the modulated oscillations. The device consists of a repeater which acts as a generator of high-frequency oscillations, and also modulates these oscillations in accordance with the low-frequency signaling impulses to be transmitted.

## NEWS OF THE RADIO CLUBS

The Modesto Radio Club has published a new paper called *"The Oscillator,"* which contains interesting topics on radio. Laurance Babize (6APO) is in charge of a new phone set. The set is owned by Mr. R. G. Adams, dealer in Hudson and Essex automobiles, Fullerton, California. Three tubes (5 watters) are being used. The present radiation is 1.2 amperes on 200 meters. Anyone over 100 miles from Fullerton hearing 6APO on buzzer, voice or C. W., please QSL by radio or mail. All letters answered. The Club will not hold its regular semi-monthly meetings until late in the fall.

# At Last! *The* Perfect Radio Loud Speaker *for the Home*

THERE is no other Loud Speaker like the DICTOGRAPH—made expressly for home use by the makers of world-famous Dictograph products—standard everywhere for the finest, most accurate and most sensitive sound-transmission and loud-speaking devices. No other organization in existence has the facilities, the skill, the experience of the Dictograph Producta Corporation for producing a perfect Loud Speaker.

## DICTOGRAPH Radio LOUD SPEAKER

Years of experience in producing the marvelously sensitive "Acousticon" for the Deaf, the Detective Dictograph and the Dictograph System of Loud-Speaking Telephones have made possible this wonderful Radio Loud Speaker that reproduces every sound—singing, speaking, instrumental music—in crystal-clear, natural tones, full volume, and FREE FROM DISTORTION AND NOISE.

The Dictograph Radio Loud Speaker gives perfect results with any vacuum tube receiving set. No alterations; no extra batteries—you simply plug in and listen. The handsome appearance of this quality instrument harmonizes with any home.

Ask for FREE DEMONSTRATION of the Dictograph Radio Loud Speaker at any reliable radio shop. Get DICTOGRAPH quality and still save money.

Price $20

Complete with 6 ft. flexible cord

*The Standard of the World*

A beautiful instrument! Finely constructed, richly finished. Highly burnished, French lacquered, eleven inch spun copper bell horn attached to die cast black enamel tone arm, finished with nickel trimmings. Cabinet 6 x 5 inches base, 4 inches high, of solid ebony-finished hardwood, mounted upon rubber knobs. Furnished complete with 5-ft. flexible cord. No extra batteries required.

## DICTOGRAPH *Radio* HEAD SET


The Dictograph Radio Head Set has established a standard of quality impossible to secure in any other head set. Its use on any receiving set, crystal detector or vacuum tube improves reception immeasurably. 3000 ohms resistance. Price, $12—the best Head Set in the world. Regularly furnished as Standard Equipment with the Leading Receiving sets made.

Dealers—Order through your jobber or write for names of authorized distributors.

## THE DICTOGRAPH PRODUCTS CORPORATION

**220 WEST 42d STREET** *(Branches in All Principal Cities)* **NEW YORK CITY**

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## VARIABLE CONDENSERS

PLATES 1/32" thick ALUMINUM

If in your opinion this condenser is not equal to the best on the market in workmanship, appearance and efficiency we will refund your money. Strongly built—Beautiful design—High efficiency.

Type as illustrated

48 plate .001, $8.50

23 plate .0005, $2.75

11 plate .00025, $2

3 plate Vernier, $1.25

**MONTROSE Mfg. Co.**

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## SOMERVILLE TERMINAL INDICATORS 4 FOR 25c

"Slip under the binding post like a washer"

Do away with engraving and prevent mistakes in hooking up your panel.

Stock readings are:

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*WESTERN JOBBERS WRITE*

## SOMERVILLE DIAL INDICATORS

For 3/16, ¼ in. shafts

4 in. diameter.....$1.75

3¼ in. diameter..... 1.00

Knob only ..... .60

Postpaid from us by return mail, or from your local dealer.

*This is the first metal dial with flanged knob and has the following exclusive advantages over imitations:*

The knob is of real bakelite and will retain shape and finish.

The dial is of brass, heavily plated with real silver and coated with a special non-peeling lacquer, which preserves the silver finish long after nickel dipped and "German" silver dials are mottled and tarnished.

The heavy brass bushings and special method of assembly assures a dial which runs true on the shaft.

The surface finish permits writing call letters on the lower calibration space.

The dial is insulated from shaft bushing, and when grounded acts as a shield from capacity effect from body.

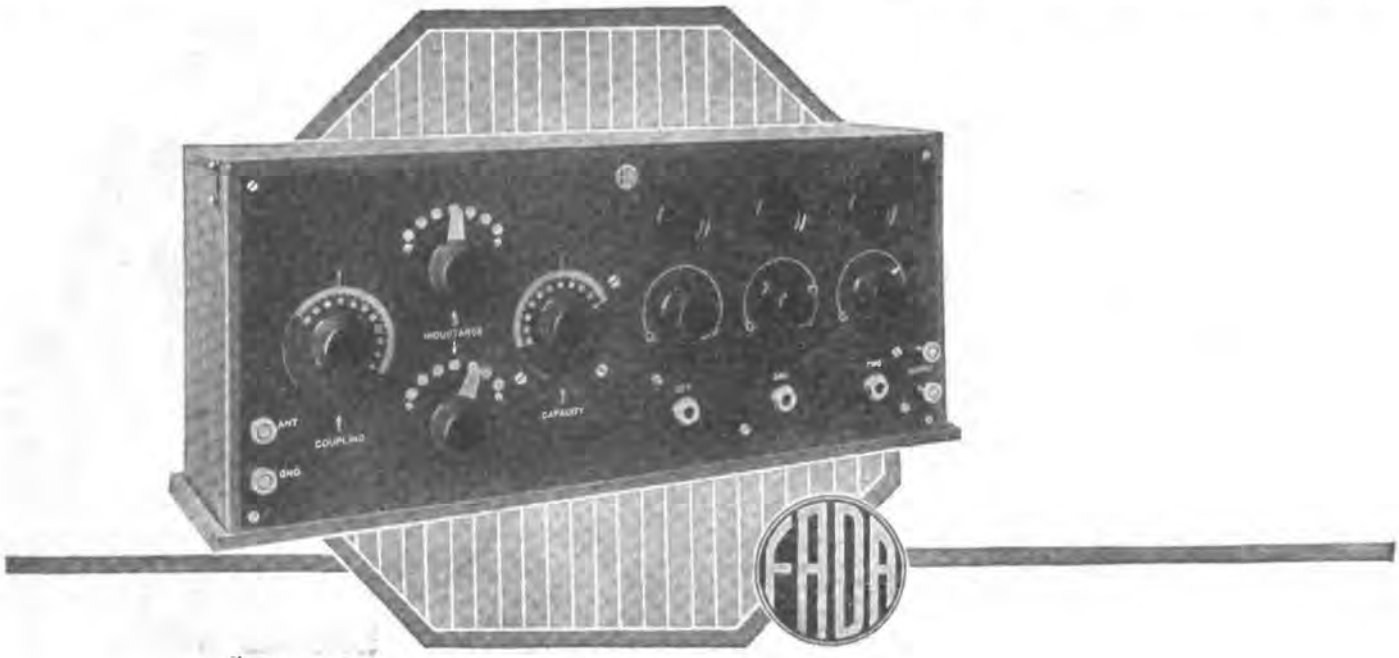
*Insist on the Original and Best*

Somerville Dial Pointer—10c

Transparent celluloid plate with black hair line allows a very accurate reading.

**SOMERVILLE RADIO LABORATORY**

*NEW ADDRESS* 43 CORNHILL, BOSTON, MASS.




# An Ideal Home Entertainer

The Fada receiver, a result of the same perfection in design and construction that distinguishes all Fada products, is gaining popularity as an ideal home entertainer.

When it's radio time in your home, you can sit back in your favorite chair, among the family circle and command at your fingers' touch, the talent of such noted artists as May Peterson, Percy Grainger, Mme. Margaret Namara, or Lydia Lipkowska.

You marvel that their voices can come into your home with such depth of emotion and true personality. Music is an inspiration to everyone, it goes to the very soul of things and brings joy and happiness to all.

With a Fada radio receiver music can be made part of your daily recreation. And after the musical program there is broadcasted a digest of important world events. You can, with a Fada receiver, literally keep a jump ahead of the headlines in tomorrow's newspapers.

*The new Fada handbook will be sent to you upon receipt of 5c. to cover postage. It's a How-To-Do-It book and you should have it.*

| | | | |
|---|---|---|---|
| Fada Receiver, Detector and Two Stage Amplifier | $80.00 | Crystal Detector | $ 2.75 |
| Rheostat ..... Now | .75 | Single Tube Socket | 1.00 |
| Inductance Switch | .50 | Double Tube Socket | 2.00 |
| | | Triple Tube Socket | 3.00 |

Get prices on other Fada equipment from your dealer or write us.

Interior view of Fada Receiver, Detector and Two Stage Amplifier

"Let me send you this Fada Handbook."

# Frank A. D. Andrea

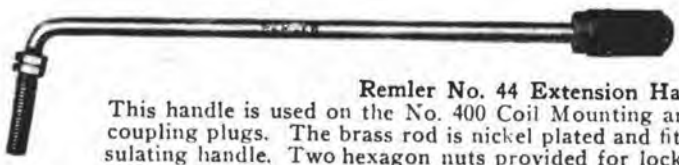
1581-F JEROME AVE. NEW YORK CITY

# REMLER Cunningham


Remler No. 42 Bakelite
Panel Plug
Price 60c


Remler No. 43 Bakelite
Coupling Plug
Price 90c


Remler No. 46 Bakelite
Coupling Plug
Price $1.00



**Remler No. 44 Extension Handle**
This handle is used on the No. 400 Coil Mounting and fits No. 43 and 46 coupling plugs. The brass rod is nickel plated and fitted with moulded insulating handle. Two hexagon nuts provided for locking on plug. Length 5¼".
**Price 30c**


**Remler No. 400 3 Coil Mounting**
The Remler No. 400 3 Coil Mounting is specially designed for the Giblin-Remler Inductance Coils, but is equipped with standard coil plugs and permits the use of any standard inductance coil. Bakelite Panel and Base. **Price $7.50.**

## *Specify Remler— It Radiates Quality*

The Remler All BAKELITE 3 coil mounting is undoubtedly the most efficient coil mounting on the market. The special shape of the Plugs allows a coupling range from zero to 90 degrees. The use of the long, insulated handles for adjusting coupling keeps the operator's hands away from the coils and minimizes body capacity effects.

For those who desire to build their own sets Remler high quality BAKELITE panel and coupling plugs and Extension Handles are sold unmounted as listed above.

Send 10c for new 40-page Remler Catalogue just off press, containing circuit diagrams for Remler Apparatus and other useful information, including a table of inductance, capacity and wave length.

## REMLER RADIO MFG. COMPANY

**248 First Street, San Francisco, Cal.** **154 W. Lake Street, Chicago, Ill.**

*"Your final choice—why not your first?"*

# Radio Supplies A-P Receiving Sets

*In buying a radio set look for a trade mark with a history—A-P is one of the oldest trade symbols in radio. It is the national standard, not for the quantity of sets produced, but for the quality, the dependability, and the perfect performance of every set bearing this symbol of excellence. There is an A-P set for every purpose. Write us the kind of set you are interested in, and we will tell you the nearest A-P dealer where you may see it demonstrated.*

## A-P Variable Condensers

*"Your final choice—why not your first?"*

A quality product. Panel type. Plates of No. 20 heavy gauge aluminum. Plate separators gauged to ½ of 1-1000 of an inch, machine turned and nickel plated shaft. Top and base of ⅛-inch sheet Bakelite Dilecto. Projecting shafts supplied on request.

| | | |
|---|---|---|
| 5 plate, | approx. .00015 mfd..... | $2.75 |
| 7 plate, | approx. .0002 mfd..... | 3.00 |
| 13 plate, | approx. .00035 mfd..... | 3.30 |
| 23 plate, | approx. .0005 mfd..... | 3.75 |

## A-P Audio Frequency Amplifying Transformer

*"Your final choice—why not your first?"*

$5.00

The kind of Transformer you have been wanting—one that amplifies just what it receives and gives you loud, pure, honest-to-goodness tones without adding a racket of discords. By special A-P process the core is constructed to reduce the external magnetic effects which produce discord and distortion. Amplifying coils have 19,000 turns of wire, filled with compound under vacuum to prevent moisture absorption. Metal parts, except the core, nickel plated. Price, $5.

*Write for complete catalog of A-P supplies and name of nearest A-P dealer*

## *Type AR-2 Detector Receiver and 2-stage Amplifier—$135*

*Licensed under Armstrong U. S. Patent No. 1,113,140, October 6, 1914, for amateur and experimental use only.*

A real performer—a genuine A-P receiving set incorporating the famous Armstrong Regenerative Circuit for maximum efficiency, and complete with an Audio Frequency Amplifier for securing volume for entertaining parties and friends. You will like this set and enjoy it. It is quickly and easily tuned. Receives either local or distant stations with equal facility, and can be operated with full efficiency on any wave length between 175 and 2,000 meters. Above all, you can depend upon getting real results in receiving either broadcasted programs or spark signals. **"Your final choice—why not your first?"** Price, **$135** f. o. b. San Francisco. Write for complete description and dealer's name.

**TYPE DR-5**

The same Receiver Detector described above, just as beautifully finished, and just as accurately constructed, but built in a mahogany cabinet by itself without the Audio Frequency Amplifier. Terminals in the rear to preserve the attractiveness of the front. Price, $85 f. o. b. San Francisco.

Manufactured by Oard Radio Laboratories, Stockton, California
Atlantic-Pacific Radio Supplies Co., San Francisco—Sole Distributors

*DEALERS and JOBBERS*
*Write for our co-operative merchandising plan*

# Atlantic-Pacific Radio Supplies Co.

Radio Supplies — 646-650 Mission St. San Francisco, Calif. — Receiving Sets

ABBOTT-BRADY PRINTING CORPORATION, S. F.