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RADIO

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"ASK ANY RADIO ENGINEER"

RADIO

Established 1917 as Pacific Radio News

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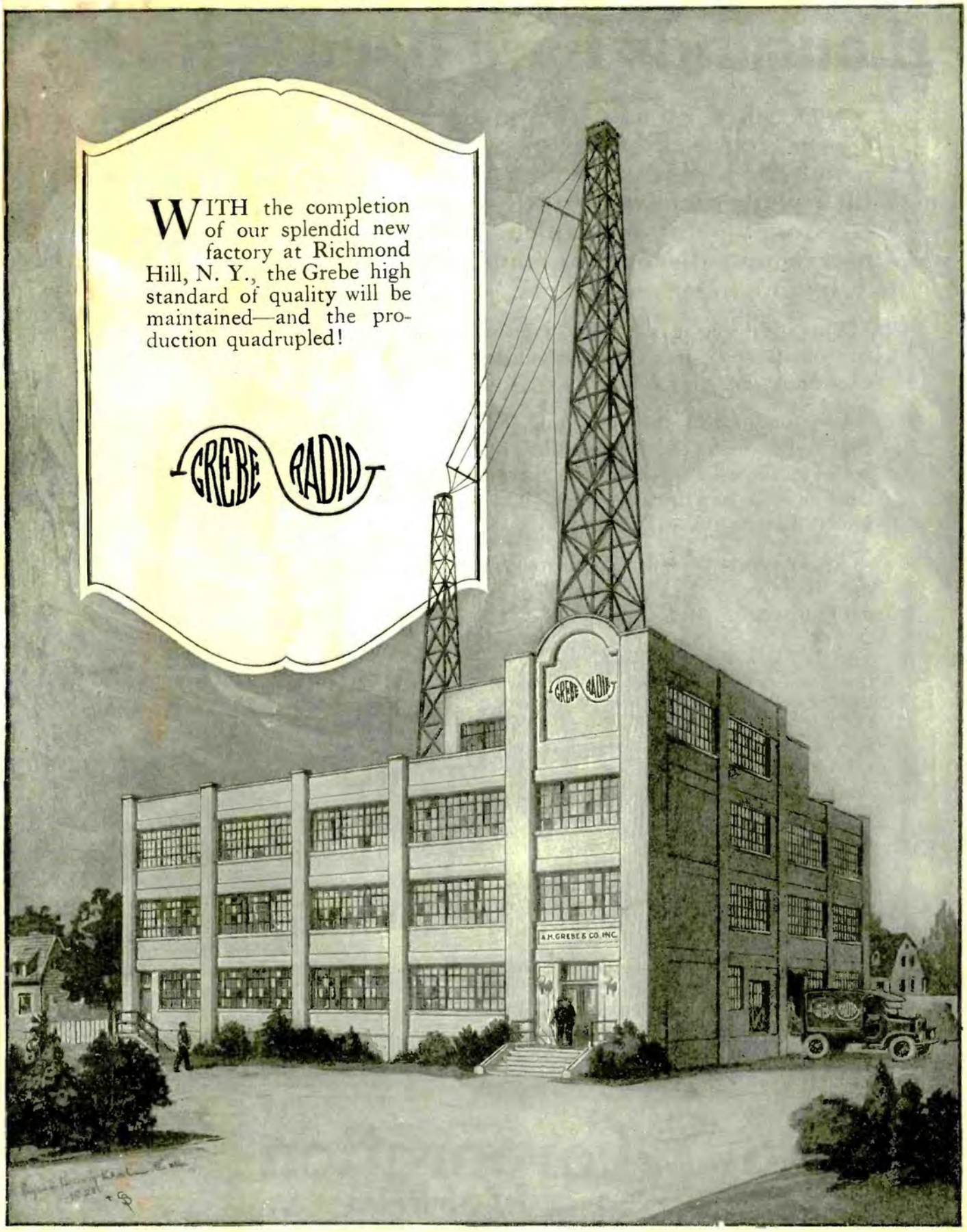
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Tell them that you saw it in RADIO

August, 1922 **RADIO** Vol. 4 No. 8

Radiotorial Comment

THERE are parasites that feed upon every vigorous, growing thing, and, in this respect, radio is no exception. The radio parasite is the unscrupulous promoter, the type of man that has made oil stocks a by-word and a stench in the public nostrils. These men see an opportunity to capitalize the public interest in radio by exciting the cupidity of small investors with impossible promises of large returns.

Nearly two thousand new companies have been formed to manufacture and sell radio apparatus during the past six months. Half million or million dollar radio corporations are formed overnight around some local "expert" as a nucleus with a flock of salesmen to peddle the stock at ten cents a share to the credulous. The wildest days of the Comstock excitement or oil gushers in new territory are tame compared to the rush to "radioland."

Of course some of these wild cat ventures will survive, but the great majority are foredoomed to failure. With increased production facilities by the old-established companies the supply of equipment will soon catch up with the demand. The owners of patents that are being carelessly infringed have already sounded warnings of prosecution. In the war for survival the "fittest" will be those concerns with real engineering advice, sound financial backing and proper distribution facilities.

So let the investor study any radio scheme as carefully as he studies investment in any other line of industry. The old Roman slogan, "caveat emptor," applies as well to the financial insecurities as to the junk apparatus with which the market is being flooded. Otherwise it is not investment, but simple gambling with the cards stacked against the player.

GREAT harm is being done to radio by the unwarranted interpretations that some of the fire underwriters' bureaus and inspectors are making of the National Electric Code rulings on radio installations. Actually there are only two hazards from an outside aerial: contact with light and power wires and lightning. As regards the former, the warning is well founded, but as regards the latter an aerial lightning switch is better than a lightning rod or other means as a protection. A wire clothes line, a tin roof or a telephone wire is just as "dangerous" as an aerial. As pointed out by "Electrical Magazine" of New York, which has energetically taken up the cudgel of defense, "an ordinary radio receiving set involves about as much fire hazard as a white enamel bath tub."

The fault lies not in the rules themselves, but in the alarmistic interpretation thereof and in the threat that rates will be raised or insurance canceled if aerials are erected. In the face of such a threat it is natural that dad or the landlord should forbid the boy to put up an aerial.

That such threats are idle as regards enforcement is shown by the fact that "any attempt to cancel insurance because of code violations, would wipe out half to three-quarters of the fire insurance business," because that number of houses already contain violations of the code in their electric wiring.

But as only a few people realize the publicity of such threats, thousands are being unnecessarily scared about a danger that does not exist. The continued repetition of this "cry of wolf" eventually will prove a boomerang to the inspectors, for when a real need for caution arises their warning will not be heeded. We believe that they will soon see that it is to their self-interest to desist in the attempts which can only temporarily retard the onward advance of radio into every home.

THE idea of a trans-Pacific test of amateur radio transmission, as suggested in July RADIO, has been taken up by the C. W. Association of America. Plans are now under way to carry on such a test this Fall, under the auspices of the Association. With such an organization of radio enthusiasts behind the plan its success seems assured.

We believe that the contest will be conducted in the broadest sort of a spirit so that every amateur, whether spark or C. W., may be assured that his signals as heard will be carefully logged. With this point in mind, our readers are invited to send in their suggestions and contributions to the secretary of the association. The preliminary announcement in this issue will be followed by a complete statement of rules and regulations in September RADIO.

THE thanks of the editor is extended to the hundreds of readers who filled out and mailed the questionnaire published in a recent issue. It is interesting to note that the grand average of all answers as to what kind of material our readers prefer to see published in these columns, coincides with what is now being published, or was already under consideration for early publication. It is hoped that all readers will continue to tell the editor what they want to read, as it is our purpose to endeavor to supply the demand without trying to too greatly simplify or "technify" the principles of approved radio practice.

Some subscribers have asked why relatively more attention is devoted to continuous wave transmission than to spark sets. The reason is two-fold; first, that the details about spark sets are readily available in simple language in the text books, while comparatively few books publish C. W. information that is understandable to the average amateur, and secondly, because C. W. is destined to supersede spark sending as amateurs become better acquainted with its simplicity of equipment, lack of interference and efficiency.

Military Radio

By Lieutenant-Colonel Robert Loghry, Signal Corps Reserve

IT is absolutely necessary that Army commanders in the field have efficient communication at all times. In certain instances, victory or defeat has hung upon the transmission of a single message and the importance of communications is so great that no engagement can be successful without a well planned system of communication. The branch of the Army, specifically charged with furnishing the major part of communication and the development of equipment to keep this communication up-to-date, is the Signal Corps. In the Regular Army, part of the Signal Corps is scattered throughout the United States and organized into companies, where from six to eight hours a day are devoted to training the personnel in communication methods and military duties, to prepare them to take the field as the first line of defense on short notice.

The Signal Corps has built, operates and maintains the only communication we have to and in Alaska. This communication is by means of submarine cable connecting Seattle with Southeastern Alaska, about one thousand miles of telegraph lines in interior Alaska and about fifteen high power radio stations. These facilities practically tie all points of importance in Alaska directly to our immense commercial telegraph systems in the United States. This system was built entirely by Signal Corps personnel in 1901-1903, and is a monument to the skill and resourcefulness of these pioneer Signal Corps men who had to put up with the extremely severe hardships of that country in its infant days in constructing these lines. This system is run and managed entirely by the Signal Corps, today, and there is no more efficient communication system in the world.

At the present time the Signal Corps is arranging to replace the old type radio spark sets, throughout Alaska, with the latest type arc apparatus, and an officer is now enroute to Alaska with apparatus and personnel to install these stations. Some of these new stations will be built further north than any other radio stations in the world and the plan covers radio communication to Pt. Barrow on the extreme north coast of Alaska.

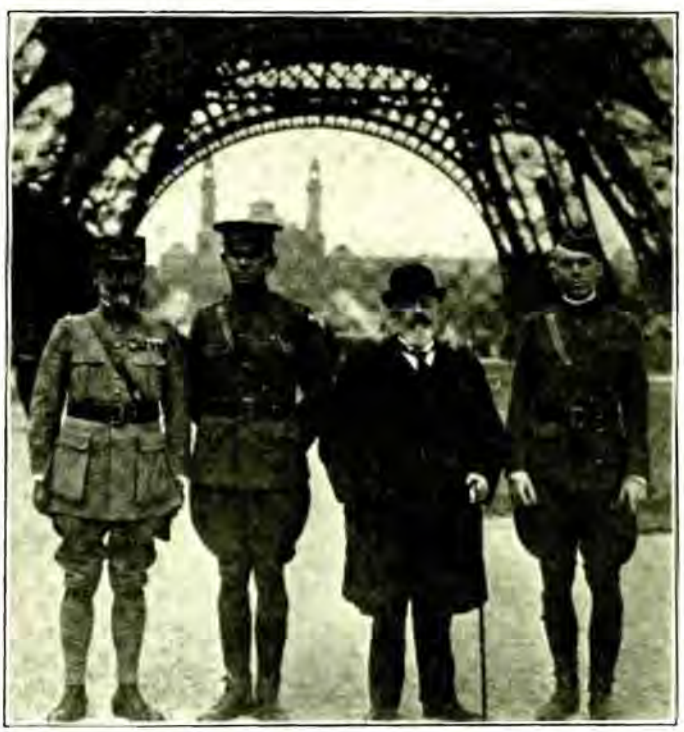
Some of the other functions of the Signal Corps include the installation, maintenance and operation of military cables, telephone and telegraph lines, radio and meteorological apparatus and stations and electric time service.

Radio is one of the main means of military communication and has almost entirely superseded visual signalling. In order to keep abreast of this rapidly advancing art, the Signal Corps has a complete radio research laboratory at Camp Alfred Vail, Little Silver, N. J., where the development of radio apparatus for the several branches of the Army is perfected. At this point a number of America's best radio engineers are constantly engaged in radio development, which does not generally get out to the public for a year or two afterwards. Due to the extreme simplicity, efficiency and mobility requirements of military radio apparatus, it is necessary that this be done by trained military radio engineers, and it is to Camp Alfred Vail we may look to solve our future military radio needs. A school for Signal Corps students is also conducted at Camp Vail. The different Signal Corps organizations throughout the United States are called upon to send students to this school annually, and upon graduating a man is fitted to become a high class military communications specialist and also prepared for a successful vocation when he returns to private life.

At the present time, the Signal Corps is just finishing the installation of a system of the latest type 1½ kw. vacuum tube stations connecting the military centers throughout the United States. For the Washington-San Francisco circuit, stations have been established at New York, Washington, D. C., Indianapolis, Omaha, Salt Lake City, San Francisco, and one now nearing completion at Cheyenne. Similar stations have been installed at Atlanta and St. Louis. In addition, all the important Army Air fields will be connected to this system. Most of these stations are equipped with remote control apparatus which allows the operator to be located a distance from the transmitting station proper and receiving to be done with loop antenna and six stage radio-audio frequency amplifiers. The main method of communication with these sets is continuous wave telegraphy but the stations are also equipped for radio telephony and buzzer modulated radio-telegraphy.

The importance of radio for an Army in the field can be realized when you consider that during the operations of the First American Army in the Meuse-Argonne battle, where about thirty divisions were engaged, a total of approximately

Signal Corps Telegraph Station at McCarty. In the Extreme Interior of Alaska on the Tanana River.



General Ferrie, Chief of Radio French Army, Lieut. Colonel Robert Loghry, Radio Officer First American Army, Professor Abrahams, Sorbonne University, and Major Edwin H. Armstrong.

Signal Corps Continuous Wave Station Twenty Miles West of Paris After the Armistice to Communicate With Spa, Coblenz, Treves, Antwerp and American General Headquarters Replacing Telegraph Lines Which Were Turned Over to French. As High as Eight Thousand Words Were Handled by This Station in a Day. Note the Loop for Reception to Eliminate Interference.

six hundred transmitting-receiving radio stations were necessary and approximately six hundred purely receiving stations for receiving from airplanes fitted with radio. For the operation supply and maintenance of this radio equipment, the services of approximately five thousand radio specialists were required. The greater portion of these were men picked from our amateur radio ranks at the beginning of the war.

The most important need for radio in an army is that between infantry regiment and battalion. In stabilized warfare, such as we had in Europe, the telephone lines in this area were constantly interrupted due to shell fire and bombing, rendering it necessary to resort to radio as a sure means of communication. As you go farther to the rear, the importance of radio diminishes and the lines are of a more permanent construction and cannot be as readily destroyed by the enemy. Here the radio becomes more of an auxiliary or secondary means, but all plans of an Army require a radio system to be installed and kept up in an efficient manner to supplement the telephone and telegraph system when emergency demands.

At the present time, with but the single exception of brigade-regiment communication, which is spark radio, all ground radio within an Army is vacuum tube or continuous wave equipment.

At Army and Corps Headquarters, as well as the larger Army Artillery and Air Service Units, large vacuum tube sets installed on tractors are used. In the divisions and other minor units, down to the regiment compact chest type vacuum tube sets are provided. In the more advanced locations, V shaped antenna about 20 ft. high, with small light weight bamboo masts, are used. For the communication between battalion and regiment, the Signal Corps has developed a small portable loop set, using vacuum tubes for both transmission and reception. The loop on these sets is about 3 ft. square, and when not in use folds up in a small bundle and is attached to the apparatus chest. These sets are operated by storage batteries. The total weight of operating chest,

American Direction Finder Near Front Lines Day Previous to St. Mihiel Attack by American Troops. These Stations Were Located About Five Miles in Rear Front Lines and Twelve Miles Apart. The Hut and Loop Are Camouflaged in Order That the German Aviators Cannot Locate the Station. Loop Used is Ten Feet Square.

Interior of Station Near Paris. Portable Radio Huts Were Used by the Signal Corps in France.

batteries and loop is in the neighborhood of 50 lbs. and can be transported by two men. These sets can be installed in a trench, dugout or shell hole and give reliable communication over a range of approximately five miles, which is considered sufficient for this extreme forward communication. These sets are also used at artillery observation points to communicate with the batteries and other points where an easily portable set which can be located out of sight of the enemy is needed.

For cavalry purposes the Signal Corps has developed a very efficient pack radio set to be carried on pack mules. Vacuum tubes are used in this set for both transmission and reception. The transmitting power is furnished by a hand-driven generator giving 350 volts. A feature of this set is the use of low filament current consumption tubes for the detector and two stage amplifier, current being supplied by dry batteries. These tubes take about .25 of an ampere each on the filament. The complete equipment consisting of operating chests, masts, generator, tent, spare parts and everything pertaining to a complete radio station is packed on three mules and weighs in the neighborhood of 600 lbs. The normal range of these sets is about sixty miles but they have carried from 150 to 500 miles under good conditions. A collapsible umbrella antenna is used with this set.

Other work of the Signal Corps includes the development of the radio telephone and telegraph apparatus for the Air Service. Wonderful strides are being made in radio telephone equipment for use on airplanes. The importance of this communication to an airplane engaged in reconnoissance over the enemy lines, in being able to communicate directly and instantly with headquarters cannot be over estimated.

Another function of the Signal Corps is the development of radio direction finding apparatus. This feature is receiving the attention of the best engineers and is near perfection. Imagine an airplane hovering over an enemy fleet, sending out signals to enable our direction finders to follow its exact location and the airplane giving a special signal when directly over a picked element of the fleet; the artillery would know the exact location of that element immediately. This is absolutely possible today. Another use of radio on airplanes is to enable an airplane to hover over the enemy's lines and keep our batteries informed of the effect of their shots. It would take only a few shots till "Rastus would be hit square in the eye."

A feature of our radio work in France and one which became very spectacular was our Radio Intelligence section. During the war nothing was known of the work of this section. It was a sort of "spy" system on the enemy's radio. Radio direction finders were located along the front about five miles from the front lines and twelve miles apart, which took hearings on the enemy's radio stations; sent these hearings back to our headquarters where they were plotted, resulting in our knowing practically the exact location of every enemy radio station at all times. Radio intercept stations were also located at each Army Headquarters which copied all the enemy's radio messages, and which, by the way were always in code, telegraphed them back to General Headquarters where a corps of code experts decoded them, and in this way our Army was able to secure valuable information on the enemy's intentions and movements. On one occasion in March, 1918, when the Germans made their great offensive against the British Army, the code along the entire enemy front was changed overnight, rendering the old code which had been known for some time, valueless. It so happened that a German Commander sent a long radio message in the new code to a subordinate commander, the subordinate replied by radio that he had not received the new code and asked that the message be repeated in the old code. In a short time the same long message was repeated in the old code. Our intercept stations copied all these messages and sent them back to General Headquarters with the result that our code experts were able to obtain several solutions of the new code which put them on the road for its entire solution. These solutions were telegraphed to the French and British headquarters and gave the American radio intelligence a big "scoop."

On numerous occasions, messages were intercepted, decoded and the troops in the front lines notified of planned attacks by the enemy before the attack took place, enabling them to prepare for it.

Another class of radio intelligence stations were known as listening stations. These stations were located in dugouts in the front line trenches with amplifiers, and wires radiating out to grounds in "No Man's Land" and in some cases actually tied on to the enemy's telephone lines. These stations would pick up the enemy's telephone talk by induction and the results obtained were wonderful. These stations also served to pick up any stray telephone conversations from our own lines and was the reason for our not extending out telephone communication to the front lines, as it was known the enemy had a similar system and could spy on our lines as well.

We also had efficient intercept stations at our General Headquarters which picked up all radio code traffic handled between the enemy countries and to some of the neutrals. This gave our Intelligence Section of the General Staff an insight into what was going on between the belligerents and neutrals.

During our participation in the war a total of 73,000 enemy messages were intercepted and 175,000 bearings were taken on enemy radio stations by our direction finders. At the signing of the Armistice about four hundred radio men were engaged in this spy work, approximately seventy per cent of whom were ex-amateurs, and their extreme loyalty to the cause was so great that not a single leak of their special work ever occurred. The amateurs are certainly deserving of our country's highest appreciation and thanks for this great work.

There is practically no end to the possibilities of radio for military uses, and young men who wish to serve their country can do so in no better way than to become qualified in radio and join the National Guard or Signal Reserve Corps. The National Guard is open for enlistments now but enlistments for the Enlisted Reserve Corps have not as yet been authorized by the War Department.

There is no more interesting study for a young man than radio, not that he necessarily take it up as a profession but as a means of general education. To understand radio, a man must study electricity and this is something everyone should become familiar with in this electrical age. Some of our best and most successful radio engineers today started out as amateurs. "Eddie" Armstrong was an amateur at Columbia University, studying under Prof. Pupin, when he invented his famous "Feed Back" which has brought him fame and fortune. Others can do as well for the ether will remain with us for some time to come.

The foregoing paper constitutes an address given before the Signal Section Association of the Army of the United States and invited guests at State Armory, San Francisco, Calif., 8:00 P. M., May 15, 1922, by the author and read before the Sunset Radio Club, San Diego, Calif., June 10, 1922.—EDITOR.

Rectifiers of Plate Supply Current for Transmitting Vacuum Tubes

Eighth Installment of "The C. W. Manual"

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

THE ELECTROLYTIC RECTIFIER

DURING the early history of electro-chemistry it was found that when a plate of aluminum and a plate of lead or carbon were immersed in certain conducting solutions a current could be made to flow in one direction only. In other words, the combination acted as a valve which soon found a practical application as a rectifier of alternating current.

Essentially, such a rectifier consists of a lead and an aluminum plate immersed in a solution of ammonium phosphate or sodium borate. Both of these substances dissolve in water quite easily. The efficiency of such a device decreases as the current to be rectified increases, especially when such currents cause an appreciable temperature rise of the solution, and seldom exceeds 50 per cent. However, in radio work, where large currents are not required, the device generally operates at a maximum of efficiency and lends itself

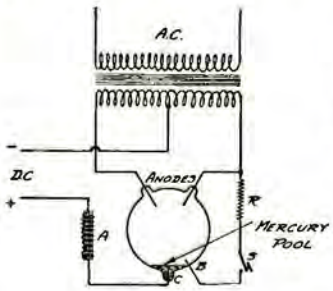


Fig. 61. Mercury Arc Rectifier Circuit

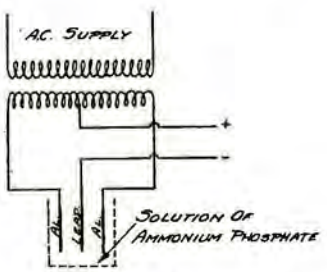


Fig. 60. Simple Electrolytic Rectifier Circuit

quite well to the task of supplying a high voltage direct or pulsating current.

The simplest form of electrolytic rectifier circuit is shown in Fig. 60 wherein one cell, consisting of two lead plates and one aluminum plate, are immersed in the solution of ammonium phosphate.

A single cell rectifier of this type is incapable of rectifying more than 50 to 70 volts effectively and where much greater voltages are to be rectified recourse must be had to additional cells in series as shown in Fig. 40-C wherein one cell is used for each 60 or 70 volts to be rectified. This limitation results from the difficulty in obtaining a sufficiently heavy film upon the aluminum plate which is the governing factor in the matter of output e.m.f.

The circuit of Fig. 40-C is one in which both sides of the alternating current cycle are rectified, with a result, insofar as construction is concerned, that twice as many rectifier units are required as would be the case if only one side of the cycle were rectified.

The advantage in rectifying both sides lies in a more nearly constant output e.m.f., which is desirable in radiophone work. Utilizing the entire cycle in this way makes it possible with a suitable smoothing out system to obtain a current that is only slightly pulsating.

The rectifier units mentioned above are quite inexpensive to construct since all the materials required are used to a great extent commercially. However, considerable time is required. As stated in Chapter V, pint Mason fruit jars may be used to good advantage in constructing the units, although small jars 1 in. by 1 in. by 6 in. deep inside will lend themselves to compactness more conveniently. The larger jars, of course, contain more solution, and heating, which lowers the efficiency of the rectifier very appreciably, is not so apt to occur.

Fill each jar to about three-quarters of its height with a saturated solution of ammonium phosphate or sodium borate (borax) and immerse in each a plate of aluminum and one of lead. For the small currents required for vacuum tube work (equipment employing not more than two of the 50-watt tubes) these plates should not be wider than 1 in. nor immersed in the solution to a depth greater than 3 in. and should be separated from each other at least ½ in. and not more than 2 in.

To "form" the aluminum plates, which consists in depositing the white crystaline rectifying film upon them, each unit should be connected to a rather high voltage source which will ordinarily be most convenient in the form of

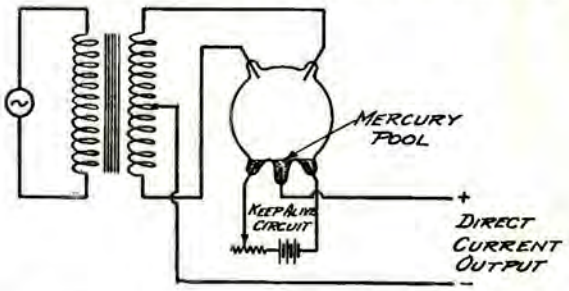


Fig. 62. Mercury Arc Rectifier With "Keep Alive" Circuit

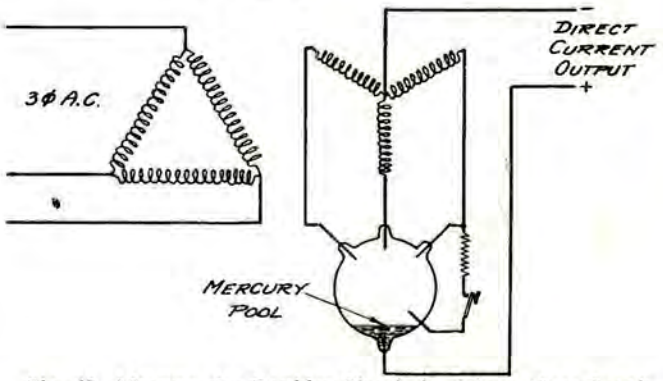


Fig. 63. Mercury Arc Rectifier Circuit for Three Phase Supply

alternating current from the transformer which will ultimately supply the current to be rectified. A secondary winding supplying 500 volts on open circuit will work very well, since during the initial "forming period" the voltage drop in the winding will govern the current flow and as the film is formed the voltage will rise gradually. When the plate is sufficiently well formed, sparking will be noticeable over its surface. During this process, the electrolyte should be kept cool by circulating water around the unit. This step is very important; likewise, it is imperative that pure aluminum plates be used.

MERCURY ARC RECTIFIER

Of late, mercury arc rectifiers have presented themselves in the field of radio as a means of obtaining the much

sought high voltage direct currents, and every application points to success. One argument favoring such a device is based upon the fact that the mercury arc is an article of commerce. These have been used for a number of years in connection with series arc light projects in many localities and, coincidently, they have been developed to function efficiently in just the power outputs and voltages that are required for high power vacuum tube work. As an example, a 4 ampere 3500 volt mercury arc rectifier is more or less standard and one of these could quite easily supply ten 250-watt tubes. Smaller rectifiers of this type could readily be developed for lower powered tube installations if the demand warranted it, and no doubt we shall see them on the market soon.

The simplest form of mercury arc rectifier circuit is shown in Fig. 61. Near the top of the figure is the alternating current transformer which steps up the voltage to the desired value. The extreme ends of the secondary winding terminate at the anodes of the valve, while the mid tap forms the negative lead of the direct current output circuit. The positive pole or negative electrode of the valve is at C, Fig. 61, and the rectified current flows from this terminal thru the sustaining coil, A, to the direct current power consuming device which, in the case under consideration, is the vacuum tube transmitter.

The resistance, R, and the auxiliary electrode, B, comprise the starter for the arc. To start, the tube is tipped to one side, causing the mercury to close the circuit CB thru the disconnect S. The spark or arc thus formed volatilizes some of the mercury, which lowers the resistance of the conducting path between the anodes and the cathode and this breaks down, forming the necessary arc. During half of the cycle the current flows from one anode to the cathode and during the remaining half it flows from the other. Were it not for the inductance, A, which must be of the order of several henries, the arc would have to be restarted by means of the auxiliary circuit after each half cycle.

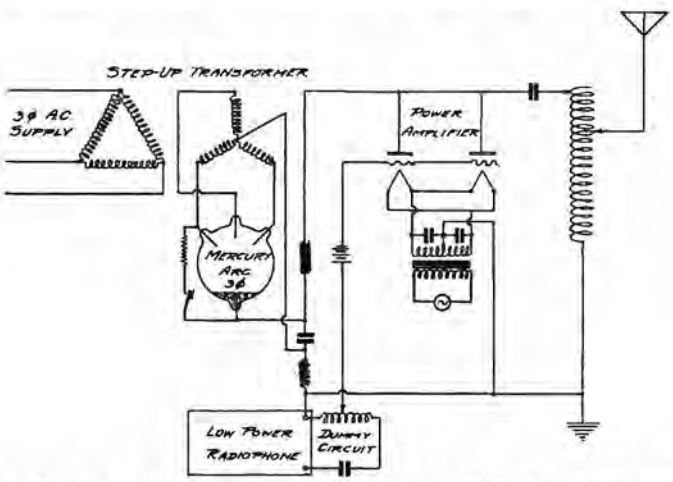


Fig. 64. Circuit Diagram of High Powered Tube Transmitter Employing Three Phase Alternating Current Pre-rectified by Means of a Mercury Arc Rectifier.

Upon the collapse of the magnetic field around this inductance, following an extinction of the arc when the alternating wave reaches zero in value, an e.m.f. is impressed across the anode and cathode sufficiently great to re-ignite the arc, and the other half cycle is rectified in the same manner.

Unless the tube is being operated at its designed output the inductance, A, will not function properly. To overcome this, some rectifiers are provided with a "keep alive" circuit wherein the mercury is continuously being volatilized. Such a circuit is shown in Fig. 62. In radio work where the load is not constant this latter type of rectifier is used. Inductances and capacities are used also in the rectifier output leads to smooth out any irregularities in the direct current.

For radio work which requires a very constant direct current source, three phase mercury arc rectifiers are often used. Such a circuit which requires no "keep alive" auxiliary is shown in Fig. 63. In this case the mercury arc is not extinguished because the potential across the tube never reaches zero value.

A high power tube circuit of the power amplifier type wherein the mercury arc rectifier is employed, is shown in Fig. 64.

THE KENETRON RECTIFIER

The kenetron or vacuum tube rectifier has, of recent years, been receiving considerable application in C. W. work with tubes. The theory of such apparatus is so simple that little explanation is necessary. This theory is, of course, based upon the unilateral conductivity of a vacuum tube comprising a heated filament and a cold plate. Fig. 65 illustrates the simplest form of such a circuit wherein an alternating current source, A, supplies power to the trans-

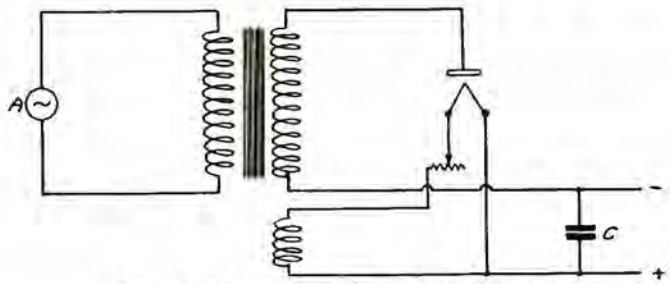


Fig. 65. Simple Thermionic Rectifier Circuit

former, T, which steps up the initial e.m.f. to that required in the form of direct current for the plate supply of the oscillator tubes and modulator tubes of the transmitter. The transformer, T, has two secondaries, one of which supplies a filament heating current for the rectifier tube.

By virtue of the above mentioned unilateral conductivity of the rectifier tube a current flows across the ionized path between plate and filament only when the plate is at a positive potential, the result being that a pulsating direct current is supplied to the condenser, C, where it is stored as energy and delivered to the transmitter as required. Such an arrangement provides for the rectification of only one-half of each cycle and the other half while not lost, is not used.

Fig. 40-B shows a previously explained circuit wherein both sides of the alternating current cycle are utilized.

To be continued

Readers of RADIO will undoubtedly be pleased to learn that Jennings B. Dow, author of "The C. W. Manual," has been commissioned a Lieutenant (J. G.), U. S. N. His promotion from Ensign to the higher rank became effective during the latter part of June. He is now serving in the capacity of Communication Officer on the U. S. S. *California*.

Capacity Measuring Wavemeter

By G. W. Cattell

MOST radio enthusiasts are already familiar with the construction and use of a wavemeter. For the benefit of those who are not familiar with the ordinary wavemeter, it may be described as being a calibrated tuned circuit with some means to indicate resonance. The tuned circuit usually consists of a fixed inductance coil and a variable air condenser connected in series. The wavemeter is usually calibrated by comparison with another meter whose calibrations are known.

The device to indicate resonance is usually a sensitive hotwire ammeter (or thermo galvanometer) or a crystal detector and a pair of telephone receivers. Some meters are equipped with both. The meter is generally used for strong signals and the detector and telephone receivers for weak signals.

To measure the wavelength of high frequency oscillations, the wavemeter is placed near the circuit carrying the current and the condenser varied until there is a maximum deflection of the meter (or maximum sound in the telephone receivers). The wavemeter is then tuned to the same wavelength as the oscillations. By referring to the calibration curve of the meter, the wavelength can be ascertained. Another method of wavelength measurement was described in the February RADIO under the title of "The Click Method of Determining Resonance."

The usefulness of a wavemeter is greatly extended by the addition of some means of exciting the circuit, causing it to become a source of high frequency oscillations having a wavelength corresponding to that for which the wavemeter circuit it turned. A buzzer is frequently used for this purpose. Fig. 1 illustrates a schematic diagram of a wavemeter incorporating the above mentioned features.

It is often very desirable to know the capacity of a given condenser or antenna. If enough data are available, the capacity can be computed, but such calculations are likely to be unsatisfactory, especially in the hands of the inexperienced. There are, however, several methods of measuring the capacity either directly or indirectly. Next to the use of the Western Capacity Meter (which requires 500 cycle current at 220 volts), the capacity bridge is the easiest and most reliable.

It is a simple matter to modify an ordinary wavemeter (such as shown in Fig. 1) so as to incorporate the capacity measuring feature. A scheme of connections is shown in Fig. 2. The only addition to the circuit is the resistance unit $R'R''$.

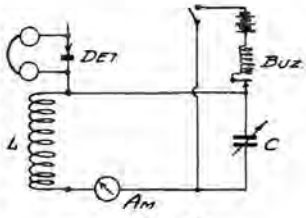


FIG. 1

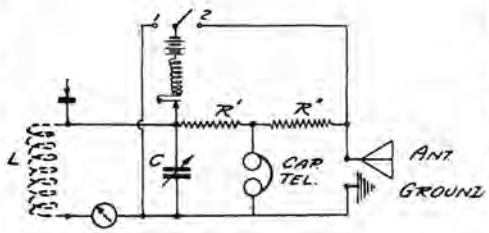


FIG. 2

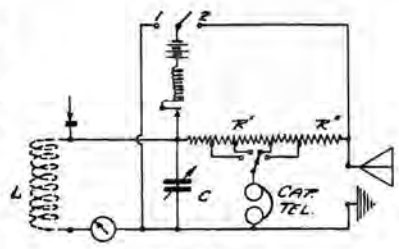


FIG. 3

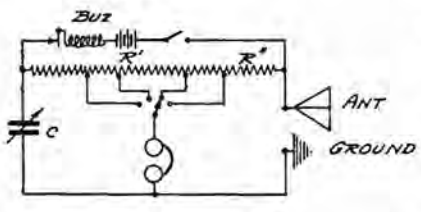


FIG 4

The resistance of both branches (R' and R'') should be as nearly equal as possible and should be approximately 10 ohms each. An easy method of accomplishing this is to cut off a piece of small resistance wire having a resistance of 20 ohms, double it in the middle, then wind this double wire as a single wire on a piece of stiff cardboard about 1¼ in. wide and 2½ to 3 in. long. The resistance unit thus built will have three terminals, one the common point between R' and R'' and the other two the other ends of R' and R'' respectively which are connected as shown in Fig. 2. The object of winding the coil in a flat form is to minimize the reactance which is necessary for satisfactory operation.

To operate the bridge, the inductance coil L must be removed or disconnected, the telephone receivers connected to the binding posts marked *"Cap. Tel."*, the capacity to be measured connected to the terminals *"Ant."* and *"Ground,"* the buzzer is then started by closing the switch in No. 2 position. The buzzer note will be heard in the receivers. By varying the condenser setting, a point will be found where the buzzer note is no longer heard. The bridge is then balanced. The unknown capacity is approximately equal to that corresponding to the wavemeter condenser. For the most accurate results the bridge should be calibrated by placing known capacities of various values across *"Ant."* and *"Ground"* and plotting these values against condenser degrees.

It is evident that the range of capacities that can be measured is the same as the condenser used in the wavemeter. In order to extend the range so that it is possible to measure capacities larger than the wavemeter condenser, taps can be taken off the resistance unit and connected to a switch. For example, if R' is three times R'', the capacity of the unknown condenser will be approximately three times that corresponding to the wavemeter condenser setting when balance is obtained. In a similar manner any number of ratios of R' and R'' can be obtained and utilized. As before, for the most satisfactory results, the bridge should be calibrated against known capacities instead of relying solely on the ratio of R' to R''.

The capacity as measured by the bridge is the "true capacity" or "capacity for uniform current distribution." The true capacity of an antenna is always lower than the "effective capacity" except when the antenna circuit is loaded up with inductance until its wavelength is several times the natural wavelength, under which conditions it approaches the true capacity.

In order to use the wavemeter as the regular buzzer excited driver, remove the telephone receivers, replace the inductance coil L and close the switch in No. 1 position.

If it is desired to construct a capacity bridge alone, some of the usual wavemeter apparatus may be omitted and the connections can be made as in Fig. 4. Suggested values of constants which could be used are shown directly on the diagram. Such a bridge is suitable for measuring capacities up to .003 mfd.

If the resistance of the capacity being measured is very different from that of the condenser used in the bridge, it may be impossible to get an exact balance. This is because it is necessary to balance for resistance as well as capacity reactance. For most work, however, especially when the capacity is small, a minimum sound in the receivers will give sufficiently accurate and satisfactory results.

A 200-Watt A.C. Radiophone Transmitter

By I. R. Lounsberry

RADIO Station, 2BH, owned by Mr. W. R. Seigle, Mamaroneck, N. Y., was formerly equipped with a 1 kw. phone set, employing a motor generator. This was found to be very cumbersome and unsatisfactory in operation. In the search for better methods it was decided to build an alternating current phone with a filter.

The tests of the set were conducted at 2BB, owned by the writer, at Ossining, N. Y. The resultant circuit was tested during December, January and February with excellent results. The filter designed was so effective that in almost every case we were reported as using a motor generator for plate supply instead of rectified a. c.

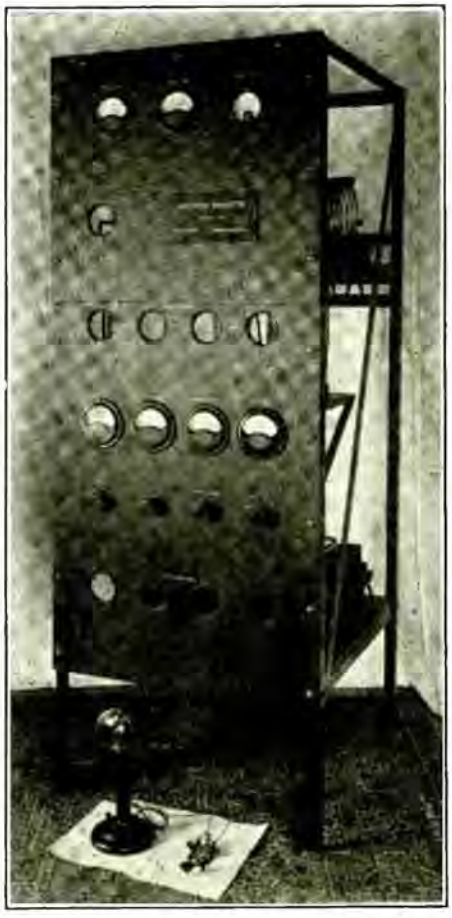
Voice transmission was used entirely with the exception of one night, at which time the I. C. W. was heard by 5ZA at Roswell, New Mexico, a distance of 1800 miles. The voice was often heard in Florida, Kentucky, Tennessee, Missouri and as far north as Nova Scotia. The best voice distance was Fairmont, Minnesota, where it was heard plainly, a distance of 1400 miles. 5XK at Knoxville, Tennessee, reported night reception often, and also daylight work occasionally. Operating for an hour and a half one night eighteen stations were worked—many of them five hundred miles away, and fifty-six reports were received during the next few days via mail, reporting the speech reception. Inasmuch as no broadcasting was done, the results of the tests are much more valuable. Operators, due to briefness of conversation, had little opportunity for close adjusting, so that it is safe to say that with better tuning time the results would have shown much better distance.

The Colpitts oscillator circuit was found to give better results under existing antenna conditions than any other. The modulating system consisted of the Heising circuit with the voice amplifier.

Alternating current was used throughout the entire circuit except for relays and microphone. Four 50-watt Radiotrons were used in radio circuits and a 5-watt Radiotron was used for the voice amplifier. In the rectifier circuit four 50-watt Kenotrons were used. The filaments of the rectifiers were connected in parallel and run off an Acme 300-watt transformer designed for a 12-volt potential at its output terminals. Control of the output was effected by five taps on the primary winding. The four Radiotrons were operated in a like manner together with the 5-watt tube. In the 5-watt tube circuit a 2-ohm rheostat was inserted in the filament side of the transformer to drop the voltage to 8 at the tube. The high voltage transformer was a special type built for us by the Acme Company. At 1500 volts a load of 600 mils could be safely drawn. The transformer was of the double winding type to work on both halves of the cycle and was tapped in the secondaries at 750, 1000, 1250 and 1500 volts.

DESIGN AND ARRANGEMENT

In designing the instrument the following points were strictly adhered to—neatness, symmetry, separation of circuits, proper spacing of wires, ruggedness and ease of control. By referring to the photographs it will be seen that the instrument is assembled in a heavy frame made up of angle irons. The overall dimensions are 5 ft. 6 in. high, 24 5-8 in. wide and 25 in. deep. Two full shelves are used, together with a half shelf. On the bottom shelf the complete power circuit is mounted. The high voltage transformer, the filament transformers and the filter condensers are mounted on this shelf. On this same lower shelf, close to the front, the four Kenotron rectifier tubes are mounted. The panel contains four portholes, through which the operation of the Kenetrons can be seen at all times by the operator. Above these portholes are the controls which from left to right are the amplifier filament rheostat, radio filament tap switch, supply plate double tap switch and rectifier filament tap switch. Above each control is a meter to check each adjustment.



200-Watt A. C. Radiophone Panel

The half shelf holds the four 50-watt Radiotrons together with "local" grid resistances for each tube, the main grid leak resistance, grid condenser and two insulating condensers in plate and filament radio frequency circuit. These latter two condensers are for protection to the power circuit should the antenna and ground become shorted. The "portholes" for these tubes are cut directly above the voltmeters.

Rear View of Radiophone Set

The upper shelf contains the balance of the radio circuit, voice circuit and also the relay circuit. The speech amplifier tube is mounted at the left. On the right side, near the panel, is the relay control circuit made up as one unit. The helix is mounted in back of relay unit, together with the variable-tap condensers used in the antenna-grid circuit and also a series antenna condenser for working on low waves. The modulation transformer, modulator-amplifier coupling condensers, plate and grid reactors, resistance rods and "C" batteries are mounted back of the amplifier tube in good wiring order.

The panel is made up in two sections, the bottom one being 21¼ in. x 24⅝ in. x ½ in., and the top is 33 in x 24⅝ x ½ in. The panel is engraved in complete explanatory of meters, controls, etc.

All connections are made in back of panel. Two terminal strips are provided. The top one for antenna, ground and

Side View of Radiophone

receiver connections; the bottom one for 12-volt battery, 110 volt a. c. 60-cycle supply, C. W. telegraph key, microphone and relay control wires.

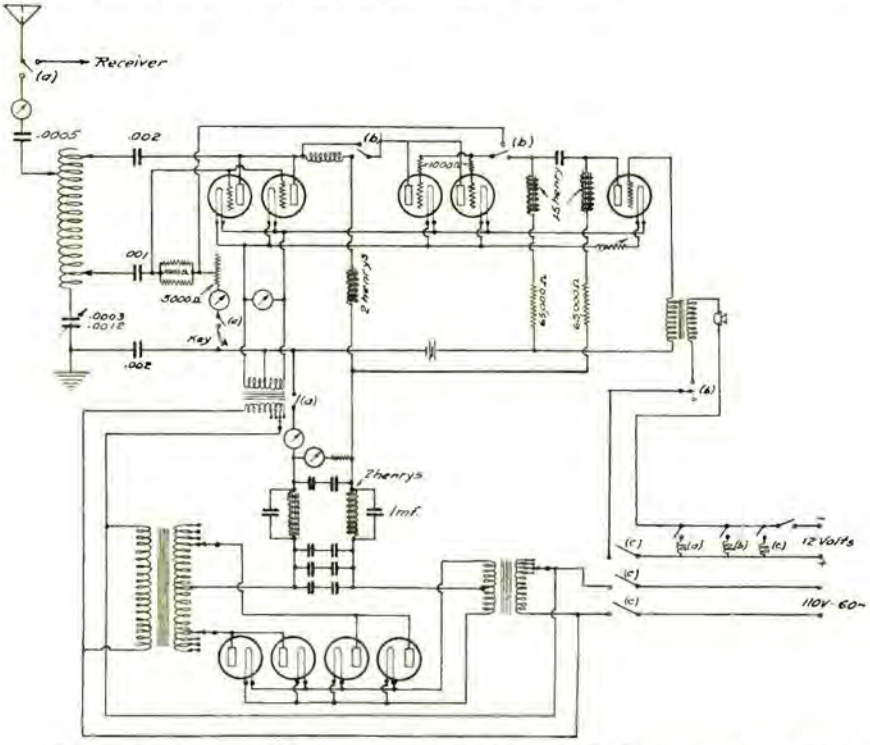
The installation cost of this type of set is very low as the 110-volt, two-wire, line is the only power lead to the set. The batteries can very nicely be placed under the "lower shelf." The microphone and C. W. telegraph key are mounted on operating table. The complete connections are provided for with an eight-wire cable.

All wiring in the set is done with No. 6 weatherproof wire. The covering is painted with glossy, black enamel to add to its appearance and for protection. Careful attention has been paid to separation of circuits and wiring so that a minimum of loss is accomplished. The wires are rugged and short as possible.

The meters, with the exception of the antenna meter, are all of the new type Weston, models 429 and 431, flush mounting. Two 0-15 volt a. c. meters are used for measuring filaments of radio tubes and rectifier tubes. An 0-10 volt a. c. meter is used to measure the filament of the voice amplifier. An 0-2000 volt d. c. meter with an external resistance as multiplier is used on the high voltage to measure the potential applied to the radio tubes. An 0-800 d. c. milliammeter measures the total plate current of all radio, modulator and amplifier tubes. An 0-150 d. c. milliammeter measures the grid current of the radio tubes. In the antenna circuit a Weston model 301 thermo-couple ammeter, 0-5 is used.

Three 20 ohm relays are used to actuate three power switches. These switches are each three pole double throw and are mounted up as one unit and controlled from the base of the microphone. It will be noted that no manual control switches are used, (except a main power line cut off switch (fuse) that cuts off the main supply power feed wires to the set). One of the relay switches controls both sides of the 110 volt a. c. supply and one side of the storage battery supply to the microphone and is "dead" in the back position. Back positions are accomplished by mechanical springs so that power is consumed from the batteries only when the relays are worked. The second relay throws the antenna to the transmitter when relay circuit is closed. It also closes the plate and grid circuits of the tubes. On the back stroke the grid is opened first to prevent a heavy surge when antenna is broken. In the back position the antenna is connected to the receiver, leaving plate and grid circuits open. The third relay throws the modulators to the radio frequency circuit when I. C. W. is used and disconnects the microphone battery supply. In the back position, which is the "talking position," the grids and plates of modulator tubes are in modulating circuit and battery circuit is completed.

The microphone is a western electric desk type. Four switch buttons have been put in the base to control the power relays. One button acts as master and will trip as many relays as are "set." The remaining three are "sets." Each one operates a relay. An example of the efficiency of this method is received from the following: If I. C. W. telegraph is desired three relays will have to be thrown. These buttons are pushed down and automatically "set," then the full control is effected by pushing and releasing only the master during complete operation. When voice is used only the power and antenna transfer relays are "set," etc. Inasmuch as a. c. is used this is the quickest change-over from transmitting to receiving possible. When receiving the transmitter is completely dead. The power is available instantaneously.



Schematic Diagram of Connections for 200-Watt A. C. Radiophone with Filter

FILTER

Regarding the filter system, which has made this set so effective, the following points are enumerated: (a) Referring to the schematic circuit it will be seen that a two-coil transformer is used as a filter. These coils are 2 henries each. The first important thing of note is that higher capacity is used on the high voltage transformer side of the circuit. The new type Radio Corporation condensers are used in series parallel. It was found that the most effective filtration was accomplished by having this side high. Additional capacity on the radio side of the filter transformers was hardly noticeable. One-half microfarad is used as the final capacity there, and 1½ m. f. d. on the transformer side of the circuit. (b) The new feature of this filter

Continued on page 68

The Arc

By L. R. Felder

IN spite of the ever growing importance of continuous wave transmission and the recognized advantages of continuous wave over damped wave transmission, very little literature on one of the first and most important C. W. transmitters, namely the ARC, appears in the amateur journals. Occasionally there appears a photograph or description of an arc set, but that is about all. Next to the radio frequency alternator the arc is the most important means of continuous wave transmission on the high powers, and it is also of great importance on low power sets, such as used on ships. Radio presents a broad field and it is therefore not a wise policy for the amateur to limit his reading and study to bulbs only, as seems to be the case at present. This article therefore aims to present to the amateur the fundamental principles of the theory and action of the arc transmitter.

In order to understand the action of the arc as a generator of radio frequency oscillations it is necessary first to know the general physical and electrical characteristics and properties of arcs. The arc, as generally used in radio, is formed by two carbons or by one carbon and one copper electrode. The arc is struck by connecting a source of voltage across the arc terminals, bringing the electrodes together in order to close the circuit and then separating them. The current through the electrodes, when they are in contact, is so great that the heat generated at the contacts is sufficient to make the terminals incandescent and thus vaporize the carbon. Upon separating the electrodes it is this vaporized gaseous carbon which acts as the conductor of the arc current.

Like all other electrical conductors, the arc has its specific characteristic, that is the relationship between its terminal voltage and the current through it. This characteristic is the well known falling one shown in Fig. 1. One very important feature is to be noted in which the arc differs from most other conductors of electricity; namely, that whereas an increase of current through most conductors is accompanied by a corresponding increase in its terminal voltage, an increase in current through the arc is accompanied by a decrease in its terminal voltage. In other words the greater the arc current the lower the arc resistance becomes. The physical reason for this is that the greater the arc current becomes the greater is the heat generated in the arc. Consequently vaporization and ionization increase, resulting in lower arc resistance. It is this characteristic of the arc which is the basis of its operation as a generator of radio frequency oscillations.

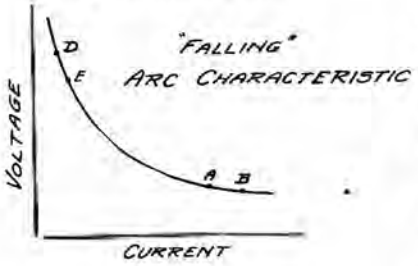


FIG. 1

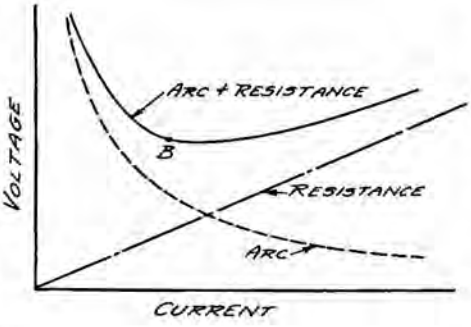


FIG. 2

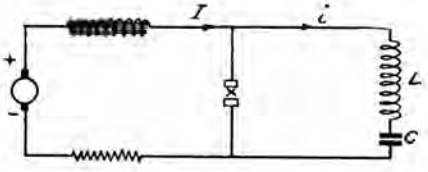


FIG. 3

The arc itself connected across a source of electro-motive force is unstable. For a stable system is such that an increase in e. m. f. results in a proportionate increase in current, and a decrease likewise. Consider for a moment what would happen in an arc circuit if there were a fluctuation in the e. m. f. across its terminals, let us say a decrease in e. m. f. This would cause an increase in the arc current, according to the characteristic of the arc, which in turn would cause a further drop in arc e. m. f., and so on until the arc current is so high that a short circuit condition would exist. On the other hand, if the fluctuation were such that an increase in arc voltage took place, the arc current would decrease and progressive diminution if arc current would take place until the arc was extinguished.

In order to guard against such changes and thus control the arc it is necessary to utilize stabilizing resistance and choke coils. The effect of a series resistance is shown in Fig. 2, in which the full line is the characteristic of arc plus resistance. It will be seen that the arc is stable after point *B*, and unstable before point *B*. By altering the value of the series resistance the value of current at which stability results can be easily controlled.

The stabilizing action of the choke coil depends upon an entirely different principle. The supply circuit to the arc is shown in Fig. 3. A fluctuation in current in the supply circuit would result in a counter induced e. m. f. in the choke coil, which would tend to restore the current to its original value, and thus have the effect of keeping the supply current approximately constant. In general both these stabilizing factors, resistance and choke coils, are used, although many generators combine both resistance and choke coil in the inductance only.

Let us now consider the manner in which the radio frequency oscillations are generated. The oscillating circuit is connected in parallel with the arc, and as explained in the previous paragraph the supply current to the arc is kept almost constant by means of the choke coil. At the instant of closing the arc circuit a voltage is suddenly impressed in the radio frequency circuit, and therefore an oscillatory current must flow in their circuit, due to the impulse action. If the arc were not present this oscillatory current would die out, due to the damping of the circuit, leaving the condenser *C* charged to a voltage *E*. However the presence of the arc results in maintaining the oscillation in the following manner.

Considering Fig. 3 again assume that the oscillatory current flows at the start in the direction shown. This oscillatory current must come from somewhere, and since the choke coil keeps the generator supply current constant it is evident that the only source of this oscillating current must be the arc. That is, the arc is robbed of current equal to the value of the radio frequency oscillating current, as a result of which the current through the arc must be decreased by that amount. Since the arc current is decreased its terminal voltage must increase, due to its falling characteristic. This rise in arc voltage results in a further decrease in the arc current, or in other words an increase in the radio frequency oscillating current, which increases the charge on condenser *C* and raises its voltage. This action continues until condenser *C* is charged to a potential considerably higher than that of the arc, at which time the condenser *C* begins to discharge through the arc. This discharge current now adds to the arc

current, resulting in a fall of arc potential, which still further assists the discharge of the radio frequency circuit since the condenser voltage is higher than the terminal arc voltage. As this action continues the condenser voltage decreases until its potential is lower than that of the arc, when this cycle of events is again repeated, thus maintaining the radio frequency oscillations.

From this description of the happenings in the arc it is clear that when the current flows from the arc into the oscillating circuit and charges the condenser *C* oscillating energy is being supplied to the radio frequency circuit. On the other hand, when the condenser *e* is discharging through the arc the radio frequency circuit is giving back this energy to the arc. The condition, therefore, for building up radio frequency energy in the oscillating circuit for radiation is that the amount of energy supplied by the arc be greater than that returned to the arc. It will now be shown that this is the case, and the conditions will be given for making this difference a maximum.

In order to show that the oscillating energy given by the arc to the radio frequency circuit is greater than that given back to the arc we must consider the relationship of the arc terminal voltage and the oscillating current in the arc. The oscillating energy in the arc is, in any case, given by the product of *Ei*, where *E* is the arc terminal voltage and *i* the oscillating current in the arc. Now the oscillating current in the arc, when the steady state is reached, is the same on both charge and discharge, but the arc terminal voltage is not. When the radio frequency circuit is charging up we saw that the arc terminal voltage was higher than normal, and when it was discharging through the arc we saw that the arc terminal voltage was lower than normal value. Consequently the product of *Ei* on charging is greater than the product on discharging, or in other words, the arc supplies the radio frequency circuit more energy than is given back to it. Hence there is available energy in the radio frequency circuit for radiation.

This difference in the amount of oscillatory energy given by the arc and given back to the arc can be graphically shown by a consideration of the important dynamic characteristic of the arc. The general shape of the dynamic characteristic of the arc, that is when taken on alternating currents, is shown in Fig. 4. The two axes of current and voltage correspond to the normal values of the arc current and voltage, and the dynamic characteristic shows how the values vary, due to the superimposing of the oscillating current. Now the area enclosed in the curve of the dynamic characteristic represents energy, since it represents the product of the current and voltage. In quadrant I the current and voltage are both positive (marked by two plus signs) relative to the normal values of current and voltage. In the quadrant III they are both negative (two minus signs). In both these cases therefore the product of voltage and current is positive hence *the areas in quadrants I and III represent the amount of energy supplied by the oscillating current circuit.* On the other hand in quadrants II and IV the currents and voltages are of different signs

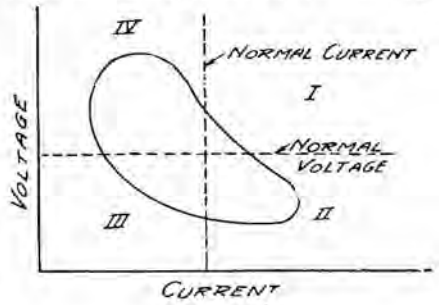


FIG 4

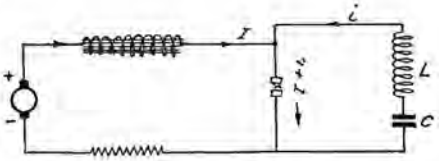


FIG 5

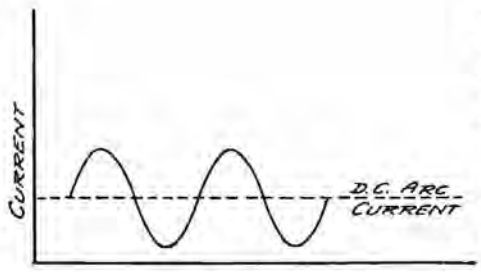


FIG. 6

(indicated by plus and minus signs). Hence the product is negative, indicating that negative energy is supplied *by* the oscillating current circuit, or in other words that positive energy is supplied *to* the alternating current circuit. Hence *the areas in quadrants II and IV represent the amount of energy supplied by the arc to the oscillating current circuit.* Therefore the areas in quadrants II and IV must be greater than the areas in quadrants I and III in order that radio frequency energy be available, and that this is the case has been shown in the previous paragraph.

It will be at once evident that any factors which make the area in quadrants II and IV larger than the areas in quadrants I and III will result in larger radio frequency energy available, that is in larger radio frequency current. One of the factors which makes this difference in areas greater is the steepness of the arc characteristic. The steeper the arc characteristic the larger will be the areas in quadrants II and IV and the smaller the areas in quadrants I and III. Hence the arc must be designed to secure steep characteristics.

The most important factor in arc design relative to the steepness of the characteristic, discovered by V. Poulsen, is the atmosphere in which the arc is burned. It was found that burning the arc in hydrogen or a gas rich in hydrogen yielded a characteristic much steeper than would otherwise be obtained. This is the reason for the use of hydrogen in commercial arcs. Frequently instead of hydrogen some liquid such as alcohol is allowed to drip into the arc chamber where, due to the intense heat of the arc, it immediately vaporizes liberating hydrogen gas.

The use of a hydrogen atmosphere in the arc chamber has moreover two other important advantages. In the first place, as will be more fully explained below, for best operation of the arc it is essential that the arc electrodes be cooled. Hydrogen has a very high heat conductivity, and will therefore rapidly conduct the heat away from the electrodes, thus cooling them. In the second place by resulting in a steeper characteristic of the arc, it enables generation of lower wave lengths than would otherwise be possible. This will be clear from the following analysis.

The amount of high frequency energy stored in the shunt condenser C is given by the expression $E=\frac{1}{2}CV_2$, where E is the amount of high frequency energy in the condenser C is the capacity of the condenser, and V the voltage.

Consider the arc characteristic in Fig. 1. If we work on the lower flat part of the curve between points A and B, a given change in current will produce only a small change in voltage. In order therefore to secure a given amount of energy it will be necessary to use large values of C, since V is small. Using large values of C means working only on high wave lengths. On the other hand suppose we were to work on the upper or steep part of the characteristic between points D and E. The same change in current produces here a much greater change in voltage than on the flat part of the curve. Hence for the same amount of energy a much smaller value of capacity can be used, since V is larger. This smaller capacity therefore permits operating the arc on lower wave lengths than would otherwise be the case. Thus we see that not only does the hydrogen atmosphere increase the steepness of the arc characteristic, but also enables operation on lower wave lengths and assists in cooling the electrodes.

Before taking up the matter of the

design of the radio frequency circuit for the arc and the other details in arc design, we will consider briefly the different types of oscillations which the arc is capable of generating. From a consideration of Fig. 5 it is seen that there are two currents flowing through the arc, the d. c. generator supply current, which is kept practically constant, and the oscillating high frequency current. The type of oscillations which the arc will develop depends upon the relative value of these currents. There are three types of oscillations which can be developed and these are:

TYPE I. In this type the maximum value of the oscillating current is less than the d. c. current. In this case, therefore, the total current through the arc never reaches zero, and the current wave is of the form shown in Fig. 6. The arc is not extinguished therefore, and very regular and steady oscillations are developed.

TYPE II. In this type of oscillation the maximum value of the oscillating current is greater than the steady d. c. current. Therefore when the oscillating current reaches the value of the d. c. and is opposite in sign, the arc current is reduced to zero, the arc is extinguished, and remains extinguished until the potential across the condenser builds up to the value necessary to re-ignite the arc. The curve showing the current through the arc would therefore be of the form in Fig. 7. During the time AB the arc is extinguished, the potential across the condenser is building up, and at instant *B* is sufficiently high to ignite the arc. Such operation takes place only if the arc is greater than a certain minimum length.

TYPE III. If the arc is less than a certain minimum length, i. e. for short gaps, type III oscillations take place. In this case again the maximum value of the oscillating current is greater than the d. c. through the arc, and therefore the arc current again drops to zero. But on account of the short length of the arc, the high voltage therefore across the arc, and the ionized condition of the gap, the arc immediately re-ignites and the oscillating current continues to flow uninteruptedly through the arc. On account of the shortness of the gap and the low voltage necessary to ignite a short gap the amount of energy thus developed is very low. In the second place, since the arc immediately re-ignites, the voltage across the arc has no opportunity to rise in value. Consequently this re-ignition and oscillation takes place with continually decreasing energy and amplitude until the energy originally stored in the condenser has been dissipated. The current then is zero, the arc is extinguished and the condenser again charges up through the arc with the same results. In other words there is generated a damped series of waves as in Fig. 8, which, of course, is of no use for continuous oscillations and is therefore not used in actual practice.

The actual type of oscillations employed in the practical arc set is actually neither of the types described above, but a cross between TYPE I and TYPE II oscillations. In this case the maximum value of the oscillating current is approximately equal to the d. c. through the arc.

The problems involved in practical arc design are those of increasing the radio frequency output, increasing the

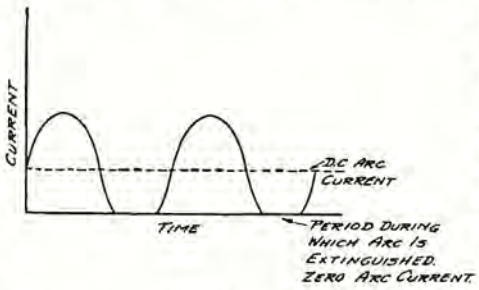


FIG 7

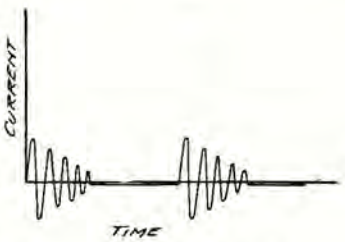


FIG 8

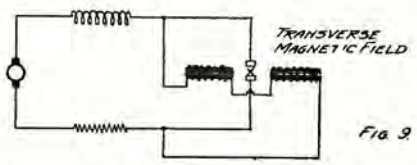


FIG 9

efficiency, and maintaining the frequency of the oscillations constant. The problem of securing maximum radio frequency output is practically the same as securing the highest voltage which will ignite the arc when it is extinguished. For the power is given by the expression $\frac{1}{2}CV_2$ and the higher V is; the higher the power. This rapid increase in ignition voltage is mainly dependent upon the state of ionization of the arc after it is extinguished. The greater the ionization the smaller will be the voltage necessary to re-ignite the arc and hence the lower will be the power. It is therefore necessary to employ means which will effect the rapid de-ionization of the gases in the arc when it is extinguished.

The means employed to rapidly de-ionize the arc space are as follows:

1. Cooling the arc space and electrodes. The colder the arc space and the electrodes the more rapid the de-ionization. Cooling is effected in several ways. First, the positive electrode is made of material having a high heat conductivity. Hence copper is used for the positive electrode. Secondly, the arc is burned in, and the electrodes surrounded by, a gas having a high heat conductivity which conducts the heat away rapidly. Hydrogen is used for this purpose, as explained in detail in a previous paragraph. Thirdly, the arc chamber is supplied with cooling fins. Finally, in the large sized arcs cooling is effected by means of cold water circulating around the arc chamber through pipes.

2. Using a "magnetic blowout." The magnetic blowout is a magnetic field whose direction is perpendicular to the length of the arc, as shown in Fig. 9. The effect of the magnetic field is to stretch out the arc and drive the gases and arc from the inside to the outside, in this way breaking or extinguishing the arc. For best efficiency it is found that there is a certain value of field strength which gives best results. Using a field strength stronger or weaker than this definite value will result in irregularity of the generated oscillations. The best value of field strength is directly proportional to the frequency of the oscillations and depends upon whether or not a hydrogen atmosphere is used. If a hydrogen atmosphere is used a much smaller value of field strength may be used than otherwise.

It is obvious that the burning of the arc makes changes in the arc electrodes. Changes in the arc length are accompanied by corresponding changes in the frequency of oscillations which is bad for transmission. To prevent this one of the electrodes, the negative carbon, is slowly rotated continuously while the arc is operating, which results in an even wearing away of the electrode.

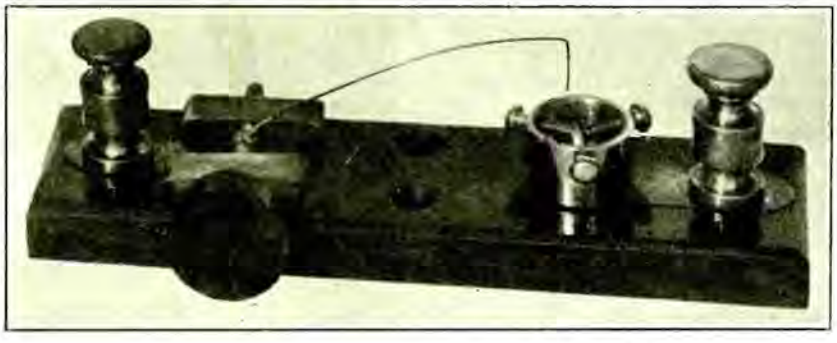
The design of the radio frequency circuit shunting the arc consists largely in proper proportioning of the values of *L* and *C*. The following considerations apply in this case. It is evident that since the energy is proportional to the amount of capacity used that the higher the value of *C* is the greater will the radio frequency energy be. But it is not advisable to increase *C* too high for the following reasons. In the first place a large capacity requires a much larger charging current than a small capacity. This means a larger arc current with increased heating and therefore greater ionization which, as pointed out previously, is bad as it decreases the power output. In the second place the larger capacity may require so much charging current, that it will rob the arc of enough current to extinguish the arc. Consequently best results are obtained with a small value of *C* and a high value of inductance. The average value of the radio of *L* to *C* when *L* is microhenrys and *C* is in microfarads is approximately 4000. Having determined on this ratio of *L* and *C* the actual values are fixed by considerations of the wave length.

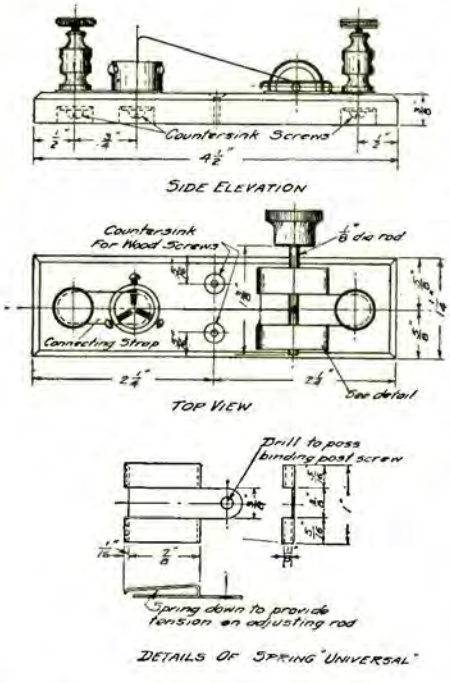
How to Make a Good Crystal Detector

By B. F. McNAMEE

A GOOD crystal detector should be easy to adjust and should keep its adjustment fairly well. The "cat-whisker" should readily reach all points on the exposed surface of the crystal, and the correct pressure should be easily obtained. Good insulation, proper terminals, and a satisfactory crystal holder, are other points which must not be overlooked.

The illustration shows a detector which possesses these qualities to a high degree. It was made by the writer (for his own experimental use). It can be easily made with few tools, and the following material:





1 piece bakelite ⅜"x1¼"x4"
1 piece No. 28 gage sheet phosphor-bronze 1"x2"
1 piece No. 28 gage sheet phosphor-bronze ⅜"x1½"
1 crystal cup with set screws
2 binding posts
1 small bakelite knob threaded for insert
1 piece round brass rod ⅛" diam. x 2" long
1 piece No. 26 phosphor-bronze wire 3" long

The illustration and drawings show how to cut and bend the larger piece of sheet phosphor-bronze. It is very important to do this correctly, as the success of the job depends chiefly on this piece. Be careful to keep the two strips that are bent back to hold the rod, absolutely straight, except for the slight turn-down at the ends.

The bakelite, after cutting and drilling, should be filed smooth along the edges, and then polished or sanded lightly with fine emery.

The rod is threaded sufficiently at one end to screw into the knob. By putting a little glue or shellac on the threads before inserting the knob, the latter will not become loose. One end of the phosphor-bronze wire, or "cat-whisker," is soldered to the center of the brass rod. Use a very small amount of solder, so that it does not flow around the rod and impede its turning.

When buying the sheet of phosphor-bronze ask the dealer to mark the direction of the "grain"; it must always be bent with the grain in order to get the benefit of its springiness. Phosphor-bronze will take a high polish very readily, and this will add much to the appearance of the instrument.

THE RADIO SEARCHLIGHT

From Institute of Radio Engineers, New York, N. Y.

THE radio searchlight, a method by which radio waves transmitted from a broadcasting station can be reflected in any desired direction, just as light rays are directed from a searchlight, was announced by Senatore Guglielmo Marconi in his address before a joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers in New York, Tuesday night, June 20.

At present radio waves, upon leaving the antenna, scatter in all directions. His apparatus, which in no way resembles a searchlight but is a series of wires arranged in a special way on towers or masts, sends the message through the ether in one direction only, Marconi said. He amplified his words by a demonstration in the hall. Messages transmitted were picked up clearly on one side of the room but could scarcely be heard with similar receiving apparatus on the other, and vice versa.

With his system of reflectors, Marconi stated that he had successfully conducted radio telephone conversations between London and Birmingham, a distance of 100 miles. This is a record in long distance radio transmission and reception with very short waves. In all these experiments the wavelength varied from one to twenty meters.

The reflectors make it possible for the receiving station to reproduce a telephone song or speech about two hundred times louder than is now possible and without distortion. The transmitting aerial can be used both for transmitting and receiving at the same time.

"In these days of broadcasting, it may still prove to be very useful to have a practically new system which would be to a very large degree secret when compared to the usual kind of radio," said Marconi.

Marconi described a revolving transmitter and reflector which acts as a kind of wireless lighthouse or beacon. "By means of the revolving beam," he stated, "it is possible for ships to ascertain in thick weather the bearing and position of the lighthouse."

In wireless, electric energy is flashed into space in waves. The distance from one wave crest to another is called "the wavelength" and is usually expressed in meters. In these days, when radio is the hobby of millions, the wavelength may be anything from 200 to 20,000 meters. In other words, the ether of space is shaken into terrific billows compared with which the mightiest upheavals of the ocean are mere ripples.

Continued on page 38

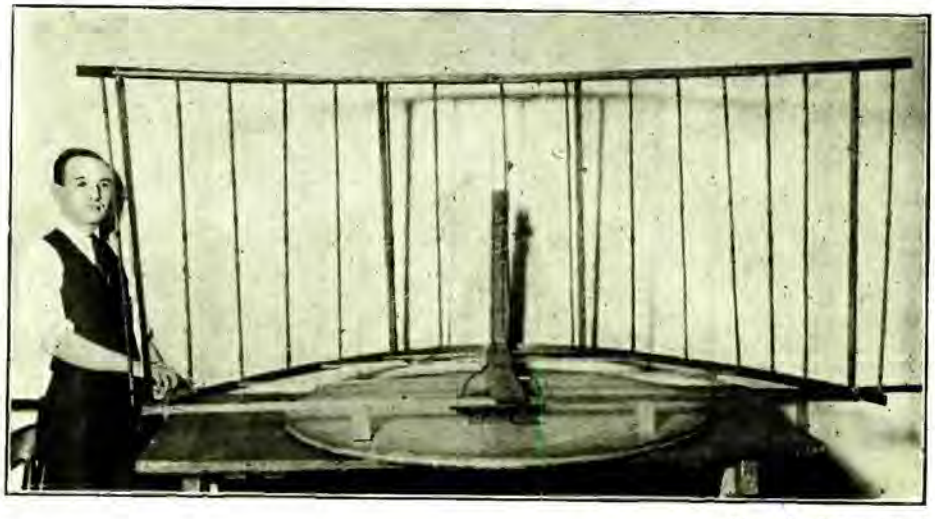
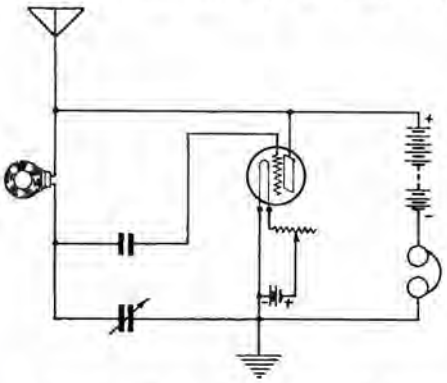


Photo by International

An All-Wave Receiver for Short-Length Pocket-books

By David P. Gibbons

THERE usually comes a period in the life history of every radio bug when all the world, which to him of course means all the radio world, assumes that dark blue tinge, when he grows very weary of turning the little trick switches and adjusting the micrometer controls of ticklers, secondary and tertiary circuits and he decides, for the 'steenth time to quit the radio game for good. Well, when it comes your turn to feel this way,



don't pile all the good old junk in the ash barrel and hurl it from a convenient dock. Just sit down again and try this on your piano. This one is the condensed essence of super-simplicity, if I do say it.

Proceed thusly. Hunt around among the ruins and pick out a variable which still condenses or condenses still. Guess that sounds rather bootleggy, but what I mean is one in which the plates don't rub. Then dig out a fixed one of small capacity, any kind of a grid condenser will do the business as a leak is not essential. Next retrieve a socket, a filament rheostat and a honeycomb coil and you have the complete collection of parts necessary to construct the most wonder—. But first to put them together.

Never mind mounting them on a panel for a start. Take a brief glance at the diagram. The aerial connection goes directly to the plate and to one end of the honeycomb and also to the positive lead of the "B" battery. The other end of the honeycomb coil goes to the grid through the grid condenser and also to one side of the variable. The other side of the variable goes to the ground lead and to the negative of the filament. The fones are connected between the negative of the "B" battery and the ground. And that's all. Absolutely. When making the connections, if at all doubtful, just take another brief glance at the diagram.

And now for the dirty work. Here are some of the poor points of this arrangement. (Ad copy writers please take notice.) For short-wave C. W. work this set is the bunk. For concert work it is *not as good* as a Grebe, a Paragon, or a Westinghouse regenerative set. And that, I think, about exhausts the defects. It brings in the concerts all right—you'll say it does—but not as well as a set built especially for that purpose. With my aerial, which has a natural period of 330, a 75 turn coil and with 15 degrees of the .001 variable, I have heard the Kennedy concert at Los Altos quite clearly when 60 miles south of the Columbia River Lightship. No amplifiers, just the one tube. Of course the size of the coil to be used for any particular wave length will vary slightly with local conditions, such as antenna length, type of coil, etc., but this is easily determined by individual experiment.

But it is on the 600 meter wave and upwards that this little outfit rises up and asserts itself. It makes some of the flossy receivers with all the fancy dewdads hide their nickel-plated heads in shame. It simply reaches out about a thousand miles or so in all directions, grabs up any and all signals regardless and slams them against your eardrums. Honest. Halfway between

The Wiring Shown in the Rear View Could Stand Considerable Improvement, But —She Perks!

Astoria and Portland KPH comes in too loud for comfort and this is by no means an ideal location for reception. Any place along the coast I can (and do) copy the weather reports from the navy stations from Tatoosh to San Diego, reliably and distinctly. On a clear night when well offshore along about midnite, Oy! Oy! how they do roll in!

But now comes the kick in this special home-brew. Take out the 75 turn coil and plug in the largest one you can lay your hands on. Vary the variable and listen to the pretty birdies. Hear them chirp and twitter! Every little old high-power arc from Marion, Mass., from far-away Nippon and to Guantanamo Bay in Cuba comes fluttering home to roost on your flat-top and fight each other to come down and whisper sweet nothings in your shell-like ear. You betcha. And sharp? Oh! boy! Why it's so sharp that—But what's the use? You

This Set Might Well Be Named the "Sphinx," It Reminds You so Much of One —So Different.

wouldn't believe me anyhow, and after you have tried it nobody else will believe you. And there you are. But I've copied WSO and WGG in the daytime while tied up at the dock at Peer 16, San Francisco, and there are not many receivers at any price in that class. On the long waves it oscillates and regenerates to beat four of a kind. The filament adjustment is not at all critical on those waves, and as all the tuning is done with the variable it is quite apparent that it is the "ne plus ultra" as far as ease of operation is concerned. Just one single knob control. Count 'em. One.

And now, if you have no objection, here is a little friendly advice from one who claims to have occasional lucid intervals. Do not try to get this hook-up patented. Put your spare money in wild-cat oil stocks, if it bothers you, but nix on the patent. The Armstrong patent covers everything except the hinges on your old cabinet. Also do not go very extensively into the business of manufacturing and selling these sets unless you can persuade John D., and J. Pierpont and Henry F. and a few more of your old college chums to come to your rescue when the U. S. marshal calls to pay an unsocial visit, as he will without fail.

The reader may have gathered from this article the impression that the writer was manifesting a slight bias in favor of this particular set, and the writer wishes to come right back at the reader and tell him emphatically, if somewhat inelegantly, "You're dog-gone tootin', old man."

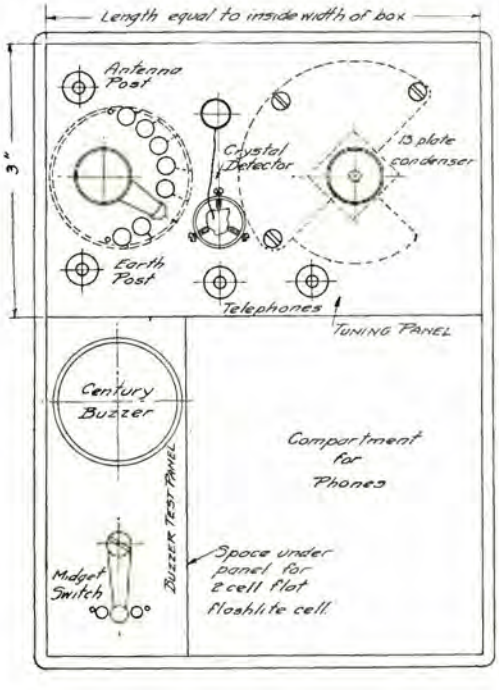
A Practical Portable Receiver

By Howard S. Pyle

WHILE a bit late in the season for portable sets to come to the fore, nevertheless, one finds many uses for such an outfit throughout the year. A portable such as described herein, can be set up at home, and the home audion connected to the antenna and earth posts of the portable, making a good little permanent installation. It is not small enough to be carried in the vest pocket, but is small and light enough to be truly portable, particularly as the fones and buzzer test with battery, are included within the case.

A Mozart cigar box, sanded, stained and varnished, forms a handy carrying case, with the addition of a suitable handle for carrying purposes. The inside of the box is also given a coat of stain to complete it.

The instrument panel carries an inductance switch, crystal detector, and variable condenser dial and knob, together with the antenna and ground posts. The panel is made of XX bakelite, 1/8 or 3/16 in. thick, in. wide and of a length sufficient to fit snugly between the sides of the case. The panel is supported by means of two small blocks, secured to each side of the case, and to which the panel is attached by nickeled wood screws. A small piece of mahogany forms a face for the compartment enclosed by the panel, and protects the under side of panel from injury. The panel is drilled as shown in the drawing, and the apparatus assembled thereon. A 13 plate condenser forms the variable capacity. The tuning inductance consists of a 2½ in. cardboard tube, 1 in. long, wound with a three layer bank winding of No. 26 cotton covered wire. Six taps are taken at equally distant turns, and together with one end of the coil, are soldered to the seven switch points. The switch has a 1 in. radius and the points used are the smallest obtainable, nickel plated.



A crystal detector of almost any small type may be used, but the ball and socket type was found most satisfactory. A small brass cup, with three clamping screws, serves to hold the crystal, which is a piece of mounted galena.

The binding posts for the antenna and ground, and for the telephone receivers, are located as shown on the panel.

A small wooden panel is next constructed to fit as shown, and serves as a buzzer test panel. On this are mounted a Century buzzer, a small nickeled switch. Under the shelf, a small flat, two cell flashlight battery is mounted for operating the buzzer.

In mounting the coil of inductance, it is slipped over the protruding screws of the switch points, from the rear of the panel, and forms a circle around them. It may be secured to the panel by small brackets if desired, but it is not necessary, as, with its connecting taps, it supports itself satisfactorily when the panel is fastened down, which holds it in place.

The single circuit method of tuning is used, for the sake of simplicity and efficiency; selectivity not being a prime factor. With the 13 plate condenser, waves from 100 to 1000 or 1200 may be reached, depending upon the size of antenna used.

The space left in the box after mounting the tuning and buzzer panels, provides carrying space for a pair of head phones; preferably of the Murdock type, as they may be dismounted thereby fitting the space better.

If it is desired to use an audion with this outfit, the leads from audion control marked *Secondary* are connected to the antenna and ground posts of the set. It will then function perfectly as an audion receiver.

FILAMENT CONTROL

Control of filament current by means of a high-grade rheostat is accepted as one of the most important operations in the satisfactory reception of radiophone messages. A word of explanation as to the function of the tube filament and radio "A" battery circuit may make this point clearer.

The tube filament when heated to incandescence gives off negatively charged electrons in all directions. These electrons are attracted to the positively charged plate when the "B" battery circuit is connected. But the "A" battery has the sole task of heating the filament and for most tubes this requires from 5 to 5.5 volts. No more electrons will be given off after the saturation point has been reached.

Scratchi Gives Some Expert Advice

By David P. Gibbons

To Editor of RADIO (Magazine which leads the monthly parade of all such).

Sir Dear:

For some time now since past my Cousin Scratchi have been enjoying extensive beach vacation and as he are quite closely approaching low water ebb of finance he decide to chase himself new opening for his radio talons. He pay visits to six or five offices and jot down name on lengthly wait lists and also fill up very blank papers with grandmother's maid name, how often in jail, what do he like for breakfast and so on and fourth. He return himself to there every brite a. m. for many following days, but fail to hook anything — not even pleasing smile.

One foggish morning (which are not very rare for this season) I collide on street with gent who were formally radiotrician on payroll of the Daily Yowl — The Paper for People who Think they Think—but are now gone back again to old job as cobbler's assistant in Los Angeles.

"There are still opening there," he inform me, "for some dumbell." I require to know if my Cousin might insert himself in this opening. "From what I know," he crack back, "he are just the proper goof." I then make rapid homeward clatter, Mr. Editor, and smash the jolly news to Scratchi who paddle over hastily to paper office and grab this splendor position with no farther questions given or asked.

When he return home again next a. m. he gather up all past numbers of RADIO and start decomposing original articles with aid of sharp shears and high speed blue pencil. He extract sufficient for several columns but find he have large vacant spaces in southeast sector of his page, which editor have threatened to fill with strong-pulling ad for Fluxated Steel—the Tonik for Pale Pink People, None Better Brewed. So he then decide to occupy this place with special Buro of Misinformation and announce in next issue to the more or less gentle readers that he will take pleasure to give answerings and advisings on radio topix to any and every body who, might be, need it.

A few evenings after this, Mr. Editor, I am on homebound way from my daily slave-waging when I am detracted by bully voice of 80 year old newsboy who have shifted tune from broadcasting crime wave to inform all bypassers of grand scoop-up by Daily Yowl which, he say, have secure service at terrible expense the world's most tremendous radio expert, the Honorable Scratchi, who, he say, are insulting engineer to the Bestinhouse Co. and Grand Specialist in Wireless Disease, and who, he say still, are now to be found only in columns of most circular paper in country—the Yowl, morning eruption, or the Yawp, which are evening upheave of same. I buy tomorrow's spasm from this poor old newsie, who I think, Mr. Editor, have more money than next year Republican campaign bag, and turn pages quickly to avoid sticky messup of murderings, wet raidings, movie exposures, soul sobbings and other education featurings which make this paper what it are, until I arrive at absorbing page which my cousin conduct.

I give slight glance at original articles which have already made first appearance in several Radio Deadjests and then make deep study of stream of teknikle wisedom which flow so freely from gifted Neversharp of this notorious expert. I snipped off some of it, Mr. Editor and desire you should pursue same with care, as it are meant for people who have very little or no knowledge at all, if any.

Here are few of hintful helps which he expects to nab up many fresh subscribers with:

Quest.—(1) Could you tell me something about static and (2) can I catch him on my Worstinhouse, Type KO, receiver.—N. O., Branes, Gen. Del., Alameda.

Answ.—(1) I could and (2) You can.

Quest.—Whilst conducting some heavy experiments in vacuum I discover that if airy serkit resistance are reduced below triple ought one two, I don't get any harmonicas at all. I am very muchly surprised. What do you sniggest?—Eymah Frique, Fresno, Cal.

Answ.—I also am very muchly surprised, Eymah. Try adding several more oughts and then multiply this by cubic root of pie. If you still fail to get the harmonicas there must be something wrong in your uphook. Visit reliable Cheerequackto, if possible.

Quest.—I have just took up radio for pastime and have read about new system of Captain Queer for wiring wireless waves. I desire to try this and shall connect my 5 watt fone set to the high power line which pass along in back of my yard, and broadcast latest news to the generally public. Do you think I will get results?—Ivor E. Dohm, Portland, Oregon.

Answ.—Yes, Ivor, you will, doubtless. Before you throw in switch, howsoever, send in your picture with age and so fourth to editor of vital statics column and tell your folks which kind of flowers you mostly wish.

Quest.—I require aid at once. I am greatest radio operator in my state, but cannot secure position. I spend 8 years in navy, 7 in army, 6 in wireless manufacture and last 5 all by myself. I know everything about radio and have triple first grade license and do not know why someone don't give me a job. What do you think?—Signed "Wonderer."

Answ.—I think you are just plain d — — never mind what I think. You should have slight trouble in picking up position to write catching descriptions of new receiving sets for any supply house in same state as you are.

Quest.—Please tell me how I mightbe improve the jazz which I catch on my Ambad, Type NG, Receptor. There are large hole in carpet under A battery, which I think are caused by some of the electrons which were discharged. I love jazz.—Fay Therwate Nudel, Hollywood, Cal.

Answ.—No, Fay; the hole are caused by your grid leaking. If you plug this up with teethpick and reverse B battery to make music come in backwise you will obtain very novel defect which you lack.

You can see from those, Mr. Editor, how my cousin give out personal knowledge at maximum radiation and why he are spoken about in such loud terms by all customers. I think he are headed for something big, Mr. Editor, and hoping you are likewise,

I still remain,

Your respectable reader.

HILOLI NOGO.

ISLAND WITHOUT COUNTRY HAS CALL "U S"

Off Honduras in the Carribean, lies a little piece of land called Swan Island, where Americans have lived for many years although the nationality or ownership of the island has never been decided. On this "Island without a country" the United Fruit Company has a commercial radio station and uses the call "U S" which, however, is not a United States call, but an outlaw call chosen by the company in 1909. Although Italy owns the three letter calls from U P A to U Z Z, "U S" does not come within the control of that country any more than does the island itself.

If the island came into the possession of the United States, the station would lose its identifying call, as all United States calls begin with the letter "N," "K" or "W."

STANDARD OIL USES RADIO COMPASS STATIONS

The fleets of the Standard Oil Tankers have been ordered to make use of the Naval Radio Compass stations to secure or verify their positions off the coasts, which indicates the great value these radio stations have become to merchant ships. The Standard Oil Company has directed all its "skippers" to make "full and frequent use of the Naval radio stations in determining their correct positions." In the event of running aground, the orders state that an investigation will be conducted to ascertain whether or not the vessel was near any of the Navy's 44 compass stations, and whether the Master of the unfortunate craft used the facilities. These facts will be considered in determining his responsibility.

A Soft Graft

A Samuel Jones Story

By Volney G. Mathison

"WOMAN is a deceivin' animal," sourly stated Samuel Jones, as he sat before Cunningham's office window moodily watching the white and the buff-colored ferry-boats stringing off across San Francisco Bay to the Oakland mole. "I don't see how ya can stand bein' married all th' time to one of 'em."

"Oho! I thought so!" chuckled Cunningham, with a knowing smile. "It's almost three months since you blew in from Alaska and went around into the Atlantic on the *'Western Glen'*; and I saw in the paper that you arrived in New York over six weeks ago—six weeks to make a train trip back to Frisco that other people manage in five days! I suppose you played Pullman cavalier to some fair dame, and got vamped again—as usual."

The veteran brass-pounder grunted, and rolled a smoke.

"You know me pretty well," he observed, gloomily; "but it wasn't no railroad cavalierin' racket this time."

With a judgment acquired from long experience, Cunningham waited; while Samuel Jones smoked and frowned at the pretty movie girl's face on the lithographed bill-board down on the opposite side of the street.

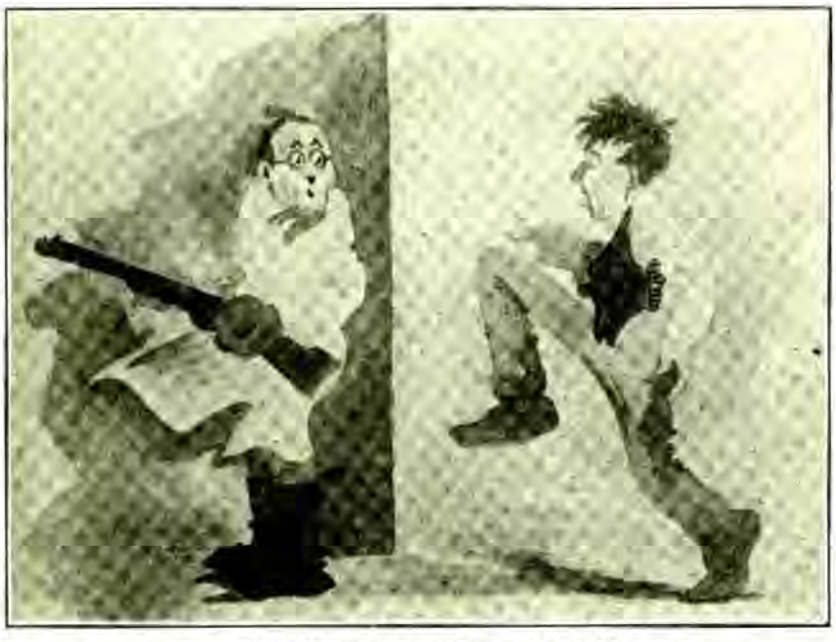
"IT was a long, lanky old hick with a dusty-lookin' sky-piece, an' luggin' a battered-up old pasteboard suit-case with th' name *'Timothy Tuggle'* an' *'Pilcher's Corners' Kansas'* stenciled on th' sides an' ends, who got me into it," at length vouchsafed the shellback operator, becoming dourly reminiscent. "He got into the same Pullman with me in th' Rock Island station at Chicago; an' when th' train pulls out, we discover we're allocated to the same berth. He starts to raise a hulla-ballo with th' Pullman conductor, but bein' such a peace-lovin' human, I agrees to take an upper. This causes him to get real friendly, an' he treats me to somethin' he was carryin' on his hip. He begins tellin' me all his private business, from which I gather that he owns a corn-an-hogs ranch at Pilcher's Corners;—an' then he wants to know all of mine.

When I informs him of my method of defraudin' th' poor ship-owners for a livin', he seems to get a lot interested.

"'Ye're one o' them wireless hee-roes, whut git famous by gettin' drownded, air ye!' he exclaims. 'By jingo!'—an' then he stops an' begins strokin' his rangy goatee, like he was doin' some tall thinkin'.

"'Say—air ye in any big rush about gettin' t' whur ye're goin' ter," he asks, after a while, as if he was turnin' somethin' over in his mind.

"'Well, I guess the hills won't fall if I don't get to Frisco just on time,' I answers, wonderin'.



"Couldn't ya tell me from a sk-kunk?"

"Old Timothy sits an' thinks some more.

"'Yep, by gum—ye're jist th' feller to cure Margy,' he says, at last, half to himself.

"'Margy!' I exclaims. 'Who's she?'

"'Margy's my datter,' he replies. 'A silly-brained, senseless young-un. Here a while back she runned off with a pumpkin-headed dunce round our way named Eusebius Ames—an' would'a married him, only Zoroaster Sims, th' preacher, wouldn't do it, 'count she bein' only seventeen.

'After that me 'an th' missus was keepin' a purty sharp eye on her, until one day we thought we was shet o' that consarned Eusebius. He druv up Logan Hill with a load o' hay, an' comes to a truck full'a cream belongin' ter Ebenezer Pitts, what was standin' acrost th' railroad track. Zachary Bilgiks was under th' truck fixin' suthin'; but Eusebius didn't see him, an' shoved th' truck off'n th' track,—an' it run off backwards all th' way down th' hill an' went slam-bang against Leander Blagan's hen-house, whur it upset an' spilled all th' cans o' cream. Zachary up an' hammers th' stuffin's out o' Eusebius; an' meanwhile a bob-tailed freight-train come along an' hit Eusebius's hay-wagon, an' smashed it all ter smithereens. Fancy Margy wantin' ter marry a dum fool like that!'

"'Never can tell about 'em,' I agrees. 'They're all nuts.'

"'They took th' durned fool t' court,' resumes Timothy. 'He gits sentenced to pay a hundred dollars ter Pete Hankins fer th' hay-wagon, an' two hundred an' thirty ter Ebenezer Pitts for th' cream an' th' banged-up lizzie-truck.

"'Eusebius not havin' th' money, he had to work it out fer Pete at a dollar a day; then Ebenezer sent him ter his rock-quarry up t' Stonefield to work out his time fer th' cream an th' truck. Stonefield's nigh onto a hundred miles from Pilcher's Corners, so we cal'lated we was rid o' Eusebius—but we ain't, by heck!'

"'How's that—does the girl keep mopin' over him?" I asks, wonderin' what in blazes he's drivin' at.

"'Wull, she was nigh ter bein' over it, fer a while,' says Timothy. 'One day she runned acrost a wireless magazine; an' right off she wanted ter git a outfit. Me an' th' missis thought as how it'd be a fine thing fer to help her forgit about thet durned Eusebius, so we let her buy a big transformer an' a rack o' copper-bound kittles, an' a sparkin' wheel,—an' aujons an' truck—cost a pile o' money, too, by gum,—an' now th' hull farm's full o' oscillations an' burn-outs, an' somebody is nigh ter gittin' kilt every day.

"'She put one o' them gol-durned ground wires onto th' pump, an' Jerry Mooly, who is one o' th' hired hands, didn't know what it was, an' took it loose. Jist as he was draggin' it off, aimin' ter nail it over a busted place in th' back fence, Margy started up thet consarned sparkin'-jinny—and Jerry ain't bin right sence. Then she put a tele-

Continued on page 46

The Keyhole of the Night

By Earl Ennis

A PHANTOM scrap of music—the lilt of harmony played by unseen hands, chattering code bits, whispering rhythmically, and an operator half risen from his chair, his face startled, tense . . . a picture clipped from the film of the night!

It was a night when static roared in . . . brittle, sharp, insistent. The tropical disturbances of the autumnal solstice were upon the season with brutal emphasis. Ship business was proceeding slowly, relayed from boat to boat. High overhead the long waves of the giant shore stations whipped and snapped in huge invisible streamers, perceptible only to the occult intelligence of crystals and lamps.

Again the music . . . The station stood on a coral reef, isolated from the rest of the world. It's range was not great—perhaps a thousand miles. There was no music near it—not within the meaning of radio distance. And yet for an instant, like a globule of light, the tones hung poised amid the blackness of the night to fade away again as they had come—ghostly, faint, intangible.

The operator reached for his tuner. It was useless. The music was gone—a memory—an elusive, pulsing breath of distant cymbals and horns, of harps and cellos. Tune as he would he could not bring it back, nor did it ever come back. Yet for that instant—like a curtain torn asunder to reveal the past mysteries of distant years, it had been there with him, in the tiny, hot, stuffy tropical operating room on an isolated coral reef—phantom music!

There was not a broadcasting station in the world, at that time, for this was many years ago when the crystal detector was still in use as a commercial instrument. Yet the music had been picked up, had been heard—music played in some auditorium, some public square, some concert hall. No wireless transmission had been used and without it, the music had carried over mountains and oceans to a lonely coral reef in a far off ocean.

There is no answer—not yet, even in the world of super-developed science and mechanistics. Radio men, consigned to far off spots, left alone with only their instruments for company, report many phenomena of this kind—mysterious music and messages and even spoken words, heard in radio receivers under queer conditions, absolutely unexplicable upon scientific foundations. With an ear to the keyhole of the night, they hear odd things.

Is there then another wave, another oscillating force—a super-carrier, greater than the radio wave, with which the world as yet knows nothing? Does the static, great mystery of the wireless, that picks and scratches at the doors of every wireless station in the country like a lonely, hungry wolf, carry the answer in its bosom?

Natives, beating on gut drums, have found something that radio men cannot fathom. The American Indian, standing with bowed head and folded arms, and closed eyes "talking" in his "spirit code" with another Indian in a distant lumber camp across the width of a lake, also has something that no radio man can explain. His system is just as sure and accurate as the radio, and yet those that can do this thing, lack the education to explain it. What is the answer?

Engineers and savants who have made a life study of radio, of the atom, of the electron, who see in the solid table, a conglomeration of vibrating parts, who hear in the twang of a guitar string a rhythm that can shatter a mountain, and who find in a kilogram of dust, potential, bottled energy greater than the output of Niagara, hold that every spoken word, and the more powerful of human thoughts register everywhere on the surface of the globe.

Hugh Robinson of New Jersey, talking to a friend only a 100 miles distant, with a set barely able to work that distance, was picked up in Scotland 1900 miles away. The cruiser California, ten years ago, lying at Point Loma and talking to a warship less than 500 feet away with a tiny buzzer and two dry cells, was copied at Mare Island station with perfect distinctness, while a whole coast marvelled at the feat, and radio men shook their heads and even then started searching for a new radio wave, greater than the one known to science.

On the threshold of super-electrodynamics, the freaks of the wireless, have developed a slow-growing conviction that up among the star-frequencies, is a new force—perhaps Corelli's "sound wave" that was hurled from the "City of Brass"—that spoke to the human ear without apparatus. Here and there are persons, already attuned to this new super-vibration—who hear radio signals and music without radio sets. Are these forerunners of a new race of the future?

What else can explain the bits of code, the scraps of phantom music that drift from pole to pole, that beat upon alien wires, high strung above the earth, that come tapping with ghostly fingers on the human consciousness, that whisper faint nothings through the key-hole of the radio, to startled ears? There is no wavelength on which they can be found, no apparatus that can bring them in or keep them when they seek to go. They are orphans of the night—the wandering Jews of the wireless—doomed to go on and on—flotsam on the surface of an ocean unknown to mankind.

The radio operator is no agnostic. He does not flout the beliefs of any man. Left alone beside his peep-hole, his finger on the control of a force he cannot hope to understand, his ears attuned to whisperings as faint as the urge of conscience, he shakes his head, and marvels. At the key-hole of the night he learns that there is much beyond—much to be learned—much to be solved. He alone, of all mankind, heterodynes with infinite Time and the Fourth-Dimension!

This then—the great Romance of the Radio!

RADIO CONCERTS FOR BUS PASSENGERS

Bus lines in California will soon be serving you music with your rides.

Should tests which the California Transit Company, of Oakland, Cal., started recently prove successful, many of the eighty-five White busses operated by this line will be equipped with radio phones to pick up daily radio concerts in the bay region.

W. E. Travis, president of the California Transit Company, sent the first radio equipped bus out on its regular run to Sacramento and in spite of the obstacles which confronted the test enough information was obtained to warrant further experiments and to assure Mr. Travis that radio concerts would soon be a reality for his patrons.

With only a two step radio shortwave receiving outfit and handicapped by the necessity of operating with a low antenna, the bus was able to pick up San Francisco and Oakland concerts as far as Martinez.

At Sacramento a test was made by special arrangement with the Holbrecht broad-casting station. It was found that by a sacrifice of speed the concert was as audible when the bus was in motion as when it was standing at the curb.

According to officials of the bus company and radio men interested in the tests from a scientific angle, some refinements will be made, and experiments continued until desired results at varying speeds are obtained.

A Radio Primer

By H. A. Eveleth

TUNING COILS IN RECEIVING SETS

THERE are several forms or arrangements of coils used in receiving circuits for tuning such circuits to the wave-length of the sending station. When two circuits are in tune the natural period of electrical vibration of the two are the same. The two circuits are tuned to resonance. The product of the inductance and capacity of the one circuit is equal to that of the second circuit. The tuning coil supplies inductance to the circuit, the amount depending on the number of turns of wire rather than on the length of wire in the coil.

The simplest form of tuning coil consists of a single layer of wire wound around a cylinder and a rod and sliding contact so arranged that any number of turns desired may be used. This is called a single slide tuning coil. It may be connected between the aerial and ground to tune the aerial-ground circuit to that of the sending station.

If two sliding contacts are used it is a double slide tuning coil. This second sliding contact permits the detector circuit to be turned more accurately to the aerial-ground circuit. The detector circuit is called the closed circuit and the aerial-ground circuit is called the open circuit. It will be seen that one winding or coil serves for both circuits.

If two separate coils are used, one for each circuit, so mounted that the distance between the two can be varied, tuning can be accomplished more accurately and there will be less interference; in other words the system will have greater selectivity. The loose-coupler consists of two windings, a primary and a secondary, one of which will slide within the other. There is no electrical connection between the two and energy is set up in the secondary winding (closed circuit) by induction from the primary winding (open circuit). The two windings are said to be coupled electro-magnetically. The coupling is close when the windings are near together and loose when the windings are drawn apart. The number of turns or inductance in each circuit can be varied either by a sliding contact or by taps brought out to switch points.

The coupling between two coils can be varied by rotating one coil within the other. The vario-coupler is of this form of construction. It can be mounted easily on the back of a panel and a knob and dial in front will permit easy and accurate adjustment of the degree of coupling.

The vario-meter is constructed similar to the vario-coupler except that the two windings are connected together. When one winding is rotated the mutual inductance between the two windings is changed and the effective inductance of the unit as a whole is changed. It has no sliding contacts nor switch points wherein there are opportunities for small energy losses due to poor contacts and it is therefore a very efficient tuning unit to employ in a receiving circuit.

When it is desired to tune the open circuit to a wave-length above that which can be secured with one tuning coil a second coil may be connected in series with the first. The second coil, which serves to add the required amount of inductance, is then called a loading coil.

There are also tuning coils known as bank-wound, honeycomb and duo-lateral wound. These coils are usually of fixed inductance and their wave-length can be varied by using variable condensers connected to them in shunt.

These coils have a number of advantages over the loose-coupler. They are much more compact and there are no losses due to poor contacts. So-called "dead-end" losses are eliminated, these being such as occur in portions of inductances not switched in circuit where sliding contacts or switch points are used. Due to the form of winding the high-frequency currents can pass through the windings with less resistance, and therefore more energy reaches the detector. Coils of different inductance values can quickly be inserted in the coil mountings and the effective wave range of the receiving set can be made to reach any practical values.

REGENERATION

A REGENERATIVE circuit is one so connected that the plate or output circuit of the detector tube is coupled, that is connected electrically, to the grid or input circuit of the same tube. In the non-regenerative circuit the plate is connected to the filament through the phones and "B" battery, while the grid is connected to the filament through the grid condenser and the secondary winding of the loose-coupler, vario-coupler or other tuning device. These two connections are called the plate and grid circuits respectively. In the regenerative circuit an additional coil or coils are so connected that energy from the plate circuit is "fed back" to the grid circuit. One way to accomplish this is to use a "tickler" coil connected in the plate circuit and so placed that there is induction between it and the secondary winding of the tuner in the grid circuit. Regeneration may also be brought about by tuning both grid and plate circuits with variometers connected in these two circuits.

When the grid voltage is varied by incoming signals a change in current flow in the plate circuit takes place, but the energy flow in the plate circuit is much greater than in the grid circuit, due to the available energy in the "B" battery, which is released by the valve action of the tube as explained previously. In the non-regenerative circuit the tube therefore both detects signals and amplifies them. In the regenerative circuit some of the energy of the amplified signal is returned to the grid circuit so that it too acts on the grid, together with incoming energy from the aerial with the result that the voltage variations on the grid are greater than ever and hence the plate current variations are greatly intensified. The tube therefore not only detects but amplifies signals to an extent which greatly exceeds the amplification which could be had without regeneration.

The Armstrong regenerative circuit is probably the most efficient and manufacturers of apparatus who use it must pay a royalty.

DAMPED AND UNDAMPED WAVE RECEPTION

A SERIES of pebbles dropped into water at intervals create a series of water waves which spread out over the surface. Each group of waves represents the disturbance caused by one pebble. The largest wave of the group is at the front and the following waves of the group gradually die down in height or amplitude, and finally no further disturbance is visible until the next group of waves approaches. Each group is called a wave train. These wave trains are damped because they are generated by a source of energy which is not sustained.

In radio telegraphy damped waves are generated by the discharges of a condenser connected inductively to the aerial and ground of the sending station. The energy stored in the condenser by the high tension transformer discharges across the spark gap first in one direction and then in the opposite, each discharge decreasing in intensity until the condenser may be said to be discharged. This action sets up a corresponding train of oscillations or flow of alternating current in the aerial-ground circuit and a damped wave train is radiated.

At the receiving station the wave trains are rectified by the crystal or vacuum tube detector and made audible. The frequency of the condenser discharge is above the limits of audibility, in other words they are at radio frequency, but the detector rectifies the al-

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High Versus Low Antenna

By Dr. A. E. Banks—6ZB

IT is with some reluctance that the subject of antenna constants is tackled by the writer, who makes no claim to engineering expertness. Owing however, to the conviction that much has been left unsaid on one side of this issue, and that certain fallacies have been foisted on the minds of many amateurs, a non-technical attack on the problem follows, which it is hoped will bring forth arguments pro and con, to the end that we may finally know the truth of the matter.

First, let us note that the average amateur (owing to the physical limitations of his terrain) would prefer a low antenna with its limited expense, ease of erection and immunity from accidents, and that whenever he has erected a high antenna it has been for the purpose of obtaining a greater so-called "radiation resistance" with the reputed greater range. If he had found results could have been obtained equally as well on the low antenna, the high one probably would not have been erected.

The largest station in the world, where expense of installation meant little, has just finished a relatively low long antenna. The Eiffel Tower is one of the world's highest antennae, and it is known that great difficulties have been encountered at certain wave lengths on account of this height. Ships practically all have low antennae. Bucher gives a table on page 121 of his "Practical Wireless Telegraphy" in which the masts range from 55 ft. to 150 ft. and yet all these use the 600 meter wave and put more energy on it than on the 300. The longest natural period noted is 426 meters with a height of 150 ft., the flat top being 250 ft.

Again and again in amateur literature we read that "the higher the antenna the better." Bucher (Page 127 Wireless Telegraphy) says, "We want the radiation resistance of an aerial to be as high as possible, etc." A search of successful amateur station records has proven that antennae of an average height of 50 ft. have done more uniform long distance work that the few 100 ft. cases reported. Further, the 100 ft. masts are most frequently utilized for wave lengths over 200 meters, especially 375 meters, and it is on these latter wave lengths that their records are frequently noted. My hearers are invited to tabulate the station constants as reported in the four leading amateur magazines of this country for the past few years and the information gleaned will be startling. Prominent stations are the following:

Name		*Height*	*Distance*
2PL		75 ft.	1000 miles
2QR		50	....
2XX		55	1000
2RK		75	3600
8XK		50	?
5GJ		65	1500
3GE	Canada	40	1000
5ZX		62	1600
6JD	T	60	1800
5ZA		55	N. Y.
5ZP	T	40	1000
8ZI	T	60	1300
1AK		50	1100

Let us now proceed to deduce what our needs really are in the matter of antennae for spark stations. Everyone knows that a relatively low antenna with counterpoise is the thing for C. W. but we are willing to admit as before stated that the dictum "as high as you can and just short of brushing" still holds sway in spark literature. First let us go to the bottom of things and start with the premises that *we want maximum current in the antenna.* This current squared multiplied by the resistance of our antenna will then indicate the watts we are radiating. Now there are two ways of getting this current on the wire. One is to force it against its will and the other is to invite it in and make its entry easy. It is a well known fact that the higher the antenna the greater its total resistance. It is remarkable that some of the most successful radiators among the huge antennae of the world are using a total resistance which is in fractions of an ohm when from the learned discourses in the amateur columns engineers might perhaps to their advantage (?) have learned that they should have tried to get the whole 36 ohms radiation resistance possible back of their watts.

Given the choice between a high and low antenna of the same physical dimensions otherwise it goes without saying that with the same source of power more current will be put into the low than the high antenna. Please note the kick in the following quotation from Bucher: "The student will note that if the average value of current in the antenna circuit remains constant, the amount of energy radiated from a given aerial system depends directly upon the effective height and inversely upon the length of the radiated wave." It is believed that this statement is true but it is also believed that with the same transmitter as the source of energy the average value of current will be less in the high than in the low antenna.

Everyone acknowledges that a high antenna has a high natural decrement. Loading this antenna will reduce it but it can only be loaded so much for a given height or its natural period will be too great. Some of the barndoor variety of wave tops have been known to emanate from antennae whose decrement cannot be further doctored without lowering the mast, which indignity the station owners would not brook. In passing, the facetious remarks of a fellow amateur are recalled relative to this subject when we were discussing advisability of the low antenna. He said, "why not make it one foot high and really get some current into it?" Of course there is a limit to everything and one might roughly state that when the total resistance of the antenna system and ground has been reduced to 3 or 4 ohms it will do. A properly constructed antenna of 50 ft. height with a flat top either L or T, where every allowance is made in favor of reducing ohmic resistance in series with a ground system which is something else than a multiplicity of high resistance leaks from the metallic conductor, should prove superior to a high antenna where in addition to the ohmic and dialectric losses we have several ohms thrown in of so-called "radiation resistance." I say *should* prove—it would be more proper to state that experience has shown such form of antenna and ground to be superior.

In conclusion it is the writer's contention subject to correction by "those who know and have the proof" that if amateurs desirous of getting the most range out of their transmitters would eliminate ohms from their closed and open circuits, no matter where those ohms appeared, and limit themselves to an antenna system whose average height would be approximately 50 ft. that they would excel stations ignoring the ohms and substituting "high-voltage-amp drivers" to force energy way up a mast through a series of resistances of no utility, at the base of which an intricate system of buried substances are disposed, none of which constitute a perfect ground and in lieu of said ground form multiple high resistance leaks. In proof thereof we offer in evidence the ship's antennae and the ocean ground, and the innumerable instances of the successful long distance work done by amateur stations using a combination of moderate height and real ground or counterpoise.

There is no use advancing the C. W. argument because everyone to whom this has been mentioned always says, "Why that is different, that is C. W." Just the same, C. W. holds forth the ideal as to decrement and unless strenuous efforts are made in the near future to cut the decrement at innumerable spark stations it is believed that the spark will be taken away from the amateur.

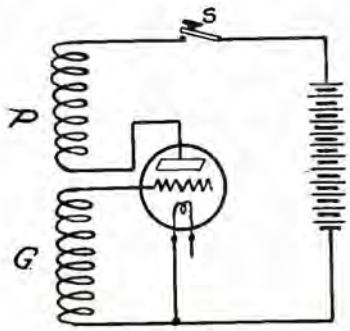
The Vacuum Tube As An Oscillator

By B. F. McNamee

THE steam engine offers a good analogy to the vacuum tube when the latter is used as an oscillator. Steam from the boiler enters the cylinder and moves the piston to the end of its stroke. The movement of the piston operates the valve which in turn controls the flow of steam and starts the piston moving in the opposite direction.

The reciprocating motion of the piston corresponds to the alternating current obtained from the vacuum tube. The steam coming from the boiler corresponds to the flow of current from the "B" battery, and the valve on the engine performs a function analogous to that performed by the grid of the tube.

To see more clearly the action of an oscillating tube the action of the circuit shown in the accompanying diagram will be followed out.



The potential of the grid, or in other words, its charge, is at present zero, because it is connected through coil *G* to the negative end of the filament, which is considered the point of zero potential is vacuum tube work.

Coils *P* and *G* are closely coupled, so that they act like the primary and secondary of a transformer, but as long as there is either no current or a steady current in coil *P*, there can be no induced potential in coil *G*. Only arising or falling current in the plate circuit can induce a potential on coil *G* and thereby affect the grid.

When the switch *S* is closed, current starts to flow in coil *P*. This rising current induces a voltage in coil *G*, making the grid either positive or negative, depending on which way the coils are wound with respect to each other. If the induced potential on the grid is negative, one of the coils should have its connections reversed; this will make the charge induced on the grid positive for a rising plate current.

But the result of a positive charge on the grid is a further increase of plate current, and this in turn induces a further positive charge on the grid. So the increasing of the plate current continues until it reaches its maximum—that is, when all the electrons given off by the filament are reaching the plate as fast as they are emitted. This is known as the "saturation current," and a further positive charge on the grid cannot cause any further increase in plate current when this point is reached.

For a brief instant the plate current remains at this steady maximum value. But since a steady current in coil *P* causes no induced voltage on the grid, the latter will immediately loose its positive charge and drop back to zero potential. This causes a drop in plate current.

Now a falling current in coil *P* must act on coil *G* in the opposite manner to a rising current; it will induce a negative charge on the grid. This will cause a still further decrease, and the action continues until the plate current is practically nothing. This results in no further action on the grid, which now looses its negative charge, becoming zero again, and allowing the plate current to rise to its normal value.

This rise in plate current starts a repetition of the same actions as described above, and they will continue indefinitely. The grid potential will swing back and forth between a positive and a negative value, and the plate current will rise and fall in strength. A coil coupled to coil *P* and connected to a tuned circuit would have an alternating current induced in it.

The frequency of the oscillations depends on the inductance and capacity of the circuits containing *P* and *G*. If *P* and *G* represent the primary and secondary of an audio-frequency amplifying transformer with iron core, the inductance has a very high value and the oscillations will take place about 200 to 2000 times per second, depending on the exact dimensions of the transformer. If a pair of telephones were connected in the plate circuit in series with coil *P*, a continuous howl would be heard.

In the case of the oscillator tube of a radiophone, these coils consist of a few turns each with air core, and the oscillations occur sometimes more than a million times in one second.

Other types of oscillating circuit are frequently used, but they depend on the same principle—a change in current in the plate circuit causes a change in grid potential, and this, in turn acts on the plate current.

RADIO STATION OF THE Y. M. C. A., DAYTON, OHIO

With the use of the 25 watt C. W. and radio telephone transmitter shown in the accompanying half-tone, the Y. M. C. A. Radio School at Dayton, Ohio, has succeeded in communicating with numerous stations in the bordering states. Stations at Troy, Ohio, report that the voice can be heard for two blocks when received

on an ordinary two step Magnavox amplifier and loud speaker.

It will be noted from the illustration that no switch points or dials are used for controls. An ordinary D. P. D. T. switch allows for wave length changes from 200 to 375 meters.

In addition to the C. W. transmitter there is the 500 cycle spark equipment. Communication is carried on with stations in Arizona and Texas by means of this transmitter.

The instructor of the school is Mr. Paul R. Fenner, formerly editor of "Pacific Radio News."

PITTSBURGH TO HAVE RADIO DAY

"Radio Day" will be a yearly event in Pittsburgh, Pa., under the auspices of the Radio Engineering Society. Westview Park will be the center of radio activity on August 24th.

There will be numerous radio contests, exhibitions and demonstrations. A number of the radio dealers in Pittsburgh will close their stores for the day.

RADIO RENDEZVOUS

The Radio Rendezvous is in process of organization. It will occupy an entire floor in the Grand Central Palace in the very heart of New York. The first radio theater and the first radio dance hall ever established will be the outstanding features of the Rendezvous. The theater will seat over a thousand people and the dance hall will accommodate over a thousand couples.

Helps for the Radio Builder

By H. Spencer Lewis
(Amorc Laboratories, San Francisco, Calif.)

THE following laboratory and shop notes will be of help to those who build their own or modify any of the standard sets. Theory and practice do not always agree in radio experimentation, and this is often responsible for the strange workings of a set after assembling, or for the failures experienced when certain results are strived for. The notes are disconnected and no attempt is made to make them constitute a logical system.

All hookups work better when assembled on an experimental table with even very loose association of parts, than when closed within a cabinet. Remember this when deciding to imprison a good working set.

An experimental table with handy aerial, ground and battery taps, plenty of room to arrange instruments far apart, is one of the best assets an experimenter can have.

Some of the finest working sets are located on such tables with the most unsystematic wiring you can imagine, but so perfectly are the parts balanced in their relation to each other that the owner would not permit a single wire or part to be moved a fraction of an inch.

Remember that amplifying transformers should be far apart or at right angles to each other.

In such tuning coils as employ a primary and secondary only, as a loose-coupler, vario-coupler, etc., bear in mind that the section of the secondary which is receiving the efficient induction from the primary, is that section which is outside the primary windings containing the aerial-ground stress. In other words a primary and secondary winding on the same coil, along side of each other, one-eighth of an inch apart, is the most efficient relation; not with secondary inside of the primary.

It is not true that in winding a rotor of a variometer the winding of the wire must be in the same direction as on the stator. Very efficient results are obtained sometimes (and only sometimes) by having the rotor wound in an opposite direction from the stator. In fact an excellent way is wind the first half of the rotor the same as the stator and the last half in the opposite direction.

After you have assembled your parts in a cabinet, try a temporary wiring hook-up before you solder connections. You may find many changes are necessary.

Place your grid leak where it will be easy to rub out any pencil marks and alter the leak. Experiment as much with the functioning of your grid leak as you do with your condensers and tubes and you will learn its importance.

No two detector tubes are alike in any sense and no two require the same grid leak values. When you change tubes, become acquainted with your set all over again. You have changed the most important link in the chain.

Every detector tube (even of the same make) requires slightly different plate voltage from the B battery, especially at critical points. You cannot change detector tubes on the same plate voltage as you do with amplifying tubes.

When all functionings of your parts in a set are balanced, your amplifying tubes should cause oscillations when the rheostat is moved, as with the detector tube.

Keep in mind when tuning, especially for distant signals or weak broadcasting, that the final adjustments and best tuning is done with your detector tube. The slightest movement of the detector rheostat will bring in or shut out a weak signal.

For the above reasons, the rheostat on the detector tube is a most important matter. Such rheostats as alter resistance gradually and not in steps, are the only rheostats to use.

Regarding detector rheostats keep this in mind also. If the rheostat is a resistance wire made into a coil about one-quarter of an inch in diameter, then every time you move the slider from one of the turns to another, you are adding or subtracting about three-quarters of an inch of resistance wire. How can fine tuning be done in such steps? Some rheostats have huge coils of wire, each turn representing over one and one-half inches of wire. They may be good for amplifying tubes but are not good for detectors.

A small bridging condenser, like a small fixed phone condenser, should be added by connecting one side to the lead that goes to the primary of the first amplifying transformer from the tickler, and connecting the other side to the lead

Continued on page 70

"KFS" The World's Finest Coastal Radio Station

By Volney G. Mathison

Photography under supervision of the author by special permission of the Federal Telegraph Co.

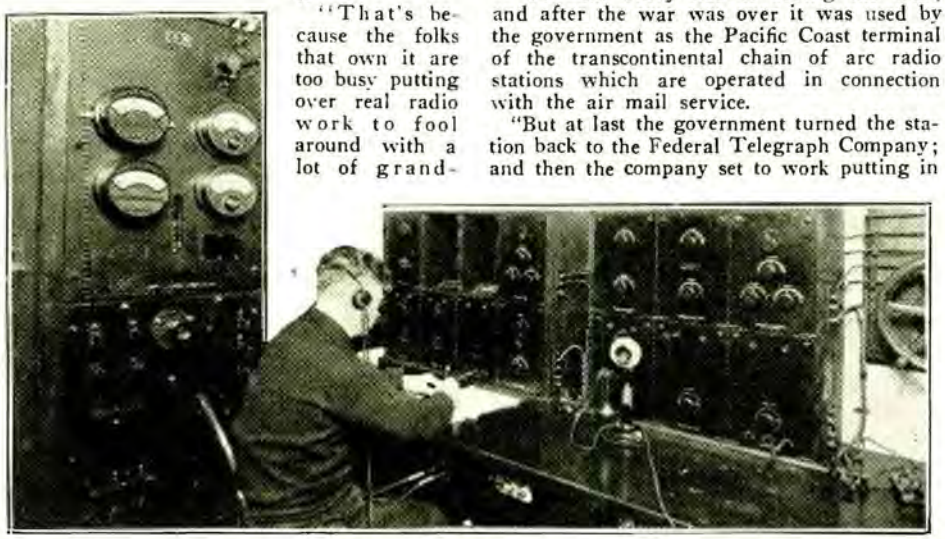
"I DON'T know just what to put in here," remarked the editor, wrinkling his literate brow as he sat tapping thoughtfully with his pencil on a big white space in the "dummy," a hundred-page blank book pasted full of printed samples of articles and cuts and ads, for August RADIO. "I've got several really good things I might use, but I wish I could find something different—something with a regular snap to it, if you know what I mean."

"Stop right there," I cut in, "and I'll tell you what I'll do. I'll go and get you something I was planning to save for September—a feature on that big radio station out on the ocean beach, just south of Golden Gate Park."

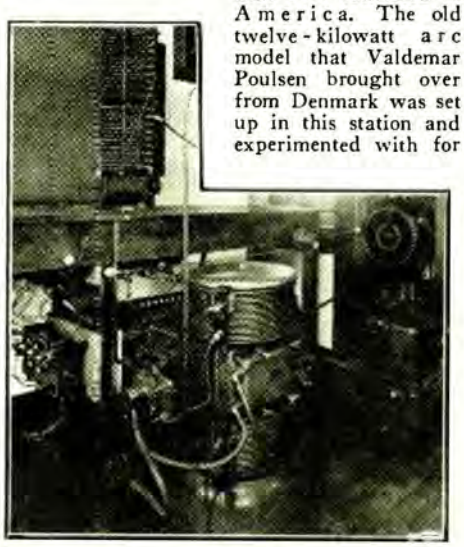
The editor showed noticeable signs of interest.

"That station is a sort of mystery," he observed. "No one seems to know much about it——"

"That's because the folks that own it are too busy putting over real radio work to fool around with a lot of grand-stand publicity guff," I explained. "The Federal Telegraph Company built the station in 1910, and installed the first arc transmitter that ever oscillated in America. The old twelve-kilowatt arc model that Valdemar Poulsen brought over from Denmark was set up in this station and experimented with for several years. You know, of course, that the Federal Telegraph Company bought Poulsen's patents and developed his invention from its crude state of those days to its present perfection; and it was the old Danish model in this Beach station here in San Francisco that showed our Navy chiefs what the arc could do and led to our national system of high-power CW stations which have brought Manila and Panama within hailing distance of Washington.



Receiving-room. From left to right, arc-control panel, 1,700-3,000 meter CW receiver, and 600-meter spark receiver. The operator hears simultaneously 600-meter spark signals in one telephone receiver and 2,400-meter CW in the other.



A corner of transmitting room, showing arc converter and auxiliaries.

"Later on, when the company began building the Navy's 500-KW arc sets at their Palo Alto factory, they used this station as a unit in their duplex overland radio system, which they operated in competition with the land-wire companies."

"Didn't the Navy operate that Beach station for a while, also?" queried the editor. "I've heard they did."

"Yes—the Navy had it during the war; and after the war was over it was used by the government as the Pacific Coast terminal of the transcontinental chain of arc radio stations which are operated in connection with the air mail service.

"But at last the government turned the station back to the Federal Telegraph Company; and then the company set to work putting in brand-new up-to-the-minute apparatus and refitted the station for working exclusively with ships at sea. It is now a commercial coastal station, open for general public business; and it's setting some world's records for long-distance work."

The editor seemed to have fully come to life now.

"There ought to be something good out there, if you can get it," he declared with enthusiasm. "Make some pictures 'n everything—and for the love of macaroni, work fast! The printing gang will raise particular Cain over delaying the work; so step on the gas——"

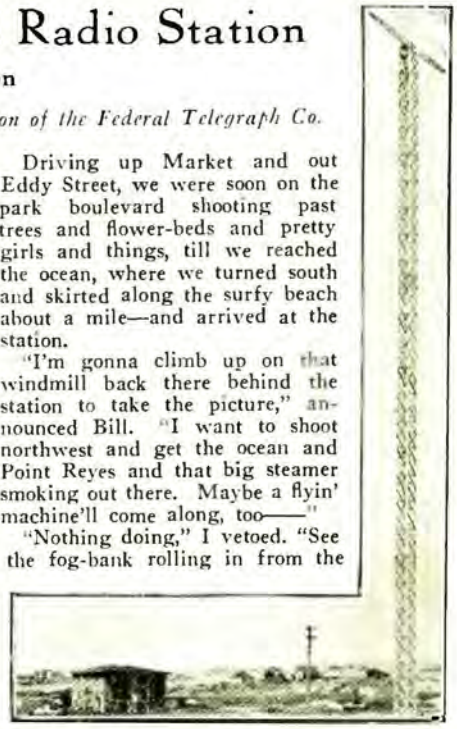
But I was already through the door, down Market Street, and into the Hobart Building, the headquarters of the Federal Telegraph Company. In his office on the eighth floor, I corralled the company's operating engineer, Mr. A. Y. Tuel, who has been in the radio game since 1899 and has seen the arc grow from the little Poulsen model to the thousand-kilowatt brute at Annapolis.

After a brief buzzing in his ear about permits and so forth, I dashed out again and down to Bill's studio. Bill, who is shaped like a camera tripod himself, has photographed everything from prize-winning billy-goats to fascinating young ladies in underwear for catalog cuts; so nothing can faize him.

Driving up Market and out Eddy Street, we were soon on the park boulevard shooting past trees and flower-beds and pretty girls and things, till we reached the ocean, where we turned south and skirted along the surfy beach about a mile—and arrived at the station.

"I'm gonna climb up on that windmill back there behind the station to take the picture," announced Bill. "I want to shoot northwest and get the ocean and Point Reyes and that big steamer smoking out there. Maybe a flyin' machine'll come along, too——"

"Nothing doing," I vetoed. "See the fog-bank rolling in from the westward, way out beyond that ship. Before you can get half-way up on the windmill that fog will be here; and then we'll get no picture at all. We'd better set up the camera down here on the beach and shoot against the sand hills back there. We'll come out and get a picture of the Pacific Ocean and a seagull some other day—no time now."



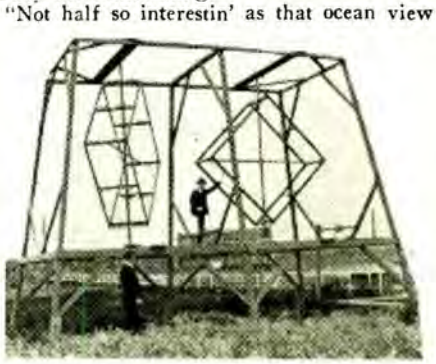
This San Francisco station, equipped with 10-KW spark and 20-KW arc transmitters and two mysterious receiving sets, is smashing all records for long-distance work with ships at sea.

"You ain't artistic a'tall," grumbled Bill. "There won't be a thing in th' picture but that darned wireless station!"

The picture taken, we picked up our photographic gear and approached the station.

"We'd better get those two loops mounted in that frame out there alongside the building," I suggested, as we came up the walk. "They look interesting."

"Not half so interestin' as that ocean view would be from the windmill," said Bill, disgruntled.



A 5,000 mile aerial! These loops are used for receiving. By means of gears and shafting the loops can be rotated by the operator at his desk (Kolster loop circuit).

As Bill was setting up the camera, I saw a man in his shirt-sleeves run out of the station; and as a precautionary measure, I climbed upon the loop frame.

"Hey—whadda-ya doing out here?" he demanded. "Come down from there."

"Still—lens open!" barked Bill; and then I climbed down.

"I've got an O. K. for photographing from

Continued on page 88

News of the Broadcasting Stations

WGY SCHEDULE

WGY, the radio broadcasting station of the General Electric Company, will continue on its present schedule of three concerts a week, Tuesday, Thursday and Friday nights, through the entire summer. Vacationists in the Adirondacks, the Catskills, in the New England states, the Thousand Islands, Eastern Canada and in the middle west will be able, if equipped with receiving sets, to enjoy excellent musical programs.

In addition to the musical programs, three times a week, stock market quotations will be broadcast at 12:30 p. m., Eastern Standard time, daily, except Saturday and Sunday, and stock market and produce market quotations and baseball results will be announced nightly, except Saturday and Sunday, at 6 p. m., Eastern Standard time.

WGY broadcasts on a wavelength of 360 meters.

KDKA, EAST PITTSBURGH, PA., HEARD SOUTH OF THE EQUATOR

KDKA, the radiophone broadcasting station of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has established a new record. It has been heard south of the Equator, having been picked up by a ship operator while in the port of Iquique, Chile.

The news that KDKA had been heard so far south—Iquique is approximately 4,200 miles from East Pittsburgh, Pa.—was conveyed in a letter written the radio division of the Westinghouse Company by Mr. Frank F. Reb, chief operator of the *S. S. Santa Luisa*, who caught the signals.

It is quite possible that other call letters, which Mr. Reb states in his letter sounded like WFD, were WJZ, the call of the Westinghouse Radio Corporation station at Newark, N. J. In any event Mr. Reb heard two Westinghouse stations, KDKA and WJZ, the same night, both of which are located over 4,000 miles from Chile.

CLOSE ROCK RIDGE STATION

The Atlantic-Pacific Radio Supplies Company has closed the Rock Ridge broadcasting station at Oakland, California, and until plans have been completed for the opening of a station elsewhere the present Rock Ridge schedule will be maintained by various bay district stations. Programs will continue to be furnished by the Atlantic-Pacific Radio Supplies Co.

PROMOTING TRADE BY RADIO

Foreign trade news and dispatches by radiophone will be another means of informing the American business man of developments in foreign fields of industry and commerce if the innovation to be made by the United States Department of Commerce on July 11 and 12 is to be established as a permanent practice.

On those dates two large gatherings of business men will be held at Boston and Baltimore; the exposition of New England Shoe and Leather Association will take place at the former city, while an import and export exposition will be held in the latter. Arrangements have been made with the Navy Department to utilize the facilities of the Arlington radio station to send these meetings the latest cabled news of foreign markets and trade opportunities received from abroad by the Department of Commerce.

For the guidance of all receiving stations, the time of broadcasting will be 8 p. m. (Eastern standard time) on two days, July 11 and 12, the station Arlington (NAA), and the wavelength 2650 meters.

NEW BROADCASTING STATIONS LICENSED

W E A K—Julius B. Abercrombie, St. Joseph, Missouri.

D K Z R—Bellingham Publishing Co., Bellingham, Wash.

W E A I—Cornell University, Ithaca, N. Y.

K D Z I—Electric Supply Co., Wenatchee, Wash.

K D Z J—Excelsior Radio Co., Eugene, Ore.

K D Z M—E. A. Hollingworth, Centralia, Wash.

K D Z Q—William D. Pyle, Denver, Colo.

K D Z K—Nevada Machinery & Electric Co., Reno, Nevada.

K D Z P—Newbery Electric Corp., Los Angeles, Calif.

W E A G—Nichols-Hineline-Bassett, Edgewood, R. I.

W E A M—Borough of North Plainfield, New Jersey.

K D Z L—Rocky Mountain Radio Corp., Ogden, Utah.

K D Y X—Star Bulletin Publishing Co., Honolulu, T. H.

W E A H—Wichita Board of Trade & Landers Radio Co., Wichita, Kansas. (Also weather and markets).

Between May 20 and 27, the following limited commercial stations were licensed by the Radio Section of the Department of Commerce:

K D Z A—Arizona Daily Star, Tucson, Arizona.

W D A O—Automotive Electric Co., Dallas, Texas.

W D A L—Florida Times Union, Jacksonville, Florida.

W D A N—Glenwood Radio Corp., Shreveport, La.

W D A Q—Hartman-Riker Elec. and Mach. Co., Brownsville, Pa.

W D A R—Lit Bros., Philadelphia, Pa.

W D A P—Midwest Radio Central, Inc., Chicago, Illinois.

K D Z B—Frank E. Siefert, Bakersfield, Calif.

W D A M—Western Electric Co., New York, N. Y.

W D A T—Delta Electric Company, Worcester, Mass.

W D A W—Georgia Railway & Power Co., Atlanta, Ga.

W D A K—Hartford Courant, Hartford, Conn.

W D A U—Slocum & Kilburn, New Bedford, Mass.

W D A S—Samuel A. Waite, Worcester, Mass.

W D A X—First National Bank, Centerville, Iowa.

W D A Y—Kenneth M. Hance, Fargo, N. D.

K D Z D—W. R. Mitchell, Los Angeles, Calif.

W D A V—Muskogee Daily Phoenix, Muskogee, Okla.

K D Z E—The Rhodes Co., Seattle, Wash.

K D Z F—Automobile Club of Southern California, Los Angeles, Calif.

W E A C—Baines Electric Service Co., Terre Haute, Ind.

K D Z G—Cyrus Peirce & Co., San Francisco, Calif.

W E A A—Fallain & Lathrop, Flint, Mich.

K D Z H—Fresno Evening Herald, Fresno, Calif.

W E A D—Northwest Kansas Radio Supply Co., Atwood, Kansas.

W E A B—Standard Radio Equipment Co., Fort Dodge, Iowa.

SUPPLEMENTAL LIST OF COMMERCIAL BROADCASTING STATIONS LICENSED DURING WEEK ENDING JUNE 24.

W F A Y—Daniels Radio Supply Co., Independence, Kansas.

K F A C—Glendale Daily Press, Glendale, California.

W F A X—Arthur L. Kent, Binghampton, N. Y.

W F A U—Edwin C. Lewis, Inc., Boston, Mass.

W F A W—Miami Daily Metropolis, Miami, Florida.

W F A Z—South Carolina Radio Shop, Charleston, S. C.

W F A V—University of Nebraska, Lincoln, Nebraska.

W G A F—Goller Radio Service, Tulsa, Oklahoma.

W A A B—Valdemar Jensen, New Orleans, Lousiana.

K F A D—McArthur Bros. Mercantile Co., Phoenix, Arizona.

W G A C—Orpheum Radio Stores Co., Brooklyn, N. Y.

W G A D—Spanish American School of Radio Telegraphy, Ensonada, P. R.

K F A E—State College of Washington, Pullman, Washington.

PORTO RICO AND SOUTH CAROLINA GET FIRST BROADCASTING STATIONS

The Department of Commerce issued 13 more broadcasting licenses during the week of June 21st to 26th, including one to a radio school in Porto Rico and one to a radio shop in Charleston, S. C., the first stations on the Island and in the State. This leaves but five states without one or more broadcasting stations.

The thirteen new stations licensed, bring the total list of broadcasters in the United States and territories to 361.

WILL STUDY STATIC AND STORM CENTERS

Plans for the study of the well-known static, so troublesome to the radio fan, in connection with its possible relation to storm centers, have been announced by the Navy Department for the coming summer months. All radio compass stations, especially those along the southern and gulf coasts, will cooperate with the Weather Bureau in taking radio-compass bearings on all static disturbances three times daily, in an effort to determine whether or not there is any connection between the center of electrical disturbances and the centers of storms. If this is found to be the case, it is said that storms originating off the southeastern coast can be followed every foot of their progress up the gulf or coast and forecasts sent in advance of them to the sections of the country which they will touch. The new static schedule went into effect May 20th, at the Hampton Roads Air Station, reports on the quantity, intensity and bearing of atmospheric static being received by telegraph from Naval compass stations, at Hog Island, Virginia Beach, and Poyer's Hill daily at 8 a. m., noon and 4 p. m.

RADIO DEBATE

A radio debate staged by White and Boyer, of Washington, recently, is the latest thing reported in radio activities in their section. Messrs. C. J. Kephart and T. E. Rhodes of the National Law School took opposing sides on the popular subject of "Daylight Saving," and the fans were the judges. The result, WJH says, will be announced shortly.

With the U.S. Radio Inspector

Conducted by Major J. F. Dillon

EXAMINATION FOR RADIO INSPECTOR

The United States Civil Service Commission announces an open competitive examination for radio inspector on June 21 and July 19. Vacancies in the positions of radio inspector and assistant radio inspector in the Bureau of Navigation Department of Commerce, at $1,800 to $2,200 a year, and in positions requiring similar qualifications, at these or higher or lower salaries, will be filled from this examination. The duties of radio inspectors will be primarily to inspect the radio apparatus on steamships, to insure its compliance with the law, and to inspect shore stations. The inspectors may also be called upon to examine radio operators. The duties of radio inspectors require some office experience, therefore competitors should outline fully in their applications any office experience they may have had. The duties of assistant radio inspectors will be primarily the assisting of radio inspectors in the enforcement of the wireless communication laws. Assistant radio inspectors will be required to inspect the radio equipment on board vessels and in land stations, which involves the carrying of 30 or 40 pounds of testing and measuring instruments. The inspection work requires a knowledge of the installation and operation of the several types of radio installations, including the adjustment and tuning of transmitters and receivers.

Competitors will be examined in the following subjects, which will have the relative weights indicated:

1. Theoretical and practical questions in the construction, use, and adjustment of radio apparatus and auxiliaries, 50 lbs.
2. Education and experience in the line of the required duties, 50 lbs. Total, 100 lbs.

Applicants must have received a bachelor of science degree from a school of recognized standing, such educational training to have included a special course in radio or kindred science, or show that they are senior students in such institutions; or have had the equivalent of a high school education and at least two years' experience in special radio work, such as the manufacture, installation, or adjustment of commercial or governmental wireless apparatus. It is essential that applicants be wireless telegraph operators.

SPARK SETS FOR SALE

The Shipping Board is offering for sale 78 complete radio spark sets formerly used on its wooden war fleet, and estimated at a total valuation of $250,000. The sets are ½, 1 and 2 K.W. sets and include transmitters, batteries and generators. They are located at Norfolk, Virginia, where they may be examined by applying to B. N. Rock, 1025 Water Street, and purchased at private competitive sale.

BROADCAST INTERFERENCE

DEPARTMENT OF COMMERCE

NAVIGATION SERVICE

Office of Radio Inspector, Customhouse,
San Francisco, Calif., June 15, 1922.

"RADIO" Editor, San Francisco, Calif.

Dear Sir:

It has repeatedly been brought to my attention that persons listening to the concerts, speeches and other matter broadcasted through the radio telephone stations complain of interference from amateur, commercial and government transmitting equipment, and a large proportion of those making the complaints appear to believe that broadcasting should be given the preference over all other classes of radio communication. However, there are several sides to this matter which the listeners either do not or cannot fully understand.

In the first place, general and restricted amateur stations are authorized to operate on 200 meters with a decrement of 0.2 or less. Commercial and government stations are authorized to operate on their respective wave lengths and their communication, being essential, cannot be interruped for the benefit of broadcast listeners or others of like character, which at best, must be regarded as non-essential communication.

Besides the essential character of the communication of these stations which is prescribed and protected by law, a great deal of reported interference by the broadcast listeners is due to their lack of skill in the adjustment of their apparatus and to the inability of their equipment to actually tune with any selectivity. It has come to my attention that a large number of the receivers now put on the market are designed with an idea to simplify them as much as possible and in many, though not all cases, these receivers are absolutely incapable of the sharp tuning necessary to reduce or eliminate the interference resulting from the operation of stations in the near vicinity. Broadcasting listeners in but very few cases are familiar with the Continental code and therefore are hardly capable of judging where the interference actually comes from and in many cases leaky power line insulators, noisy plate or filament batteries or other sources cause as much interference as a nearby transmitting station.

As stated above, the Government, commercial and amateur stations and their status defined by law and are just as much entitled to operate within the requirements of the law as any broadcasting stations and the listeners thereof are entitled to the use of the broadcast wave length.

(Signed) D. B. McGOWN,
Asst. Radio Inspector.

BUYERS ASK PERFORMANCE TESTS FOR RADIO RECEIVING SETS

Ever increasing public interest in radio has added to the troubles of department store buyers and others handling such equipment. Because of the rather technical problems involved, actual and prospective sellers of "ether wave" receiving devices say they are up against it in their efforts to satisfy the trade. Finding no information available to use in selecting good or rejecting bad apparatus and fearing the loss of established good will, appeals have been directed to the Bureau of Standards of the Department of Commerce to devise standard testing methods.

Performance test methods for immediate use by a commercial testing laboratory were recently agreed upon in an outline by representatives of the Bureau of Standards, the Electrical Testing laboratories of New York, and the National Retail Dry Goods Association. Suggestions regarding improvements on these methods, or new methods for testing the equipment submitted by the National Retail Dry Goods Association, will be subject to approval of the Bureau of Standards.

The tests outlined include examination as to the materials and workmanship of construction, the mechanical and electrical design, simplicity of adjustment, ruggedness, sensitivity, sharpness of tuning, wavelength range, and faithfulness of reproduction in radio telephone reception.

The Investigating Committee of the National Retail Dry Goods Association has suggested that from a commercial standpoint it would be of assistance to their members if responsible manufacturers would plainly mark their equipment, indicating the receiving radius of each instrument under every atmospheric condition. Owing to the large number of factors which enter into the determination of the range over which signals can be received with a given set, this is a very difficult problem, impossible to overcome at present by a brief statement or mark. Strength of signals required by a receiving operator, height and location of receiving antenna, power of transmitting station, its location with respect to other stations capable of causing interference as well as the sensitivity of the particular receiving set, must all be considered, according to Bureau of Standards experts.

Navy Asks for $3,828,460 for Radio

"I have estimated the cost of maintaining the Navy's 214 coastal stations for the fiscal year 1923 at $2,822,360, over $100,000, less than was appropriated last year," Admiral Robison stated, "and have asked Congress for that amount, as well as $1,006,100 for new radio and sound equipment and its maintenance on board ships." He continued, "it now looks as if the Congress would cut the total sum by about one million, necessitating great economies in our program."

"The operation of the shore stations pays a dividend into the Treasury more, by 100 per cent, than the amount of its expenses

Continued on page 80

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.

In the 10 watt self-rectifying set shown on page 15 of June RADIO, could I use an Acme 200 watt C. W. unit in place of the transformer shown? What changes would have to be made to use voice? What is the wavelength of an aerial 100 feet long, 75 feet high with 40 foot lead in? A. T. Chicago, Ill.

Yes, you could use the Acme transformer. This set was designed for telegraph only, and too many changes would have to be made to be practical in this particular case. Your antenna would have a fundamental wave length of approximately 210 meters.

Please publish the circuit of the U. S. Signal Corps amplifier "L-3."
J. E. C., New York City.

Information on this circuit is not available. Suggest that you write to Signal Officer, Fort Leavenworth, Kansas.

Can a Remler amplifier panel Type 333 be used in a radio frequency amplifier circuit? A. B. C., Spokane, Wash.

Change the present audio frequency transformer to one of the radio frequency variety and you can use it as a part of a radio frequency amplifier unit. Suggest that you use it as shown in Fig. 1.

Please publish a circuit for one stage of radio frequency amplification and detector, using the single circuit regenerative tuner described in March RADIO. What would be the correct number of turns for the primary and secondary of a radio frequency amplifying transformer.
A. L., Lodi, Calif.

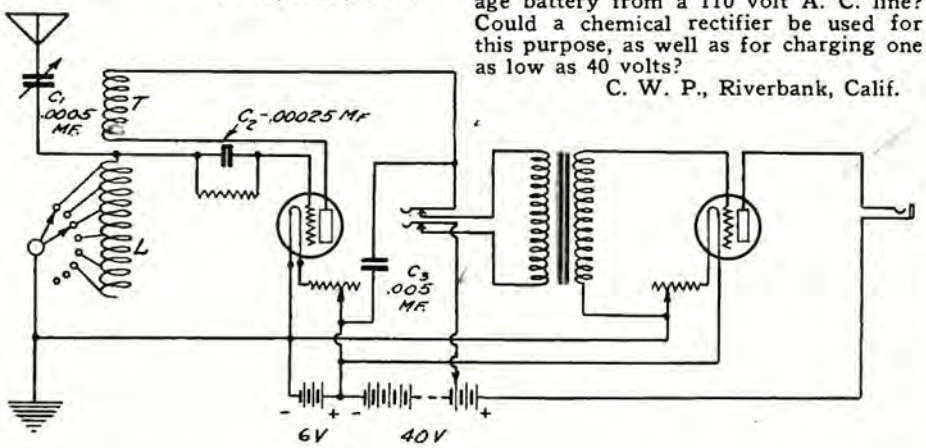


Fig. 2

The set shown in March RADIO was not designed for use with radio frequency amplification, where the regenerative feature is desired. You will have to use a two circuit tuner to get any kind of results with short wave radio frequency amplification. Would advise against your trying to construct a short wave radio frequency transformer, as good ones can be purchased for a small amount, and the results you might obtain from a home-made one would probably not warrant the expenditure of time or money. See the question page in July RADIO for a good two circuit tuner used in a radio frequency circuit.

Does shielding the back of a panel, in a receiver, cut down the signal strength? Will a long coil of iron wire with a copper wire running through it make a good aerial. If the aerial lead is made into a little pancake coil and two celluloid discs are put on both sides of it, will it cut out static?
R. L., Watsonville, Calif.

All three of your questions can be answered in one word; NO.

Is it possible to charge an 80 volt storage battery from a 110 volt A. C. line? Could a chemical rectifier be used for this purpose, as well as for charging one as low as 40 volts?
C. W. P., Riverbank, Calif.

Yes, a chemical or electrolytic rectifier, as it is called, could be used in either case. In order to prevent heating the jars of the rectifier, would suggest using four jars, two on each side of the wave. In the case of the 80 volt battery, place the battery in two units, of 40 volts each, in parallel across the charging voltage.

How can the necessary power in watts to supply a given number of 50 watt tubes be determined, when ordering a motor generator set for the plate supply?
W. R. T., Ottawa, Ill.

Fifty watt tubes have a normal plate current of 150 milliamperes at 1000 volts, so that two tubes, for example, would require a generator output of at least 300 milliamperes at 1000 volts, or in other words, an output of 300 watts. To provide for overload, the generator should

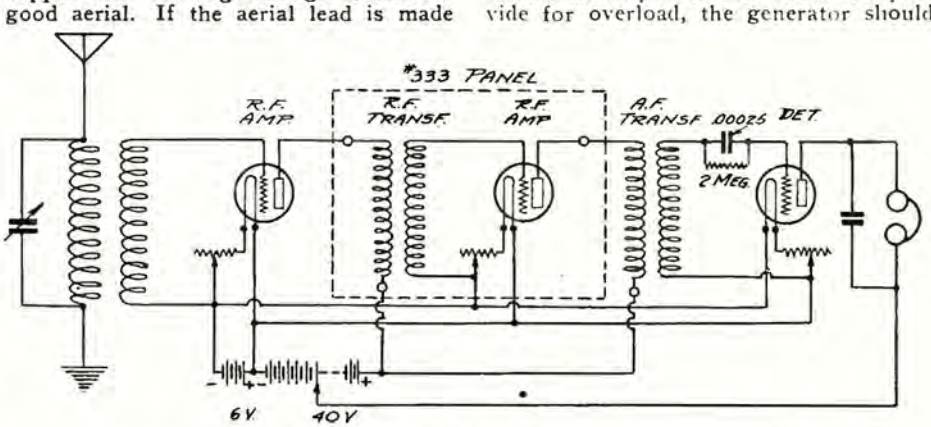


Fig. 1

be large enough to handle 400 to 500 milliamperes for a short time.

Kindly show how a one stage audio frequency amplifier may be added to the receiver described by D. B. McGown in March RADIO.
F. T. K., Springfield, Mass.

Fig. 2 shows the original receiver circuit, with one stage of amplification added.

What are the values of C-1, C-2, C-3 and L-1, in the circuit shown in Fig. 7 on Page 24 of June RADIO?
F. O., Cambridge, Mass.

While no accurate figures on this particular diagram are available, condensers of .001 M. F. capacity would appear to be the proper size. L-1 would have to be a coil of at least 100 turns 3 inches in diameter, in order to include the wavelength of 1,000 meters in its range, as mentioned in the article.

What is the wavelength of the Catalina Island public wireless telephone system, operated by the Pacific Telephone and Telegraph Company?
H. W. P., Santa Cruz, Calif.

The Long Beach station transmits on a wavelength of 450 meters, and the Avalon station operates on a wavelength of 320 meters.

Does the phrase "gas-content tube" refer merely to an incompletely evacuated tube, or does it indicate that an inert gas such as argon or nitrogen has been introduced into the bulb?
H. H. M., Oakland, Calif.

As a rule, a soft or "gas-content" detector tube is an incompletely evacuated tube, no inert gas being used.

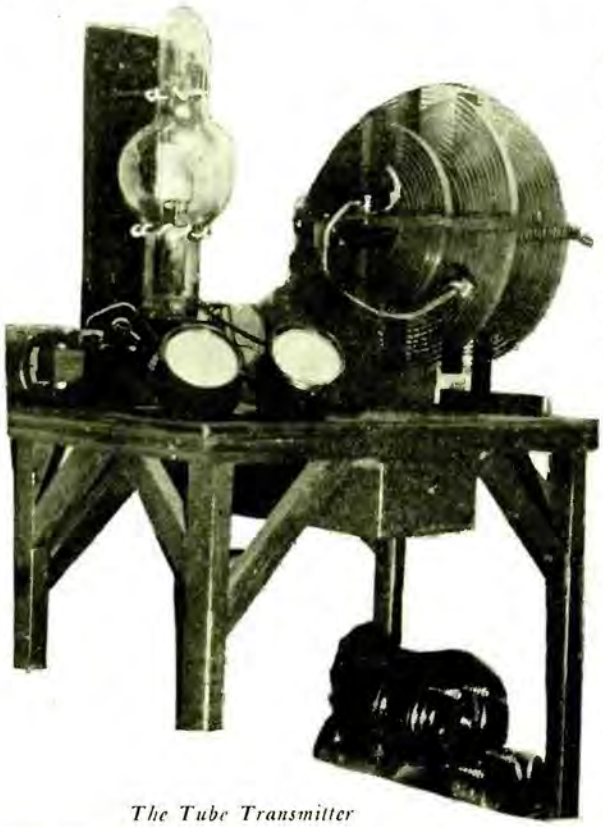
C.W. Association of America
Founded by Lawrence Mott

Lawrence Mott, 6XAD, President *G. G. Griffeth, 6AA, Secretary* *H. O. de la Montanya, 6AUL, Treasurer*

C. W. Station of 6EN, Los Angeles

One of the Most Efficient Tube Transmitters in the U. S.

MANY an ardent spark lover will relegate his equipment to the junk heap after reading what Mr. H. A. Duvall of Los Angeles expects to accomplish with his new ether wrecking, fifteen ampere radiation, tube transmitter. H. A. Duvall, better known on the air from East to West as 6EN, is constructing a powerful transmitter in an endeavor to outrival the famous 6KA.



The Tube Transmitter

From the photo of his new transmitter you can see that it is of such proportions as to allow his radiated energy sufficient lee-way from one circuit to another without loss of efficiency. Note the size of the oscillation transformer, the heavy wiring and the monster tube. Power will be supplied from a synchronous rectifier. Two 2 K.W., 6,600 volt power transformers and a 6-inch bakelite disc, having two AC rings and two DC segments, driven by a two pole motor, constitute the rectifier. The Modified Hartley circuit, using inductive coupling, will be used. The by-pass condensers are of the Murdock moulded section type and another similar section is used for the grid condenser.

6EN states that it would be possible to filter the current of 2,700 volts for plate supply by using several sets of both R. F. and A. F. chokes and condensers of at least 3 mfd. capacity, but it is hard to get a condenser to hold up under the strain.

The antenna is by no means being overlooked. It consists of six wires, 56 feet long, suspended on 18-foot spreaders.

A 10-inch cage lead-in is brought down to the operating room. The counterpoise ground is 48 feet long, 10 feet above the earth, and contains 20 wires. The mast is 90 feet high.

6EN operated one of the first CW stations in Southern California. His first transmitter was of the 5 watt size. 9XM of Madison, Wisconsin, reported hearing signals from this small set. Then came a 20 watt transmitter and also a 50 watter. Many records were made with the 50 watt equipment. Signals were reported from stations in every district. Communication was established with 4EZ one hour after "sun-up," a distance of nearly 3,000 miles. 2DN copies the signals on a detector and two stage audio frequency amplifier with his aerial disconnected from the set.

The following notes on CW development in Southern California have been supplied by Mr. Duvall:

6CU, 20 watt, AC, doing very good work.

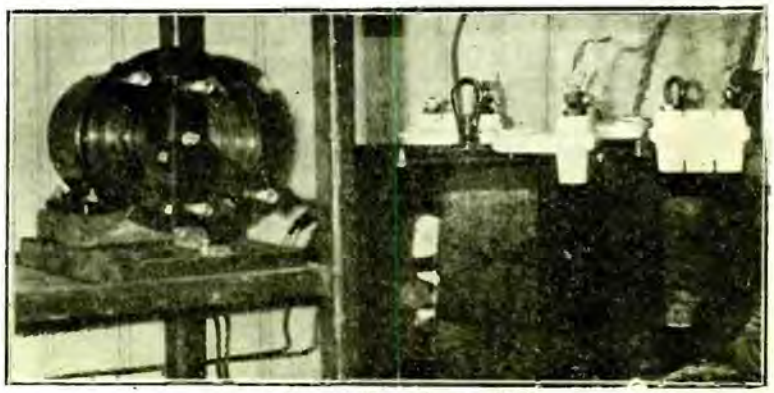
6KY, 10 watt, DC, not on air at present but will have 100 watt CW set working soon.

6FT, 50 watt, AC, also doing good work.

6ALU, 6PI, 6RR, 6AWP, and many others getting out in fine shape. 6KA doing exceptionally good work with his big tube set and synchronous rectifier. 6ZG (6JD) has two 50 watters and a synchronous rectifier.

Front View of Receiver and Transmitter

Members of the C. W. Association and others interested in the Trans-Pacific Test are requested to forward suggestions and entries to the Secretary of the Association.



Rectifier and Transformer Unit

A New Radio Bill

Welcome, indeed, is the new radio bill from Washington. Numerous changes of importance for the regulation of radio communication are embodied in the accompanying bill which, after it is made a law by Congress, will benefit amateur and commercial radio development and operation.

In the Senate of the United States, April 20 (calender day, June 8), 1922.

Mr. Kellogg introduced the following bill; which was read twice and referred to the Committee on Interstate Commerce.

A BILL

To amend an Act to regulate radio communication, approved August 13, 1912, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That the Act of Congress entitled "An Act to regulate radio communication," approved August 13, 1912, is amended by striking out sections 1, 2 and 3 thereof and by inserting in lieu thereof the sections 1, 2 following:

"SECTION 1. A. That no person, company or corporation within the jurisdiction of the United States shall use or operate any apparatus for radio communication by telegraphy or telephony as a means of intercourse among the several States or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for the transmission of radiograms or signals by telegraphy or telephony the effects of which extend beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby with the transmission or reception of messages or signals from beyond the jurisdiction of said State or Territory, except under and in accordance with a license in that behalf granted by the Secretary of Commerce and except as hereinafter authorized.

"B. That the Secretary of Commerce from time to time shall (a) classify licensed radio stations and the operators required therein; (b) prescribe the nature of the service to be rendered by each class of licensed station and assign bands of wave lengths thereto; (c) make, alter, and revoke regulations applicable to all licensed stations not inconsistent with this Act or any other Act of Congress or with the terms of any radio communication convention to which the United States is a party concerning the service to be rendered by each class of stations so established; the location of any station; the wave lengths to be used by any station; the kinds of instruments or apparatus in any station with respect to the external effect produced thereby; the power and the purity and sharpness of the waves of each station or the apparatus therein; the area to be served by any station and the times and methods of operating any station or the apparatus therein; (d) make such other regulations not inconsistent with law as he may deem necessary to prevent interference between all stations affected by this Act.

"C. That radio stations belonging to and operated by the United States and used exclusively for communications of official business, shall not be subject to the provisions of paragraphs A and B of this section. Every other station owned and operated by the United States shall be subject to the provisions of said paragraphs A and B of this section. All stations owned and operated by the United States and all other licensed stations on land or sea shall have special call letters designated by the Secretary of Commerce, and such stations and the designated call letters shall be included in the list of radio stations of the United States as published by the Department of Commerce. Radio stations owned and operated by the United States and used exclusively for the communication of official business shall use such wave lengths as shall be assigned to each by the President, and shall observe such regulations as the Secretary of Commerce may make to prevent undue interference with other radio stations and rights of others, except that upon proclamation by the President that there exists war or a threat of war or a state of public peril or disaster, or other emergency, the President may suspend for such time as he may see fit all such regulations of the Secretary of Commerce applicable to such stations owned and operated by the United States.

"D. That every such license shall provide that the President of the United States in time of war or public peril or disaster, may cause the closing of any station for radio communication and the removal therefrom of all radio apparatus, or may authorize the use or control of any such station or apparatus by any department of the Government upon just compensation to the owners.

"SEC. 2. A. That paragraph A of Section 1 of this Act shall not apply to persons sending radio messages or signals through a radio station belonging to and operated by the United States for the transmission exclusively of official business nor to persons sending such messages on a foreign ship while the same is within the jurisdiction of the United States.

"B. That the station license required hereby shall not be granted to, or after the granting thereof such license shall not in any manner, either voluntarily or involuntarily, be transferred to (a) any alien or the representative of any alien; (b) nor to any foreign government or the representative thereof; (c) nor to any company, corporation, or association organized under the laws of any foreign government; (d) nor to any company, corporation, or association of which any officer or director is an alien or of which more than one-fifth of the capital stock having voting power is owned or controlled by aliens or their representatives or by a foreign government or representative thereof, or by any company, corporation, or association organized under the laws of a foreign country.

"Such station license, the wave length or length authorized to be used by the licensee, and the rights therein granted shall not be transferred, assigned, or in any manner, either voluntarily or involuntarily, disposed of to any other person, company, or corporation without the consent in writing of the Secretary of Commerce.

"C. That the Secretary of Commerce, subject to the limitations of this Act, in his discretion, may grant to any applicant therefor a station license provided for in Sections 1 and 2 hereof, except that he may grant such license only to a station which is in the interest of the general public service.

"No license granted by the Secretary shall be for a longer term than 10 years, and any license granted may be revoked as hereinafter provided. Upon the expiration of any license the Secretary, in his discretion upon application therefor, may grant a renewal of such license for the same or for a lesser period of time.

"The Secretary of Commerce is hereby authorized to refuse a license to any person, company, or corporation, or any subsidiary thereof which, in the judgment of the Secretary, is monopolizing or seeking to monopolize radio communication, directly or indirectly, through the control of the manufacture or sale of radio apparatus or by any other means. The granting of a license shall not estop the United States from prosecuting such person, company, or corporation, for a violation of the law against monopolies or restraint of trade.

"D. That the Secretary of Commerce, may grant licenses only upon written application therefor addressed to him, which application shall set forth such facts as he by regulation may prescribe as to the citizenship, character, and financial, technical, and other ability of the applicant to operate the station; the ownership and location of the proposed station and of the stations with which it is proposed to communicate; the wave lengths and the power desired to be used; the hours of the day or other periods of time during which it is proposed to operate the station; the purposes for which the station is to be used, and such other information as he may require. Such application shall be signed by the applicant under oath or affirmation.

"E. That such station license as the Secretary of Commerce may grant shall be in general form as he may prescribe, but each license shall contain in addition to other provisions a statement of the following conditions to which such license shall be subject: (a) The ownership or management of the station or apparatus therein shall not be transferred in violation of this Act. There shall be no vested property right in the license issued for such station or in the bands of wave length authorized to be used therein, and neither the license nor any right granted thereunder shall be assigned or otherwise transferred in violation of the Act; (b) such licenses shall contain such other conditions not inconsistent with this Act, as the Secretary of Commerce may prescribe.

"F. That any station license granted by the Secretary of Commerce shall be revocable by him for failure to operate service substantially as proposed in the application and as set forth in the license, for violation of or failure to observe any of the restrictions and conditions of this Act or of any regulation of the Secretary of Commerce authorized by this Act or by the provisions of any international radio convention ratified or adhered to by the United States or any regulations thereunder, or whenever the Secretary of Commerce shall deem such revocation to be in the public interest; *Provided,* That no order of revocation shall take effect until thirty days' notice in writing thereof to the parties known by the Secretary to be interested in such license. Any person in interest, aggrieved by said order, may make written application to the Secretary at any time within said thirty days for a hearing upon such order and upon the filing of such written application said order of revocation shall stand suspended until the conclusion of the hearing herein directed. Notice in writing of said hearing shall be given by the Secretary to all the parties known to him to be interested in such license twenty days, prior to the time of said hearing. Said hearing shall be conducted under such rules and in such manner as the Secretary may prescribe. Upon the conclusion thereof the Secretary may affirm, modify, or revoke said orders of revocation.

Continued on page 72

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS

NEW RHEOSTATS

The Cutler-Hammer Company, well known in the electrical field, and more particularly as one of the largest manufacturers of rheo-

stats in the United States, has developed two new types of radio rheostats, illustrated herewith.

These rheostats differ from those now on the market insofar as contact-making device

and terminal connections are concerned. It will be noted from the illustrations that the entire resistance element revolves.

A stationary, flexible spring rests on the revolving element with sufficient pressure to insure proper contact at all times.

NEW L. A. CONCERN

The Superior Radio Company, managed by Mr. L. A. Kaplan, has established itself at 122 West Ann Street, Los Angeles, California.

The new company will manufacture various types of receiving equipment, including the new Type 101-A audion set, the smallest set of its kind on the market, the manufacturer claims.

The entire set is mounted in a cabinet, 10x8, arranged in such a manner as to accommodate the various instruments without loss of efficiency.

Mr. Kaplan, the designer and inventor of the new receiver, is a former A. E. F. Signal Corps man and has had extended experience as a commercial operator at the big Tuckerton and New Brunswick stations, as well as with the merchant marine.

San Francisco's third radio show was held in The Emporium during Shrine Week, June 12th to 17th. Credit for the success of the show is due to both Mr. Mauzy and Mr. Civilli, of The Emporium's radio department. Thirty-eight radio manufacturers, dealers and representatives displayed their wares. The major part of the third floor of this well known department store was devoted to booth space. Many thousands of visitors expressed their approval of the exhibits as well as the artistic arrangement of the booths, an idea of which can be had from the four accompanying views.

LARGE RADIO CONCERN EXPANDS

W. A. Layman, President of the Wagner Electric Manufacturing Company of St. Louis, Missouri, and C. B. Kennedy, President of the Colin B. Kennedy Company of San Francisco, announce that the two companies have joined in an arrangement to increase the facilities of the Kennedy Company in serving the radio field.

The Wagner Company has acquired a substantial interest in the Kennedy Company which in turn will take over the Wagner Company's St. Louis plant No. 2, a six-story building of about sixty thousand square feet of manufacturing space, the extensive equipment of which has been adapted to the manufacture of Kennedy radio apparatus.

The engineering personnel includes radio men of national reputation.

The engineering department is under the direction of Dr. Leonard F. Fuller, who is largely responsible for the development of the Poulsen arc transmitter as now used for world-wide communication in practically all the high power stations of the United States Navy. These stations have ratings up to one thousand kw. and include those located at Bordeaux, France, Annapolis, Md., San Diego, Cal., Pearl Harbor, Hawaii, Cavite, P. I., Sayville, N. Y., and El Cayey, Porto Rico.

The Kennedy Company will continue to operate at full capacity the manufacturing plant established at San Francisco, the output of which will be used to meet the requirements of the western trade and supplement production at St. Louis.

ST. LOUIS RADIO SHOW

The annual St. Louis Radio Show, given under the direction of the St. Louis Radio Association, in conjunction with the Missouri State Radio Association convention and the mid-west division A. R. R. L. convention, will be held during Fall Festival Week, October 4th to 7th, inclusive.

The Radio Corporation of America announces the opening of a district office of its sales department at 10 South La Salle street, as well as a warehouse at unit "B", Central Manufacturing building, Chicago, Ill. This new office is to provide a more central point for distributors and thus offer them convenient facilities for the handling of radio apparatus. The states to be served by this Chicago office are those west of Chicago.

NEW RADIO CATALOGS

Bulletin No. 312 of the Bristol Company, Waterbury, Connecticut, describes a new loud speaker, the "Audiophone," which operates without auxiliary magnetizing current.

The latest eight page Wilcox folder deals with new receiving sets and amplifiers.

THE RADIO SEARCHLIGHT

Continued from page 31

"As far back as 1895 and 1896 I had obtained some promising results with waves not more than a few inches long," said Marconi. He then proceeded to describe how he had returned to his original idea of using short waves.

Marconi stated that when very short waves are used, disturbances caused by static can be said to be almost non-existent and the only interference comes from the ignition apparatus of automobiles and motorboats. He predicted that "the day may come when we will have to screen our ignition systems or carry a government license for transmitting."

SENDING RADIO MESSAGES AROUND THE EARTH

"The question as to whether it would be possible to transmit radio signals right around the world is one which has always fascinated me," Marconi assured his hearers. He discovered that "there is something in the idea of the wireless waves traveling around the earth in various ways and reuniting at the Antipodes." Sometimes these radio waves traveling around the earth in different ways reinforce each other at the receiver and sometimes they interfere with each other. Tuning, however, overcomes the interference. The enormous station built by the Radio Corporation of America at Port Jefferson, Long Island, Marconi found, sent waves which "preferred to travel three-quarters of the way around the earth rather than come the shortest way round."

Static, a subject to which the research engineers of the Radio Corporation of America have devoted much study in this country, was also discussed by Marconi. He told his hearers that there are particularly violent types of static over Africa and South America, but that static did not interfere very seriously in transoceanic communication in temperate zones.

Senatore Marconi is visiting this country for the first time in a decade as guest of the Radio Corporation of America. He came in his yacht, the Elettra, a floating radio laboratory, to consult with American engineers on recent developments in this new science.

RADIO "MOVIES"

Radio Films Inc., is a California Corporation composed of the following individuals: John W. Boyle, President; Otto K. Oleson, Vice President; E. H. Kaufman, Treasurer.

The company is producing a series of two reel educational comedies based on the science of Radio, each picture will teach a direct lesson as to the construction and operation of various kinds of receiving and transmitting Radio apparatus. In the first three series the Hatton boys are featured in the main roles and the pictures in addition to portraying an interesting story with educational value, have on the end a question and answer department in which Radio Films show by actual operation and animation the answers to knotty problems that confront the embryo Radio fan. The Radio apparatus used in the pictures actually works.

Mr. Oleson, Vice President of the Company, is an electrical engineer and is manufacturing Radio apparatus and all instruments are constructed under his direct supervision.

In addition to two reel educational comedies, the company is producing five reel Radio dramatic features and "The Radio Supplement," a one reel straight educational on Radio, what to do and what not to do, the importance of lightning arresters, danger of erecting aerials near high voltage wires, etc., etc.

KENNEDY EQUIPMENT

Type 220
Intermediate-Wave
Regenerative Receiver
with Type 525
Two stage amplifier

KENNEDY EQUIPMENT

All Kennedy
Regenerative Receivers are
Licensed under
Armstrong U.S. Patent
No. 1,113,149

KENNEDY

Intermediate-Wave Regenerative Receiver Type 220

Maximum effectiveness with a high degree of selectivity on all wave lengths within its tuning range of 175 to 3100 meters is assured by the design of Kennedy Receiver Type 220.

This receiver is made for those who want highly efficient reception over a range of wave lengths somewhat more comprehensive than that provided by the ordinary short-wave instrument.

In its design full use has been made of the accepted principles of the best radio engineering practice. This has resulted in a highly effective receiver of maximum effectiveness.

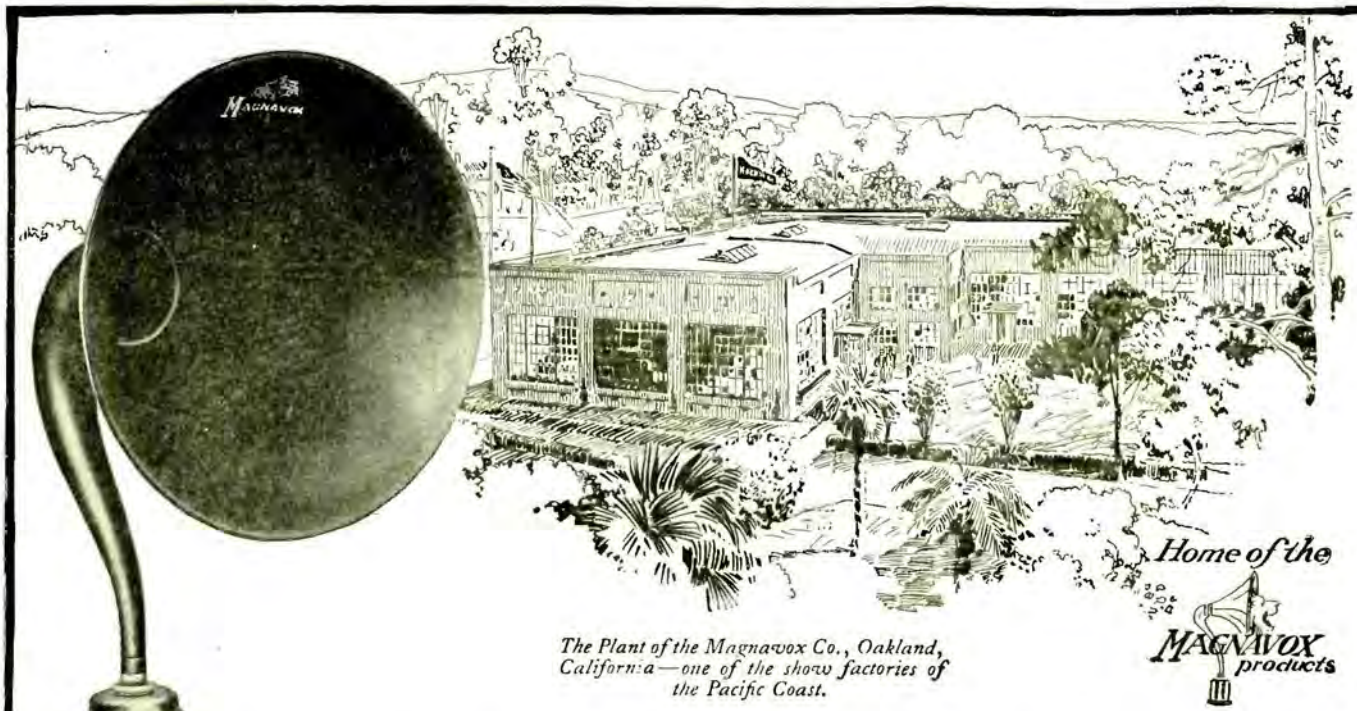
Type 220 receiver has proved very popular for the reception of radio amusement, educational features, news and market and weather reports.

Kennedy Radio Equipment is sold by good dealers everywhere

Write for Latest Bulletin C-3

THE COLIN B. KENNEDY COMPANY
INCORPORATED

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



The Plant of the Magnavox Co., Oakland, California—one of the show factories of the Pacific Coast.

R-2 Magnavox Radio

with 18-inch Horn

THIS instrument serves the requirements of professional use for large audiences, dance halls, etc.

It is the same in principle and construction throughout as Type R-3, but possessing greater amplifying power and requires only ⅙ of an ampere for the field.

Price, $85.00

No Wireless Receiving Set is Complete without MAGNAVOX RADIO

NOT many months ago the Magnavox Radio occupied a relatively unimportant position in the list of Magnavox products—today even our greatly increased production facilities are taxed to supply the demand for Magnavox Radio—the Reproducer Supreme.

Among radio experts and users everywhere, the name MAGNAVOX stands for basic patents representing some of the most interesting and important developments in the radio field.

It is the Magnavox Radio which is invariably selected for important demonstrations of technical or public

MAGNAVOX

An essential part

interest. The two sizes of Magnavox Radio (as here illustrated) meet every requirement of volume and range —from the home gathering to the largest public audience.

Any receiving set of good quality can be equipped with the Magnavox Radio, no alterations or adjustments being required. With either type of Magnavox Radio the hookup is as simple as connecting an ordinary head set.

Concert and dance music, speeches, songs, vaudeville and market reports, Magnavox Radio amplifies them all in tones of marvelous clarity and power.

The electrodynamic principle involved in its construction makes Magnavox Radio the most efficient converter of electrical energy into sound waves.

The Magnavox Radio and Magnavox Power Amplifier Model "C" may be had of good dealers everywhere.

THE MAGNAVOX CO.
Home Office and Factory:
Oakland, California
***New York Office:* 370 Seventh Ave.**

3-Stage

Radio
of every receiving set

R-3 Magnavox Radio
with 14-inch Horn

THIS instrument, constructed on the electro-dynamic principle, is ideal for use in homes, amateur stations, offices, etc. It is furnished with a special metal horn and requires one ampere field from your filament battery.

Price, $45.00

Model C Magnavox Power Amplifier

THE use of the Magnavox Power Amplifier insures getting the largest possible power input for the Magnavox Radio. Switching from stage to stage is made easy by master switches as illustrated. Can be used with any "B" battery voltage which the power tube may require for best amplification.

Best results are obtained with power tubes as these amplifiers are specially designed for their use.

With either type amplifier it is necessary to use an amplifying transformer between your receiving set and Magnavox Amplifier.

Handsomely finished in solid mahogany case.

2-Stage
AC-2-C, Price $80.00
3-Stage
AC-3-C, Price $110.00

CALLS HEARD

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

BY 6APO—R. G. ADAMS RADIO STATION, HUDSON & ESSEX AGENCY, FULLERTON, CALIF.

C. W.—5za, 6cu, 6en, 6jd, 6ka, 6xad, 6aif, 6alu, 6bes, 6aat, 6aau, 6awp, 6ec, 6aag, 6bjr.

Spark—6gt, 6iv, 6kc, 6km, 6lc, 6hy, 6od, 6om, 6ol, 6aak, 6aei, 6adl, 6afn, 6agf, 6ahq, 6aih, 6avr, 6atf, 6aqp, 6bik, 6aio, 6ark, and many others too numerous to mention.

BY RADIO 6ABU—OAKLAND, CALIF.

Spark—6eb, 6ef, (6cc), (6gr), (6gf), (6gt), (6gp), 6hf, 6hy, (6iv), 6kc, (6ke), (6mh), (6od), (6ol), (6ou), (6pr), (pj), (6uo), 6xad, (6aak), (6ala), (6ald), (6aey), (6atf), (6ajh), (6ajr), 6sa, (6ahp), (6avr), (6up), 6avd, 6aau, (6aer), (6bbv), 6bbc, (6bmp), (6za), (6zu), 6zr, 6zam, 6zz, (7tj), 7vo, 7vx, 7bk, (7xb), (7yj), (cl8), (9bd). C.W.—(6cu), 6ka, 6jd, 6ea, 6bak, 6bes, 6zf, 6zz. All those having 6abu please Q. S. L.

BY 6BQL—ARTHUR M. SNELL, 575 TWENTY-FIRST AVENUE, SAN FRANCISCO, CAL.

Spark—6cc, 6dd, 6ea, 6eb, 6gt, 6iv, 6kc, 6ke, 6lc, 6mh, od, 6ol, 6up, 6zj, 6aak, 6abw, 6aev, 6aey, 6ahf, 6ajh, 6ajr, 6akl, 6ald, 6amw, 6apy, 6aqx, 6ars, 6asc, 6atf, 6avr, 6baj, 6bbd, 7bh, 7ga, 7to, 7tj, 7ya, cl8, 9bd.

C. W.—6cu, 6ea, 6ec, 6ef, 6ek, 6en, 6fh, 6ft, 6gy, 6jd, 6ka, 6ku, 6pi, 6zb, 6zf, 6zac, 6aat, 6aeh, 6aiu, 6akl, 6alu, 6aqa, 6awp, 6bbc, 6bcd, 6bmd, 6bqc, 6bqq, 6bqt, 6xad, 7na, 7sc, 7xg, 9amb, 9zaf.

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

Spark—(6acr), (6ala), (6ark), (6aqu), (6ajr), (6agx), 6avb, 6aen, 6arb, 6abh, 6gr, (6ib), (6hc), (6hp), (6tu), 6awh, 6ex, (6tu), 6vx, 6ic, 6cc, (7bk), 7ack, 7aax, (7ey), (7fr), (7ge), (7hi), 7iw, 7iy, 7jm, 7jw, 7fq, 7kj, 7mu, 7ot, (7oh), 7qu, 7tj, (7vz), 7ve, 7xa, (7zj), (cl8).

C.W.—(5bq), 6asj, 6ang, (6bhk), 6bir, 6aat, (6awt), 6cu, 6jd, 6en, 6ft, (6ka), 6gf, 6gr, 6nx, 6gx, 6ti, (6zi), (7bs), 7ey, (7aw), (7nw), (7na), (7qw), 7qu, (7sc), (7ex), 7ack, (bt3).

U. S. Eastern amateurs pse QSL to W. D. Wood, Barron Hotel, Vancouver, B. C., upon hearing my C.W. or SPK.

BY 6EB—"SPK" AND "C.W."

C.W.—5za, 6gf, 6gx, 6gy, 6ku, 6lv, 6ni, (6ti), (6zi), (6zx), (6arb), 6asj, (6awt), (6bed), 6bhk, 6bmu, (6bsa), 6xaf, 7na, 7nf, 9wd, 9amb.

Spark—5xd, (6as), 6cc, (6ex), (6gr), (6gy), 6hc, (6hp), 6ib (6ic), 6im, 6km, 6lk, 6ng, (6qr), 6qy, 6tc, (6tu), 6vk, 6vx, 6wg, 6xh, 6zi, 6zq, 6aau, 6amk, 6ark, 6avb, (6bak), 6bgl, 6bip, 6bms, 7bh, 7mf, 7ot, 7ya.

"WESTERN RADIO"

We Do Not Carry Radio as a SIDE LINE

The Western Radio Electric Co. employ only men who are experienced in the radio field.

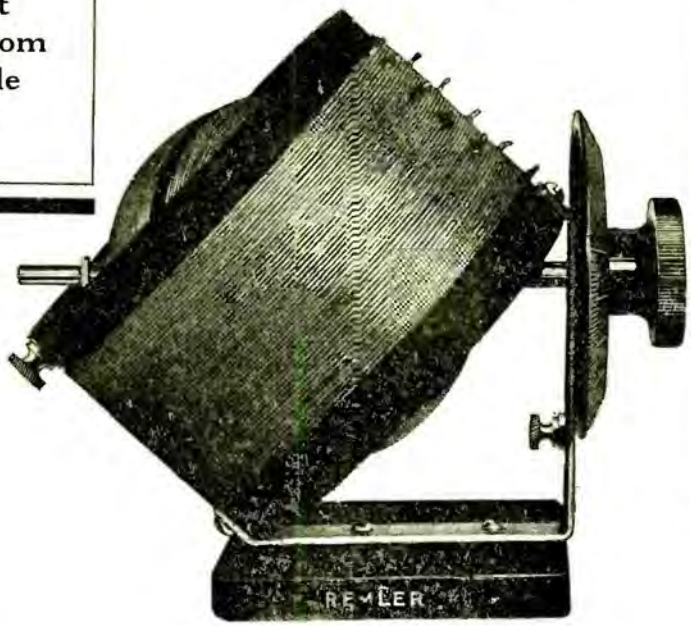
Write us for reliable engineering information.

Try us for real radio service.

We solicit inquiries from responsible dealers.

Remler-Giblin Coil

Remler Rheostat



Remler Variocoupler

Radio Pioneers in Southern California *and* The Oldest Established 'ALL RADIO' Company on the Pacific Coast

RADIO JOBBERS

Representing

Radio Corporation of America
A. H. Grebe
Remler Radio Mfg. Co.
The Magnavox Co.
Western Electric Co.
Federal Tel. & Tel. Co.
Adams-Morgan Co.
General Radio Co.

Western Radio Electric Co.

637 So. Hope St., Los Angeles, Calif.

Use the nearest store

1200 Franklin St., Oakland, Calif.

Book Review

HOW TO MAKE AND OPERATE A RADIOPHONE RECEIVER, by J. A. Dowie, I. R. E. This book, size 5x7, contains general information on various types of receiving equipment, and simplified radio formulæ. The purpose of the book, the author states, is to aid the young radio experimenter in building and operating an inexpensive radiophone receiver. There are fifteen illustrations, various formulæ and a dictionary of the common radio terms. Bound in heavy paper. Price, seventy-five cents.

ELEMENTS OF RADIO TELEPHONY by William C. Ballard, Jr., M. E. 132 pages of popular radio data. The purpose of the book is to present in simplified form a brief discussion of what happens when messages are sent and received by radio—also a simplified description of the apparatus required to produce these effects.

The book is published by the McGraw-Hill Company. Beautifully bound. Printed on enameled paper. Price, $1.50.

"The Radio Library," volume 1, published by the Radio Electric Company of Pittsburgh, Pa., is a 24 page pamphlet on radio receiving methods and devices. The authors are J. W. H. Weir and Parker E. Wiggin. It will be of assistance to the new "American Radioist."

"The Complete Radio Book," by Raymond Francis Yates and Louis Gerard Pacent, is the work of two experts in the radio field who have taken much care in collecting, organizing and presenting useful material in a 330 page book.

The book is illustrated with diagrams, photographs and maps. It is heavily bound, size 5x7, price $2.00 per copy. Published by the Century Company, New York City, N. Y.

"Radio Installation Rules" is the title of a pamphlet issued by the Board of five Underwriters of the Pacific, 914 Merchants Exchange building, San Francisco. Copies will be mailed upon request.

RADIO ENTERS THE HOME, a 128-page combined catalogue and instruction book, issued by the Radio Corporation of America. The book is divided into four parts. Part I deals with broadcasting, fundamentals of radio reception, classes of apparatus, and general information on receiving sets.

Part II deals with acessories, such as vacuum tubes, batteries, and charging equipment. Part III extensively covers transmitting equipment, numerous circuits, and much data on rectification. Part IV contains general information for the amateur, technical radio terms, National Electric Code radio rules, radio laws and regulations, international abbreviations, a log sheet for stations heard, and a half dozen open pages for various memoranda that the user of the book may "jot down."

This is perhaps one of the most valuable publications on the market. Size 8x11. Bound in heavy paper. Price 35 cents.

RADIO FOR THE AMATEUR, by A. H. Packer and R. R. Haugh. This book deals with the construction and operation of radio receiving sets. It contains 208 pages of non-technical, understandable material, and is well illustrated with 72 diagrams. Published by Goodheart-Willcox Company, Inc., 2009 So. Michigan Avenue, Chicago. Bound in board, size 5x7½. Price $1.50.

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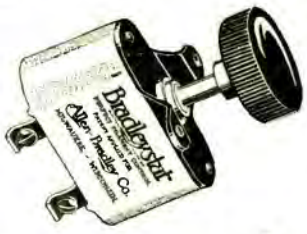

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A SOFT GRAFT

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graft on th' fence-wires over ter Sally Spilker's house; an' when old Ezekiel Gibbs come an' set up on th' fence ter gas with th' hands plowin', like he allus does, Margy put thet sputterin' juice-squirter onto th' wires, an' old Ezekiel keeled over into th' ditch, with a big hole burnt clean through his best pants. He allows he kin feel th' fire flyin' up an' down his back-bone yet—an' I had ter pay fer th' pants. We kept puttin' up with it, anyhow, hopin' fer th' best; —an' then whut do ye s'pose we found out?

"'Search me,' I answers, puzzled.

"'Why, ding bust it, sh'd read a fool yarn in them wireless magazines about a gal named Lizzie Pratt, or suthin' like that, who uster talk ter her feller by wireless—an' here Margy is doin' th' same durned thing with thet gosh-danged Eusebius! Seems like some good-fer-nothin' young upstart up ter Stonefield is lettin' Eusebius use his outfit—or I guess th' kid's runnin' it fer him, 'cause thet dum-headed fool couldn't wind up a kitchen clock 'thout bustin' it! But that Margy—

"'That's just like 'em,' sympathizes. 'Did you tear down her outfit?'

"'Crickety, no!' Timothy exclaims. 'Twouldn't be safe ter handle a lively, high-strung young gal like Margy that way. She might go an' do suthin' desprit. But now, I was jist a'thinkin' if we could git a reg'lar wireless feller like you ter come an' stay awhile with us, 'thout lettin' on ter Margy who ye be, ye could likely cure her. Ye could slip around an' keep her wireless contraption bunged-up, so's she'd hev a peck o' trouble with it;—then mebbe after while she'd git sick o' th' durned thing an' give it up. Now, if ye'll come—

"'No—I don't think I want that kind of a job,' I tells him, promptly. 'I'd be sure to land in all kinds of cussed complications—like I always do.'

"'But we kin say ye're a friend o' my nephew Cornelius in Chicaggy,' replies Timothy, eager-like. 'There won't be no complicated bizness about it. Ye jist hev ter try t' cure up Margy's danged wireless fever—an' I'll give ye a hundred dollars, if ye kin do it or no. Ye kin cancel ye're ticket at Kansas City, an' I'll pay th' diffrunce on a new one from Pilcher's Corners to thet Indian camp whur ye're goin' ter.

"'No, I don't want'a fool with it,' I tells him. 'Plenty trouble comes my way without me huntin' for it.'

"'Tain't goin' ter be no trouble', insists old Timothy. 'It'll be jist like a vacation fer ye. Th' missis'll have reg'lar Sunday dinner fer ye every day, with fried chicken an' apple dumplin's an' rhubarb pie, an' ye kin hev a fine colt ter ride, an' there's a crik ter go fishin'

Continued on page 48

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Ask also to see the Willard All-Rubber Radio "A" Battery—a 6-volt battery built especially for Radio reception.

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Willard THREADED RUBBER BATTERY

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in—an', by gum, ye kin use th' fambly Ford any time ye want ter!

"'Well, I don't know,' I says. 'I had a vacation once—

"'I'll give ye a hundred an' fifty dollars—pay ye right now!' breaks in Timothy, hopeful-like. I hev ter do suthin' ter cure up Margy.

"I was kind'a weakenin'; but then I feels my old reliable hunch comin' on, an' my mind is made up. 'No,' I tells him. 'Absolutely no. Nothin' doin'.'

"'By gum, that's too darned bad!' says Timothy, real disappointed-like. 'But hev a little nip, anyhow,'—an' he produces his flask.

"I takes the nip, an' another one, an' the flask is dry; but Timothy breaks out a second;—an' then I gets to feelin' hard-boiled an' foolish, an' th' next thing I clearly knows, I've got off my train at Kansas City an' am sittin' in a dusty day-coach on a bangety-clatter old milk-can railroad, with Timothy's hundred an' fifty in my pocket, an' chuck full'a determination to bust up Margy's wireless fever, if I have to break my neck.

"LATE in the afternoon, th' train stops out in a field, alongside a post with th' name *'Pilcher's Corners'* painted on it, an' we disembarks. A hired man is waitin' fer us with th' lizzie; in which we jounces up th' dusty road a couple miles to Timothy's farm. It was a fine-lookin' farm, too, though I mostly observed the small aerial which was strung between the house and the nearest barn, with th' lead-in runnin' down into a wood-shed about half-way between.

"As we turn into the drive-way, I notices a big white-an'-yellow cat sittin' up on the top of a telephone-pole alongside the road.

"'By jingo, that looks like our tom-cat, Perseus,' says Timothy, puzzled-like. 'Wonder what—he stops talkin' all of a sudden, an' I see he's starin' at a big bay horse who is gallopin' round an' round in a circle out behind th' barn, snortin' an' kickin' up his heels like a young colt.

"'What in tarnation's got into old Independence ter make him go gallivantin' round like that!' mutters Timothy. 'Crickety — what's happened 'round here, anyhow!'

"The lizzie stops alongside the house; an' a motherly-lookin' old missis, with good ample beam, breezes out to meet us.

"'My land, it's about time you was gittin' home!' she says, mighty relieved, after she'd smacked old Timothy, an' I'd been introduced as a city-weary side-kicker of Cousin Cornelius; 'that girl Margy an' her wireless is jist got me worried clear to death. Three days ago somebody took that awful ground-

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C W MANUAL

Jennings B. Dow, U. S. N.
AUTHOR OF THE C. W. MANUAL

The Book You Need

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Chapter II—C. W. Circuits to Date.
Chapter III—Experimental Phone Circuits.
Chapter IV—Ten Watt C. W. Transmitter, I. C. W. Transmitter and Phone Set Using Direct Current.
Chapter V—Design and Construction of Ten Watt C. W. Transmitter for Use on A. C.
Chapter VI—An Inexpensive 50 Watt C. W. Transmitter.
Chapter VII—A Ten Watt Power Amplifier.
Chapter VIII—Design and Construction of a 250 Watt Amplifier and C. W. Transmitter.
Chapter IX—Rectifiers of Plate Supply Current for Transmitting Vacuum Tubes.
Chapter X—Design of a Low Powered Circuit for Duplex Operation.
Chapter XI—Notes for the Experimenter and Constructor.

THE C. W. MANUAL

Design and Construction of Radio Telegraph and Telephone Transmitting Equipment

By
JENNINGS B. DOW
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8-22

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wire of hern off the pump again, an' Perseus got hisself tangled up in it, an' it burnt most all his fur off! He runned up the telegraft pole out on the road, an' he's bin up there ever since. Then this mornin' one of her antenner wires broke an' fell down on old Independence,—an' now he thinks he's a merry-go-round or a jumpin'-jack, heaven knows which. 'Nother part of the wire hit poor Jerry Mooly, who was sleepin' out in the sun, bein' it was Sunday, an' he skedaddled under the cow-barn, an' won't come out no more. I even offered him a lemon-custard pie; but he won't budge. He says he's kilt.'

" 'Bout time ter do suthin', by gum!' Timothy mutters under his breath, lookin' at me.

" 'Just then I hears a laugh an' a patter, an about five foot four inches of smiles an' curls comes skippin' up an' throws her pretty arms around old Timothy's neck.

" 'Oh, I'm so glad you're back, Pa—did you bring my new audions?" she gurgles, smackin' him first on one cheek an' then on the other. She was a mixture of sweetness an' mischief all through; she showed it in her black eyes an' her thick heavy curls;—a little sweety, an' a little devil. No wonder old Timothy didn't smash up her wireless—how could he with a girl like that?

" 'When she gets through huggin' him, he introduces me; an' before I know what's comin' off, she puts her arms round my neck an' goes through the same performance as she had with Timothy. I begins to think maybe I havn't landed such a bad job after all—an' I feels sure I haven't when we have supper—roast duck an' jellies an' layer-cake, an' all the rest. It made me feel sad to think of all th' raw fish an' burnt cow-hide I'd eat in my time on ship-board, when there was grub like this in the world.

"AFTER supper Margy drags me off to the wood-shed to see her wireless outfit. She had the gear for a first-class one-kilowatt set, but it was all lashed together in a tangle of wires like a pile of boulders overgrown with ivy. The shed was littered up with pieces of telephones, an' clocks, an' phonographs, an' tools scattered all over—a regular dump.

"Of course I'm s'posed to know nothin' about wireless; so Margy hands me a spiel that for humbug an' hot-air would make the worst stuff I ever slipped to green steamer-passengers sound about as original an' clever as the jokes a ten-cent variety-show actor hands out to the crowd on a rainy Monday night.

" 'I've been reading some stories about a wireless operator by the name

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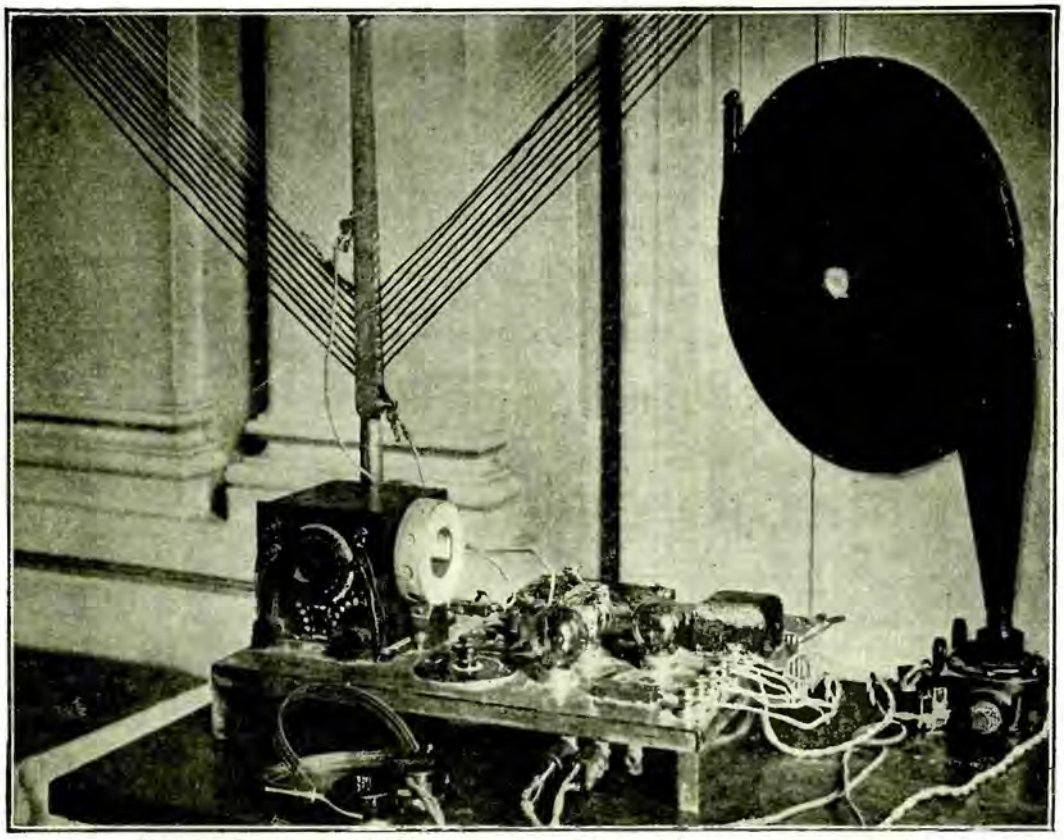
Armstrong Uses Pacent Radio Essentials in His New Super-Regenerative Circuit



Pacentized Equipment used by Major Armstrong to demonstrate his super-regenerative circuit before the Institute of Radio Engineers

WHEN Major Edwin H. Armstrong recently demonstrated his new super-regenerative receiver before the Institute of Radio Engineers, he was able to receive from the famous WJZ station at Newark (25 miles distant) by the use of three vacuum tubes, although only a small loop aerial was used in the steel framed building of the Engineering Societies, New York City. The program was reproduced with such great volume that it filled the lecture hall and corridors.

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of Samuel Jones,' she tells me, pickin' up a familiar-lookin' magazine. 'He's just the awfullest boob, and he does the craziest things. You ought to read about him.

"I politely declines.

"'Pa says my poor Eusebius boy is a dunderhead,' she remarks, with a sigh; 'but he's smart as a whip compared to this silly Samuel Jones that puts his stories in the magazine.'

"Durin' the next few days Margy keeps me pretty busy. First she takes me around to be exhibited to all th' neighbors; then she drags me off in the lizzie to a Sunday-school picnic; next I have to go out an' pick blackberries with her—an' while I got all scratched up on briars an' bit up by ants, I stood for it just the same, because I figured that she had to have some one to take her mind off that donkey of a Eusebius, an' I might as well be the goat as anybody.

"'For the first week, I didn't try to tamper with her wireless set; but one night when she is monkeyin' around in the wood-shed, I reads on the spark-gap a kind of a half-coded spoony message, which I figures must be for that confounded clodhopper, Eusebius; an' right then I resolves it's time for action. Of course I wasn't jealous or anything—an' you don't need to smile that way neither,—I had to do what old Timothy had hired me for.

"'Pretty well after midnight, that same night, when everybody was asleep, I puts on my clothes; then slips downstairs, an' out into the yard. It was a queer night, even for Kansas. A strong dry wind was sweepin' in from the south, swishin' through the sycamore trees around the house; an' the low barns an' the fields were splotched with flyin' streaks of pale moonlight, for the sky was full of rollin' clouds, through which the moon was scootin' like she was scared somethin' was after her. It was one of them nights like you read about in a story-book, when there's goin' to be a murder.

"In th' wood-shed, it was pitchy dark. Th' first thing inside the door, I steps on Perseus, the family cat, who lets out a yowl that makes me jump half out of my shirt. Somehow I have a hunch that somethin' is wrong. Fumblin' around in th' dark, I can't see nothin'; but I feel as if there is some darned thing slinkin' around in th' wood-shed that doesn't belong there. Every time the wind moans outside, it makes me shiver, an' I get so nervous an' jumpy that I begin to wonder if all th' fine grub I've been stuffin' myself on has give me a sleep-walkin' nightmare, my system not bein' used to anything richer than moldy sea-bread an' soggy spuds; so I pinches myself hard to make sure I'm awake, which I am.

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"Havin' brought some matches with me, I was about to strike one; but just then I hears a clicky, rasping noise, and right after that a groan—a gaspin', horrible groan like somebody stabbed an' bleedin' to death—right at my feet! Froze stiff as a' icicle an' my hair standin' on end, I holds my breath an' hugs myself, wishin' to heaven I could remember where th' blasted door was—which I couldn't.

"Finally I manage to get up against the wall, where I stand tense as a steel spring, and listen. Everything is still as death now, except for the whining of the wind outside, and a low, gurglin' sound, like the gushin' of blood. Just as I am makin' up my mind to start creepin' along the wall and try to find th' door, all of a sudden there begins right in the same place beside me a terrible, blood-curdlin' scream, *'Yar-r-r-r-oo-oo-oo-o-o-o!*—half howl an' half shriek—that sends me flyin' straight across th' wood-shed, leavin' behind my suspenders an' half of my pants, which got caught on a nail in th' wall. Makin' a whizzin' spurt to where I hoped th' door was, I trips up on a blasted grocery box full of scrap-iron an' junk, and sprawls flat on my face, digging my nose half way through th' floor. I bounces to my feet an' makes another dash, but I comes so fast that I rams my head against th' wall with a *k-r-r-rumpt!* that sends a million stars shootin' in front of my eyes. Findin' myself at the door, I yanked it open so hard I tears th' door-knob off, an' suckin' in my breath like a gas engine, I catapults out into th' yard.

Gettin' half-way to th' house in two jumps, I puts th' breaks on again an' comes to a skiddin' stop as old Timothy comes dashin' out onto th' back porch in his night-gown, carryin' a lantern an' a double-barreled shot-gun. The instant he sees me out in th' dark, he levels his blunderbuss an' blazes away in my direction with a fire-belchin' *bang!* like a bustin' cannon. A piece of burnin' wad stings me on th' cheek, but th' charge of buck-shot goes by. This was too much for me. My knees cave clear in, an' I sags down on th' grass.

"'I got him! hot durn his onery hide—I got him!" yells old Timothy; an' he comes gallopin' at me with his night-gown flappin' in th' wind like a main-sail gone adrift, an' his second shot-gun barrel ready for business;—but when he recognizes me, he stops, astonished-like.

"'Goshamighty tunkets!' he ejaculates, 'I thought ye wuz thet gol-durned skunk agin!'

"'Sk-sk-skunk!' I mumbles, staggerin' weakly onto my feet. 'Couldn't ya tell me from a sk-skunk?'

"'No—thur's some low-down thievin' amachoor bin gittin' away with Margy's aujons an' things—I thought sure I'd

got him, by gum!' Timothy pants, kind'a disappointed-like.

"'Well—well, wh-what's that cursed thing in th' wood-shed?' I gasps.

"'Thet's Margy's bug'lar-scarer,' answers Timothy. 'She's got a 'lectric bizness rigged up so's if anybody opens th' door at night, it starts off a' old phonygraft hid down under th' floor with a home-made record on it whut sounds like somebody was bein' burnt t' death by Californier Indians. We made it by gittin' Jerry Mooly, th' hired hand, ter try t' sing "Rocked in th' Cradle of th' Deep," when he was full a' Jim Hogan's moonshine.'

"I GOT back to bed without Margy findin' out who'd been shot at. Next day she has me help her rig up another contraption in th' wood-shed, so that if anybody tries again to sneak in there, three flat-irons an' a topmaul will come crashin' down on his neck. So far as I was concerned, there was no need of riggin' anything. I was through with night-hawkin' around that place.

"One afternoon, though, I manages to slip into the shed with a handful of carpet-tacks, which I dumps into the cells of Margy's filament-current storage-battery. I sees next day that they're puttin' th' battery on th' blink, all right; so a while afterward I hunts up old Timothy to tell him the good news. I finds him standin' out in th' yard alongside his Ford, in his town clothes, lookin' peeved as blazes.

Margy's storage-battery's gone up the spout, somehow 'r 'nother,' he tells me. 'I had to give her th' battery out o' th' ottymobile, an' take th' bunged-up one. Zachary Bilgiks sez as how th' price o' butter hez riz two cents down ter Rapsville, an' I got ten pounds I hev ter take down, right away. I wish ye'd try an' see if ye kin doctor up this durned bat'try a little.'

"I fixes th' battery—an' if I didn't say nothin', I thought plenty.

"I leaves th' wood-shed alone for a while, after that; but a few evenings later I overhears Margy sendin' another of those confounded half-coded notes to somebody; an' feelin' sure it must be for that homely worm of a Eusebius, I gets pretty wrathful.

"As I said before, I wasn't jealous; I'd been hired to stop this foolishness an' I was determined I was goin' to do it, if I had to burn down th' whole darned ranch.

"The next morning, I manage to get away from Margy while she is busy washin' th' breakfast dishes; an' hikin' out into the wood-shed, I hunts up a spool of fine magnet-wire—about number thirty. Taking this, I goes out an' twists the end onto the ground wire of the wireless set, an' runs it up th'

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wall of th' shed, pushin' it under a batten where it couldn't be seen; then I climbs up onto th' roof, figuring to bring the wire up onto the aerial lead-in.

"After spendin' quite a lot of time workin' the wire into small cracks an' crannies, at last I have the upper end ready to twist onto the lead-in. To do this I have to hang way out over th' end of th' roof an' reach down;—an' just while I am hangin' in this neck-breakin' position, tryin' to make the connection, I hear the confounded rotary-gap down in th' shack beginnin' to hum. Before I can let go of that blasted tangly lead-in, th' spark crashes out with a terrific *whr-oo-oo-o-o!*—and' th' next thing I know, I'm lyin' flat on my back down on th' ground, tryin' to get my breath.

"A few minutes later, Margy comes out, and sees me lyin' in the grass.

" 'Takin' a sun-bath, aren't you?' she chirps, trippin' up alongside.

" 'Yes, it's right pleasant lyin' here,' I answers, tryin' to look drowsy an' contented; but swearin' to myself that I'd never try that stunt again.

"THAT was the last time I ever fooled around that wood-shed. There didn't seem to be any need of it, anyway; because Margy an' I were gettin' to be better pals every day. We were goin' skylarkin' in the lizzie pretty frequent now; we sit together in the hammock on the front porch every evening; and we even begin to hold hands under th' post-card album when old Timothy butts into th' parlor after supper to read th' *'Corn Planters' Journal'*

"Margy keeps gettin' more sweet an' cuddly every day, and sometimes I would find her gazin' at me with a kind of starlight dancing in her black eyes that—well, after sittin' down one day an' thinkin' it all over for a long time, I finally comes to the conclusion that the only thing left for me to do is to marry her. I hadn't fell for her or anything—you want to understand that—but she was too sweet an' pretty a girl for that codfish of a Eusebius to get away with, and it was up to me to save her, even if I had to dig up th' price of a weddin'-ring. Course old Timothy hadn't hired me to go quite so far as that, but th' ranch cookin' seemed to agree with me, and it was up to me to save her, I believe in always doin' a little more than just what I'm paid to do; I never was a work-pincher or a clock-watcher.

"So one evening out on the lawn, it comes to a show-down. I hands Margy th' old spiel, orates the only-girl-in-the-world mush with all th' trimmin's, an' waits for th' answer.

" 'Ask pa!' she says, looking up shyly from under her dark lashes; an' then she runs away.

"I breezes up to old Timothy while my courage is up, an' asks him.

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"He looks kind'a surprised, an' strokes his goatee awhile.

"'Wull, I reckon it's all right,' he says, at last. 'I'd let her marry a Chinaman, 'fore I'll see her spliced up ter thet durned Eusebius!'

"THE weddin' is set for Margy's eighteenth birthday, which is due in two weeks;—an' then there begins th' greatest stewin' an' preparations you ever saw. Th' whole darned farm was turned upside down with dress-makin'; cake-bakin'; red an' green paper bells; and invitations to all th' farmers in th' state of Kansas. I was a happy imbecile until two days before th' big day, when trouble lands on me with both feet.

"As I was sittin' out in the shade on the front porch dreamin' about the girl an' the home-cookin' I was goin' to have all th' rest of my life, Margy comes cryin' an' all upset and tells me that it's all off. At first she wouldn't say what was th' matter; but after a lot of honey-fussin' around, she takes me out to the wood-shed an' shows me a bunch of old bills for wireless instruments.

"'I'd forgot!' she sobs, like she was clean heart-broke. 'It was about three months ago—I sent for a lot of apparatus collect on delivery—and pa was so mad that time because he'd found out I was using my wireless to talk with Eusebius, I was afraid to ask him to pay for it. I—I told Eusebius I'd wait for him to work all his time for old Ebenezer Pitts if he'd pay for it—and he did.'

"That was a stunner; but after thinkin' it over awhile, I sees a way out.

"'How much was it? I asks her.

"'A hundred and forty-nine dollars and fifty-three cents, altogether,' she says, wipin' her pretty eyes, an' lookin' at me, hopeful-like.

"I was determined I wasn't goin' to let a little thing like that get between me and strawberry short-cake for life. Next mornin' I takes possession of Timothy's lizzie, tellin' him I'm goin' down to Rapsville to buy some new togs. I rambles all the way up to Stonefield, and after doin' some inquirin', I finally locates Eusebius—a fat-faced idiotic-lookin' cross between a donkey an' a clod of dirt.

"'I'm tyin' up with Margy Tuggle,' I informs him, right square off the bat. 'Here's your blasted hundred an' forty-nine bucks an' fifty-three cents for that wireless gear of Margy's you paid for, an' a note from Margy—and now we're clear of you! If I ever catch you hangin' around Pilcher's Corners, I'll rip you inside an' throw you to th' buzzards!'

"I departs, leavin' th' rube standin' there with his mouth gapin' wide enough for a' elephant to have shoved his foot in it.

Continued on page 60

A Better Variable Air Condenser Because It Is Made Better

The time has passed when any condenser would suit you. You must have sharp tuning. You must have a condenser that will work smoothly and be easy of control now and years from now. COTOCO Condensers have established a reputation for low electrical losses and precise mechanical construction.

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87 Willard Ave., Providence, R. I.

"HITON" Variable Condensers

Ends, moulded bakelite—Plates, half hard aluminum—Large knob—Positive rotor stop—Soldered pigtail connections—Adjustable tension on rotor.

43	Plate	.001 mfd.	$5.25
23	Plate	.0005 mfd.	3.60
13	Plate	.0002 mfd.	2.75
7	Plate	.0001 mfd.	2.35

If your dealer does not stock we make IMMEDIATE DELIVERY

Hiton Radio Laboratories

641 No. Bronson Ave. Los Angeles, Cal. U. S. A.

Continued from page 58

"THE old lizzie had run all right comin' up to Stonefield; but she bucks all th' way back like a' ornery broncho. Tires blow out; the gas-tank springs a leak; the radiator goes dry; th' timer falls to pieces; an' every other blasted thing breaks down.

"As I crawl up alongside th' house, where the engine gives a last wheezin' gasp an' dies a long-deserved death, I can smell calamity in th' very air. Timothy meets me on the runnin' board, his goatee standin' out stiff, like a typhoon-warnin'. He shoves a note into my hand.

" 'Read it!' he jerks out. I reads it.

'Don't you think I saw what you were doing the day you fell off the wood-shed? You are the awfullest boob. Margy.

" 'Huh!' I gasps, clean dazed. 'What —where—

" 'She's gone!' raves Timothy. 'Some gul-darned skunk guve thet dum Eusebius a lot o' money, an' he paid off his debt t' Ebenezer Pitts—an' early this mornin' he comes with a weddin'-license an' sneaked off with Margy! Margy was eighteen at half-past six—an' thet cussed ol' Zoroaster Sims married 'em three minnits after! Said he hated ter do it, but Eusebius had ten dollars, an' butter's riz agin. If I kin ever find out who guve Eusebius thet money, I'll bust his rotten head—hot durn 'im!'

" 'Well,' I sighs, jugglin' some forty-seven cents in my left-hand pants pocket: 'You sure ought to.' "

Nationally Advertised

G-W Sliders and Rods

$\frac{3}{16}$" 25c

$\frac{1}{4}$" 30c

G-W sliders make perfect electrical contacts due to a patented bow spring which presses firmly against the slider rod, and a spiral tip contact spring which tunes on a single wire and slides across the coil easily in either direction without cutting the wire.

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MON-YOUGH RADIO ASSOCIATION ELECTS OFFICERS

At a semi-monthly meeting of the Mon-Yough Radio Association, held Thursday evening, June 1st, in the club rooms, 326 Fourth Avenue, McKeesport, Pa., the following officers were elected:

Vice President, John Hunter; Assistant Secretary-Treasurer, Emil Klob; Technical Committee, H. F. Kelso, Donald Willard; Chairman, Albert G. Moore; Membership Committee, Walter Estep, Chairman; Albert G. Moore, Harry W. Wallis.

The new officers will assume their duties July 1st, for a term of one year.

The Mon-Yough Radio Association is an affiliated society of the American Radio Relay League, and has a membership of 72. Four of the members are licensed operators, two of whom hold a limited broadcasting license identified by call WIK.

Two classes of membership are available, junior and senior. The membership fee and dues are very nominal. Radio fans are urged to investigate and consider the advantages of affiliating with this association, which meets regularly the first and third Thursday of each month, at 8 o'clock p. m. Information may be obtained by addressing a post card to the association at the above address.

SUNSET RADIO CLUB

The last meeting of Sunset Radio Club was thrown open to all interested in amateur radio and broadcasting and was largely attended, the Chamber of Commerce Directors' room being well filled. The papers of the evening were by Lieut. Col. Robert Loghry of the Presidio, San Francisco, on "Military Radio," and Mr. Cattell of the Mare Island Laboratory, whose paper was on the "Vacuum Tube." Mr. Davis presented a complete Reinartz tuner for demonstration. Dr. A. E. Banks presented a home made wavemeter, calibrated from 150 to 600 meters.

Sunset Radio Club in an effort to further the interest of broadcasting receiving stations has prepared a series of lessons in radio telegraphy which will be broadcasted nightly from KDPT, the Southern Electrical Co. station of San Diego. It is felt that the ranks of amateur radio will be added to considerably, following the completion of this course.

Major Lawrence Mott is expected to read a paper before the Club at the next regular meeting.

Owing to QRN, local relay stations are suffering with the rest of the District, but a fair degree of service is being maintained at certain hours.

The members of Sunset Radio Club were delighted to greet Mr. F. H. Schnell, Traffic Manager, A. R. R. L., at a special meeting called at the Federal Building on June 19th. The speaker was introduced by Major John F. Dillon, Radio Inspector 6th District. Both Major Dillon and Mr. Schnell thoroughly covered the subject of amateur co-operation and were enthusiastically received. An unfortunate incident whereby a certain rowdy element endeavored to break up the meeting was promptly squelched by Major Dillon and the four individuals in question left the room, much to the delight of all remaining, when the speaker, Mr. F. H. Schnell, proceeded with his talk.

C. W. has now invaded San Diego in earnest and most of the old sparks are disappearing. Station 6ZB, which has operated a C. W. for over two years, is still going strong. 6TW, the best in the locality, is getting ready for next winter's traffic. 6BJY has recently installed a keen set. 6AJH is reported to be in favor of installing one. Rumor has it that the following stations are about to install C. W.'s: 6JI, 6IZ, 6MZ and 6AHF.

A RADIO PRIMER

Continued from page 27

ternating current and there is a deflection of the diaphragm of the telephone receiver for each wave train and the sound or note produced in the receiver depends on the number of wave trains arriving per second.

Referring to the water analogy, if the water is struck rapidly by the blades of a revolving paddle wheel a series of waves of equal amplitude will be generated. There will be no damping because the source of energy is constant and an undamped or continuous wave train is set up.

Undamped waves may be generated electrically by using an electric arc with special equipment or by using the three-electrode vacuum tube, which when properly connected, will generate undamped oscillations. The advantages of C. W. (continuous wave) over damped wave are the greater efficiency of reception and sharpness of tuning which results.

It is obvious that the crystal detector will not "detect" C. W. because the wave train is not broken up into groups.

The heterodyne method of detecting C. W. signals consists of generating high frequency oscillations at the receiving station with special apparatus and then superimposing the high frequency oscillations on the C. W. oscillations in the detector circuit. If the oscillations generated locally are made a little more or less than the antenna oscillations "beats" will be produced, which will be audible in the telephone receivers.

The autodyne method of reception utilizes one vacuum tube both as a detector and generator, for with certain connections the tube will both generate continuous wave alternating current and detect C. W., thus giving a self-heterodyne effect.

The regenerative receiver makes use of detecting, amplifying and generating actions of a vacuum tube. It will detect spark or damped waves, it will regenerate or greatly amplify damped and undamped waves and it will cause the tube to oscillate and generate radio frequency currents, which when superimposed on the incoming antenna currents will render audible C. W. signals.

The regenerative receiver under certain conditions (when the tube is oscillating) may actually radiate energy back into the ether, that is the set may receive and send out energy at the same time, this action taking place when the tube is made to generate C. W. and secondary circuit is tuned to antenna-ground circuit.

METHOD OF OPERATING REGENERATIVE RECEIVER

TO properly operate a regenerative receiver one should have a knowledge of the function of each unit com-

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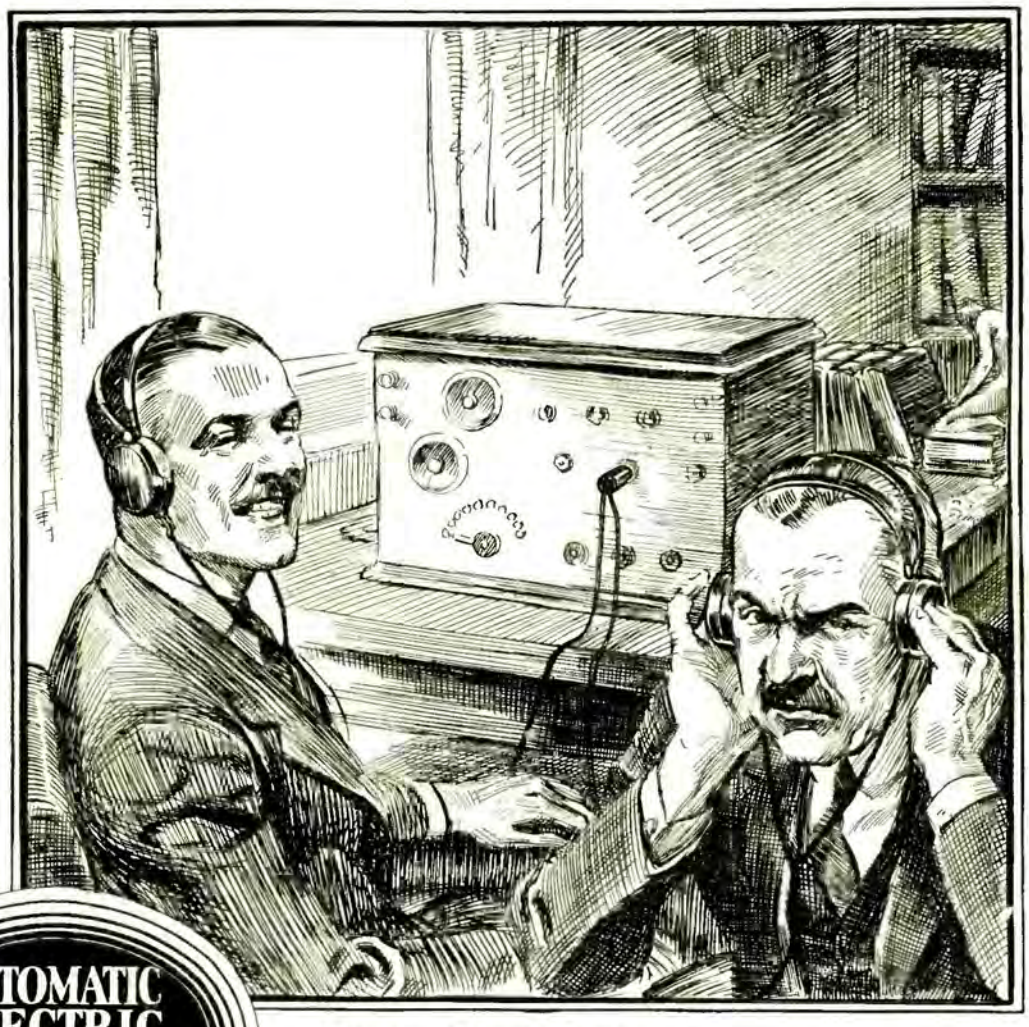

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THE man with the smile is enjoying a radio musical program through an Automatic Electric Head Set. Scientific design and careful manufacture assures him loud and distinct reproduction without distortion or foreign noises. These are qualities that are seldom found in receivers that are carelessly designed, or in which high resistance is given first importance.

The Automatic Electric Head Set was designed and perfected by a staff of engineers who have had more than thirty years of experience in the development of telephone talking apparatus. It is made in only one style and resistance,—the one proven by careful experiment to be the most efficient under all conditions.

The Automatic Electric receiver is designed with a single powerful electro-magnet which takes effect at the exact center of the diaphragm. This produces concentric vibrations, avoiding all distortion and false overtones. The coil is wound on a cylindrical core. The absence of sharp corners gives practical immunity from short-circuited turns—even after long continued use.

Whether used with crystal or vacuum tube detectors, multi-stage amplifiers or loud speakers, all signals are reproduced with maximum loudness and clearness.

This is the high grade plug that comes attached, when desired, to *Automatic Electric Head Sets*. It will take care of any kind of cord terminals, will fit any kind of jack and will accommodate two head sets. With this plug attached to our head set you can be sure the head set is properly "poled."

Automatic Electric Company

ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

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prising the receiver so that the most satisfactory results may be secured.

The first operation is to bring the filament of the tube to approximately the right temperature so that it will function as a detector. When the temperature becomes too high a slight hiss will be heard in the telephones and the rheostat should be turned back until the hiss stops.

The antenna or primary circuit should now be adjusted to the approximate wave-length of the station to be received. The amount of inductance in the primary circuit may be adjusted by the variable contact switch, each point of which gives a definite wave setting and any intermediate wave setting between contact points can be secured by operating the primary variable condenser. A series-parallel switch is often included in the primary circuit whereby the variable condenser may be switched either in series or in parallel with the primary inductance, the former connection enabling the primary circuit to be tuned to a lower range of wave-lengths than can be secured with the parallel connection alone.

The secondary circuit should be tuned to approximately the same wavelength as the primary circuit by manipulating the secondary inductance switch and the secondary variable condenser. The coupling between primary and secondary circuits controls the amount of energy transferred between these two circuits. It regulates the mutual induction between the primary and secondary inductances, the transfer of energy being maximum when the coupling is close and minimum when the coupling is loose. It is usually best to set the coupling part way between these two points in which position great selectivity can be obtained and interference from stations not desired may be almost entirely eliminated. The adjustment of the secondary condenser will usually be quite sharp, especially when long distance stations are being received, and a vernier attachment is often included to permit accurate adjustment of this unit.

A very close adjustment of the "B" battery potential may be secured by using the plate potentiometer, but this is of value only with certain tubes.

When the station is being received with maximum loudness the strength of the signals may be increased considerably by adjusting the regeneration. For each adjustment of the secondary circuit there is a point in the regeneration setting at which the vacuum tube will oscillate, that is, generate currents of radio frequency which will "feed back" to the grid circuit. If speech or music is being received the oscillating of the tube will cause distortion and the amount of regeneration should be reduced a little to

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eliminate such distortion. The tube must be in an oscillating state when receiving C. W. telegraph signals.

Final adjustments of primary and secondary condensers, filament temperature and regeneration should now be made to secure maximum signal strength with minimum distortion.

One or more stages of amplification may be used in addition to get signal strength sufficient to operate a loud speaker, but if too much amplification is used there will be distortion and when receiving speech or music it is generally preferable to sacrifice loudness for quality.

It should be remembered that the life of a tube depends to a great extent on the temperature at which its filament is burned and hence no more current should be passed through the filament of a tube than is necessary to give satisfactory results.

When through operating the set the rheostat should be turned back to zero or "off" position, and this will automatically open the "B" battery or plate circuit, as no current can flow between plate and filament when the latter is cool.

200 WATT A. C. RADIOPHONE

Continued from page 17

system and really the most important is the condensers shunted across the coils. This was discovered by the writer and is very effective. This is a tuned circuit, apparently to a harmonic of sixty cycles. In the case of the filter coils used, a 1 m. f. d. shunt was found to be the proper value. Higher or lower values had the effect of throwing the a. c. out of phase. While experimenting with this, having set radiating and listening to a. c. in wavemeter, one side of line was built up in steps by multiple condensers. As condensers were added the peak voltage of the loaded side, as applied to the radio tubes, was apparently shifted from a direct right angle until a peculiar off-phase hum or "beat" was observed. When this circuit is tuned properly the filtering will be very effective. It is found that this method cuts down the necessity of having high condenser capacity across the line as ordinarily used. The voltage across the coils is much lower than that across the line, thereby reducing the number of condensers used by "series-paralleling." (c) It is important when two iron core filters are used and clamped together as a unit, that they must be poled properly. (d) The a. c. is given further filtration in the modulator tubes by inserting individual resistance rods, 1000 ohms, in each grid circuit. By reference to the schematic it will be seen that these are in series with grids. (e) The plate and grid reactors and also resistances of modulator and amplifier tubes also aid in the filtering. (f) It was noted that when the proper filtering was accomplished the complete transformer circuit became very quiet. This condition was chiefly brought about by the tuned filter system mentioned in "b" and proper capacities in "a."

It is hoped that this article will help those using a. c. radiophones. An a. c. phone if properly filtered is highly desirable, because of its flexibility and ease of control and also by the fact that it has just as sharp a wave as generator sets and is not a "O. R. M. hound." It is admitted that there are many a. c. sets not accomplishing good results that are creating enemies every time they open up. Instead of enemies our set has made many friends, while operating on test at 2BB. After further tests are completed the set will be used regularly by Station 2BQH, located at Mamaroneck, N. Y.

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INTERCHANGEABLE WITH ALL COIL MOUNTINGS

The new Giblin-Remler Coil has achieved a remarkable success. Placed on the market thirty days ago, it has already achieved enthusiastic response from all sections of the country.

Thomas P. Giblin, in designing the Giblin-Remler Coil has built an inductance coil that is infinitely superior in every respect to both the Honeycomb and Duo-Lateral Coils of which he is also the originator.

The Giblin-Remler Coil is equally effective on all wave lengths—the self capacity is far less than any previous compact inductance—this giyes selectivity and sharp tuning for a given coil which is of special advantage to the amateur who usually has an antenna of low capacity. The high frequency resistance is also lower than any previous type.

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-micro-farads, Accuracy 1%	Wave Length Range in Meters using Condenser of .001 max. and .00004 mfd. min.		High Frequency Resistance in Ohms at Wave Length Shown			
							Minimum	Maximum	200	500	1000	2000
RG 20M	1.50	RG 20U	.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	.....	8.8	4.4	.....
RG 75M	1.65	RG 75U	.85	.377	163	19.8	266	1170	.....	28.3	12.1	6.2
RG 100M	1.70	RG 100U	.90	.666	217	19.9	358	1550	.....	80.3	26.8	12.6
									1000	2000	5000	10000
RG 150M	1.75	RG 150U	.95	1.503	281	14.8	512	2320	69.8	23.8	7.1	.....
RG 200M	1.80	RG 200U	1.00	2.68	374	14.7	690	3110	.....	50.6	12.5	.....
RG 250M	1.90	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	4680	.....	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 600M	2.40	RG 600U	1.60	29.2	1024	10.1	2260	10250	.....	111	43.8	.....
RG 750M	2.65	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	.....	.....	.....	.....

These tests have been made by Robert F. Field of Cruft High Tension Electrical Laboratory, Harvard University, Cambridge, Mass.

Giblin-Remler Inductance Coils are patentable—they are manufactured by patented machinery. This protects you and insures your receiving the genuine Giblin-Remler Coils.

If you cannot secure Giblin-Remler Inductance Coils from your dealer send to us direct. Order now as these coils will help you get truly wonderful results from your set.

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General Manager
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San Francisco, Calif.
154 W. Lake Street
Chicago, Ill.

HELPS FOR THE RADIO BUILDER

Continued from page 3

from the secondary that connects with the filament of the detector tube. On 360 meter work this condenser will strengthen the signals and make the regeneration more sensitive and efficient. If a small variable condenser can be used instead of a fixed condenser, greater efficiency in tuning for loudness (especially with a loud speaker) will result.

Very often the fixed condenser across the phones will have to be removed if one or more loud-speakers or a Magnavox is attached in addition to the phones. It is well, therefore, to have the phone condenser connected with a switch.

Flexible wire connections, even though unsightly at times, are far better, hanging loose or running in various directions, than bus-bar wiring, which is so often in parallel. Flexible wiring, loose and uneven, prevents induction, hissing and howling. That is why so many sets on experimental tables work so well. The bus-bar wiring is only a fad and does not make for short connections in many cases.

Don't think that because your tubes are lighted that you have perfect contact with the four prongs of each tube. It takes only two of the prongs to light the lamps. I have seen cranky sets where neither the plate or grid prong were make poor contact, touching at times and then not touching. Bend the lips of each socket up to be sure of four perfect contacts.

Unless the outside lead from the secondary of an amplifying transformer is connected with the grid, there will be no efficient operation of the tube—of any tube.

If perfect regeneration is not secure with the tickler, reverse the connections from the tickler, that is change the connections from the tickler where they unite with plate and transformer or at the coil.

A larger condenser will often increase the sound volume and broaden the tuning, especially on the 360 meter waves. More small sets are hampered in efficiency by a small primary condenser (in either the ground or aerial) than by any other factor.

When you are planning to arrange your primary condenser so that it can be in the ground circuit or in parallel with the primary coil, also arrange to have it in the aerial circuit. There are some signals and especially some broadcasting stations which, come in better with the primary condenser in the antenna circuit, some with it in the ground circuit. It seems strange that such is the case, but try it.

NEW BIDS ON NAVY TUBES

Jacob Loving of 610 Broadway, New York, was high bidder for the 30,000 surplus vacuum transmitting tubes offered for sale by the Navy Department. He bid $4.0069 each for all or none. The lowest bid was ten cents each, made by L. M. Alexander of Cincinnati.

STANDARD TESTS FOR RECEIVING SETS O. K.'D

The Bureau of Standards and the Electric Testing Laboratories of New York have approved in outline a standard method of testing complete radio telephone receiving sets. The method is said to be for immediate use in testing sets manufactured for receiving Radio Telephone Broadcasting, but details have not yet been made public.

Improvements on the method or new methods used in testing the equipment submitted by the National Retail Drygoods Association will be subject to the approval of the Bureau of Standards, the Bureau co-operating with the Electric Testing Laboratories in establishing these methods as standard procedure.

A NEW RADIO BILL

Continued from page 36

"SEC 3. A. That the actual operation of apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued thereunder. No person shall operate any apparatus in such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

"B. That the Secretary of Commerce, in his discretion, may grant special temporary operators' licenses to operators of radio apparatus under such regulations, in such form, and upon such conditions as he may prescribe whenever an emergency arises requiring prompt employment of such an operator.

"C. That an operator's license shall be issued by the Secretary of Commerce in response to a written application therefor, addressed to him, which shall set forth (a) the name, age, and address of the applicant; (b) the date and place of birth; (c) the country of which he is a citizen; and if a naturalized citizen of the United States, the date and place of naturalization; (d) the previous experience of the applicant in operating radio apparatus; and (e) such other facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicaht under oath or affirmation.

"D. That an operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is proficient in the use and operation of radio apparatus and in the transmission and reception of radiograms by telegraphy and telephony. Except in an emergency found by the Secretary of Commerce to exist, an operator's license shall not be granted to any alien, nor shall such a license be granted to a representative of a foreign government.

"E. That an operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by him for a period not exceeding two years upon proof sufficient to satisfy him that the licensee: (a) has violated any provision of any act or treaty which the Secretary of Commerce is authorized by this Act to administer, or of any regulation made by the Secretary under any such Act or treaty; or (b) has failed to compel compliance therewith by any unlicensed person under his supervision; or (c) has failed to carry out the lawful orders of the master of the vessel on which he is employed; or (d) has wilfully damaged or permitted apparatus to be damaged; or (e) has transmitted superfluous signals, or signals containing profane or obscene words or language.

"F. That a license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was at the date his license was granted to him, or is at the time of revocation, ineligible for a license.

"SEC. 4. A. That after the approval of this Act the construction of a station for which a license is required by this Act shall not be begun, nor shall the construction of a station already begun be continued, until after a permit for its construction has been granted by the Secretary of Commerce upon written application therefor. This application shall set forth such facts as the Secretary of Commerce by regulation may prescribe as to the citizenship, character, and the financial, technical, and other ability of the applicant to construct and operate the station, the ownership and location of the proposed station and of the station or stations with which it is proposed to communicate, the wave or wave lengths desired to be used, the hours of the day or other periods of time during which it is proposed to operate the station, the purpose for which the station is to be used, the type of transmitting apparatus to be used, the

power to be used, the date upon which the station is expected to be completed and in operation and such other information as the Secretary of Commerce may require. Such application shall be signed by the applicant under oath or affirmation.

"B. That such permit for construction shall show specifically the earliest and latest dates between which the actual operation of such station is expected to begin and shall provide that said permit will be automatically forfeited if the station is not ready for operation within the time specified. The rights granted under any such permit shall not be assigned or otherwise transferred to any other person, persons, company, or corporation, without the approval of the Secretary of Commerce: *Provided,* That a permit for construction shall not be required for Government stations to be used exclusively for communication of official business or for private stations as provided for in Section 4, fifteenth regulation, of the Act of August 13, 1912. The granting of this permit to construct a station as herein required shall not be construed to impose any duty or obligation upon the Secretary to issue a license for the operation of such station.

"SEC. 5. That an advisory committee is hereby established to whom the Secretary of Commerce shall refer for examination and report such matters as he may deem proper relating to: (a) the administration or changes in the laws, regulations, and treaties of the United States relating to radio communication; (b) the study of the scientific problems involved in radio communication with the view of furthering its development; (c) the scientific progress in radio communication and use of radio communication.

"The advisory committee shall consist of twelve members, of whom one shall be designated by the Secretary of State, one by the Secretary of War, one by the Secretary of the Navy, one by the Secretary of Agriculture, one by the Postmaster General, and one by the Secretary of Commerce, to represent these departments, respectively, and six members of recognized attainment in radio communication not otherwise employed in the Government service to be designated by the Secretary of Commerce.

"The necessary expenses of the members of the committee in going to, returning from, and while attending meetings of the committee, including clerical expenses and supplies, together with a per diem of $25 to each of the six members not otherwise employed in the Government service for attendance at the meetings, shall be paid from the appropriation made to the Department of Commerce for this purpose.

"SEC. 6. That radio telephone stations, the signals of which can interfere with ship communication, are required to keep a licensed radio operator, of a class to be determined by the Secretary of Commerce, listening in on the wave length designated for distress signals during the entire period the transmitter of such station is in operation.

"SEC. 7. That regulation first of Section 4 of said Act of Congress approved August 13, 1912, is amended by striking out the words 'this wave length shall not exceed six hundred meters.

"Regulations third and fourth of Section 4 Act of Congress approved August 13, 1912, is amended by striking out the words 'provided that they do not exceed six hundred meters or that they do exceed one thousand six hundred meters.'

"Regulations third and fourth of Section 4 of said Act of Congress approved August 13, 1912, are amended by striking out the words 'exceeding two hundred meters' and substituting in lieu thereof the words 'of not less than one hundred and fifty meters nor more than two hundred and seventy-five meters.'

"SEC. 8. That any person, company, or corporation who shall erect, use, or operate

any apparatus for radio communication in violation of this Act, or knowingly aid or abet another person, company, or corporation, in so doing, or knowingly make false oath or affirmation for the purpose of securing a permit or a license, shall incur a penalty not to exceed $1,000, which may be mitigated or remitted by the Secretary of Commerce, and the permit or license of any person, company, or corporation, who shall violate any of the provisions of this Act, or of any of the regulations of the Secretary of Commerce issued hereunder, or knowingly make any false oath or affirmation for the purpose of securing a permit or license, may be suspended or revoked by the Secretary of Commerce.

"SEC. 9. That the Secretary of Commerce is hereby authorized and directed to charge, and through the imposition of stamp taxes on applications, licenses, or other documents, or in other appropriate manner, to collect, the fees specified in the schedule following. The Secretary shall collect said fees through the collectors of customs or other officers designated by him, and he may make such regulations as may be necessary to carry out the provisions of this section."

"SCHEDULE OF FEES TO BE COLLECTED"

"For trans-oceanic radio station license, $300 per annum; for commercial land station license, other than trans-oceanic, one kilowatt transmitter input or less, $50 per annum; and for each additional kilowatt or fraction thereof, $5 per annum; for ship station license, 25 per annum; for experiment station license, $25 per annum; for technical and training school station license, $15 per annum; for special amateur station license, $10 per annum; for general and restricted amateur station license, $2.50 per annum; for commercial extra first-class operator's license, $2.50 per annum; for commercial first-class operator's license, $1.50 per annum; for commercial second-class operator's license, $1 per annum; for commercial cargo grade operator's license, 50 cents per annum; for experiment and instruction grade operator's license, $1 per annum; for amateur first-grade operator's license, 50 cents per annum; for amateur second-grade operator's license, 50 cents per annum; for commercial extra first-class radio operator's examination for license, $2.50 for each examination; for commercial first-class radio operator's examination for license, $2 for each examination; for commercial second-class radio operator's examination for license, $1.50 for each examination; for commercial cargo grade radio operator's examination for license, $1 for each examination; for experiment and instruction grade radio operator's examination for license, $1 for each examination; for amateur first-grade radio operator's examination for license, $1 for each examination; for amateur second-grade operator's examination for license, 50 cents for each examination.

"In the event that other classes of station and operator's licenses or other examinations shall hereafter be prescribed in any lawful manner, the Secretary of Commerce is hereby authorized and directed to charge and collect in the same manner as herein provided fees for such new classes of licenses and of examinations, which fees shall be substantially of the amount herein specified for the license and examination nearest in character and purpose to the new license or examination so prescribed.

"For failure to pay at the time and in the manner specified by the Secretary of Commerce any of the above fees the Secretary of Commerce is authorized to refuse to issue such licenses; or if issued, to suspend or revoke the same, as he may deem proper.

"SEC. 10. That wherever the words 'naval and military' stations appear in the Act to regulate radio communication, approved August 13, 1912, said words 'naval and military' shall be stricken out and the word 'Government' substituted in place thereof.

"SEC. 11. That all Acts or parts of Acts in conflict with this Act are hereby repealed."

IS RADIO HERE TO STAY?

By E. P. EDWARDS

For years, and until 1920, the typical drummer's story held sway in the smoking compartments of our trains. Then, with the enactment of the 18th Amendment, it was "how to make it" and "where to get it." Now, the talk is all radio.

Has the country gone mad over a fad?

To many it would seem so and, in many respects, the present furore is unfortunate, creating an unprecedented demand which nobody was prepared to meet.

In consequence the population of the country is divided into two classes, those who are clamoring for radio equipment and those who are trying to manufacture it—the latter class being almost as strong numerically as the former.

As a result, the market will shortly be flooded with good, bad and indifferent devices and the public, together with the legitimate manufacturers, will suffer from the activities of the radio "bootleggers" whose number is legion.

Radio will not supplant the wire telephone on land; it will not take the place of the phonograph or the daily newspaper; it will occupy a field of its own creation, and supplement rather than supersede. Radio is destined to play one of the most important roles in the world's history.

It will do more than any other one thing to stimulate the "back to the land" movement, by bringing news, crop, market and weather reports to the farmer and his family, thus giving him that element of human contact, the lack of which has driven so many of our people from the farm to the cities.

Has radio come to stay, or is it a passing craze?

That is a question which many of us are asking.

A little psychological reasoning seems to satisfactorily answer the question.

The favorite indoor and outdoor sport of the American people is centered around the pleasure they derive from "kicking." This national trait of being dissatisfied with things as they are, coupled with the ability to criticize constructively, is what has put us in the forefront of progress and invention.

Do you ever get tired of your phonograph? If so, isn't it because you get what you want when you want it with a minimum of trouble, and with unvarying results?

Do you get tired of golf? You would if you could steadily improve your game to a point where you could play every hole in par with certainty. True, you burn, break, sell or give away your clubs at irregular intervals, but you do not stop playing. Why not? Isn't it because of the element of uncertainty in the game?

This same element of uncertainty attaches to billiards, fishing, matrimony and many other well known sports.

In radio we have a deadly parallel introducing all kinds of uncertainties, such as static, interference, fading and "birdies."

Do you not think that from the very "nature of the beast" that our people will find the keenest enjoyment in that competition for better results, which will lead to the perfection of an art that is now only in its infancy?

Don't forget to read the classified Ads on page 94

WILL TRY OUT AUTOMATIC RELAY

The Radio Section of the Signal Corps plans very soon to try out the operation of an automatic relay at Chicago, controlled from Washington, thus enabling the Capital station to control traffic through Chicago west, probably at least as far as Omaha. If the circuit works well, it is also planned to install a similar relay at Omaha and to operate to the far west from Washington by means of the 20 K. W. set at Arlington. Omaha will be advised when the messages are to be relayed through their station and will stand by letting Washington work through the relay to Salt Lake City or even farther west.

Last month the Radio Section of the Signal Corps handled 5,232 official messages numbering 175,672 words, and equalling a saving of approximately $2,718 over what the cost would have been via commercial lines. Except for the interference of static in the west, these figures would have been doubled, it is said.

NAVY ASKS APPROPRIATION

Continued from page 33

every year," he stated. Going further into details, the head of the Navy's radio research and maintenance department explained that the shore stations did not interfere with other government or commercial services, and that they were necessary to the safety of merchant and war ships, both in times of peace and war.

Today the Navy has 214 shore communication stations, including 90 on the coasts, 46 on light vessels, 54 radio compass stations, three radio laboratories, 10 carrier pigeon stations, and 11 super power trans-Atlantic stations, all of which practically pay for themselves besides being essential in the interests of the country.

Earns $23,000 Per Month

For the first six months of the current fiscal year, Naval radio stations earned the sum of $144,659, an average of $23,000 per month. In 1921 the number of words carried decreased by 24,946,657, due to the discontinuing of many war-time activities, the reduction of Shipping Board operations, and the elimination of much telegraph and radio traffic in the interests of economy. Therefore, the earnings or "savings" decreased in 1921 some two million dollars over what they were the year previous, being only $3,509,386, a sizable saving, nevertheless, it was pointed out.

"It is worthy of note," the Admiral interjected, "that the interests of the U. S. Navy in radio communication has resulted in the United States commercial interests becoming predominant in world radio communication."

The Navy's net is almost world wide, and connects all the Government's outlying possessions with the United States, furnishing as well a medium of rapid communication with our fleets of war and merchant marine.

Some Radio Developments

Replying to a question as to what the Navy had done specifically to develop the art of radio telegraphy and telephony, Admiral Robison stated that a few of them included improvements in facilities for secret communication; increased the range of aircraft radio sets from 50 to 500 miles, and reduced the weight materially, making long-range spotting possible; developed a pilot cable for harbors and aircraft landing fields, increasing the safety of both water and aerial navigation; made possible the sending and receipt of five simultaneous messages; increased long-distance speed from 10 to 60 words per minute, and made possible automatic transmission and reception. Other work includes the development of the kite aerial for transmitting from a seaplane on the water; radio compass improvements making radio applicable as a direction indicator and position finder; the elimination of static and "mush;" an advance in the radio controlled torpedo and vessels, and the introduction of the arc transmitter and uniwave system of signalling.

MARCONI VISITS BIG RADIO PLANTS

WELCOMED by scientists and engineers of international note who joined in high praise of his great accomplishments in the field of radio, Senator Guglielmo Marconi spent a busy day at the plant of the General Electric Company, Schenectady, N. Y., on June 26, inspecting the big electric works and conferring with the wireless experts of the G-E Company and the Radio Corporation of America.

Senator Marconi made a special trip as far as Albany in his yacht *Electra* and was brought over to Schenectady by automobile, accompanied by a large party of officials of the Radio Corporation, officers of the Italian Navy, the United States Army and Navy and others.

During his visit he delivered a speech on wireless from the General Electric Broadcasting Station WGY, held an informal reception for several thousand Italian residents of the city, attended an informal dinner tendered to him by E. W. Rice, Jr., honorary chairman of the board of directors of the General Electric Company, and a large luncheon in his honor given by the company. He returned to New York the following day.

The greater part of the distinguished inventor's visit was filled with inspection of the radio manufacturing division of the General Electric Company, its broadcasting station and an examination of the famous Research Laboratory.

At the luncheon held at the Mohawk Golf Club, the toastmaster was Mr. Rice and the speakers included Owen D. Young, chairman of the board of directors of the General Electric Company and of the Radio Corporation, Dr. W. R. Whitney, director of the Research Laboratory, Dr. Irving Langmuir, assistant director, Mayor George R. Lunn of Schenectady and G. P. Baccelli, Italian Consul in New York, a member of Senator Marconi's party. Among other officials present were Edward J. Nally, president of the Radio Corporation, J. W. Elwood, secretary, and David Sarnoff, general manager. About 125 persons, including officials of the G-E Company, attended the luncheon.

The spontaneity of the greeting accorded Marconi pervaded the whole city and came not only from the scientific workers who are engaged in engineering problems, but from the lowliest citizen, all turning out to do him honor.

O. D. Young, in a keynote address at the luncheon, classed Marconi with Edison as "the leading inventor of the world." Dr. Whitney and Dr. Langmuir pointed out some of the high spots of his epoch-making investigations and predicted new and greater fields for the extension of radio communication. The freedom of the city was tendered by Mayor Lunn and a brief address of welcome was given by Consul Baccelli.

In responding to the toast Marconi spoke of the influence which radio is having and is destined to have on world human relations by facilitating communication between nations and between peoples of the world, and the infinite future possibilities of the art of wireless as new knowledge of this strange and little understood phenomenon begins to be known.

Marconi's experiments in short and long wave radio transmission were touched on with the prediction that the feat of encircling the globe by wireless was a possibility in the not distant future.

RADIO THIEVES MAKE BIG HAUL

People are bound to have radio sets, even if they have to steal their instruments.

What is believed by detectives to be the work of boys was the robbery of between $900 and $1,200 worth of apparatus from the Radio Concert Equipment Company's store at 734 West Sixth Street, on the evening of July 4, the biggest haul of radio equipment ever made by robbers in Los Angeles.

Among the apparatus taken were five audion sets, twelve Thordarson transformers, twenty-five Kilbourne & Clarke telephones, six pairs of Manhattan telephones, three home chargers, fifteen crystal detector sets, soldering irons and many odds and ends, such as switch points and switches.

The thieves entered by the rear door, breaking the glass with a piece of gas pipe and unlocking the door from the inside, according to Will Brenniman, manager of the concern.

NATIONAL RADIO CLUB ORGANIZING

PITTSBURGH, Pa., is the scene of the organization of a club that seems destined to play a big part in the future of radio. The work of enrolling members is already well under way and articles of incorporation have been filed along with application for a charter.

While one of this club's fundamental purposes is to promote and finance the installation of radio equipment in hospitals, it will also use its influence to keep the broadcasting art on its present high plane; enlarge musical and educational radio programs; keep all members informed regarding developments, improvements and news of interest regarding radio; answer, without charge, all technical questions asked by members; receive and file articles written by members for reference; lend the moral support and influence of the club to those agencies endeavoring to eliminate the confusion of signals; promote fraternity and good fellowship among members with the aid of a distinctive official button and card of membership.

The organization committee includes Harold B. Coe of New York City, Charles W. Payne of Philadelphia, F. R. McCray of Los Angeles, Otto J. Palm of Cincinnati, R. Gordon Craig, Ray Mansmann and Francis G. Albertson of Pittsburgh, all radio enthusiasts who are sparing no effort to promote the interests of radio transmission.

Although the National Radio Club has been assured the hearty co-operation of the large manufacturers it will maintain a strictly neutral attitude in all matters of equipment and its officers and directors will be selected from radio enthusiasts not engaged in making or selling radio apparatus.

A nominal membership fee of two dollars will be paid by applicants who will have issued to them a membership card and club button.

Interested persons can get in touch with the club by writing to Francis G. Albertson, Secretary, 419 Fulton Building, Pittsburgh, Pa.

FADA TUBE SOCKETS

FADA

Trade Mark Registered

THE proper selection of radio parts is the first secret of success. To eliminate the "chance", purchase FADA rheostats, inductance switches, series-parallel switches, crystal detectors, binding posts, and tube sockets. FADA single, double and triple tube sockets have these good features:

1. Genuine Condensite base affording the highest insulation resistance.
2. Deep trenches make contact springs immovable except as a tension against the tube contact pins.
3. Heavy phosphor bronze springs.
4. Socket base has metal inserts for panel mounting and nickel plated screws are furnished.
5. Position of tube on base is offset to allow compact rheostat panel mounting, as shown in illustration below.
6. Screw holes for base mounting.
7. Terminals plainly marked.
8. Highly nickel plated and polished brass tube with bayonet slot eliminating slot breakage as with moulded shellac or porcelain sockets.

Single Socket.....	$1.00
Double Socket.....	2.00
Triple Socket.....	3.00

The illustration below shows an easy, compact and efficient method of panel mounting FADA rheostats and sockets.

All exclusive FADA features are protected by Pats. applied for.

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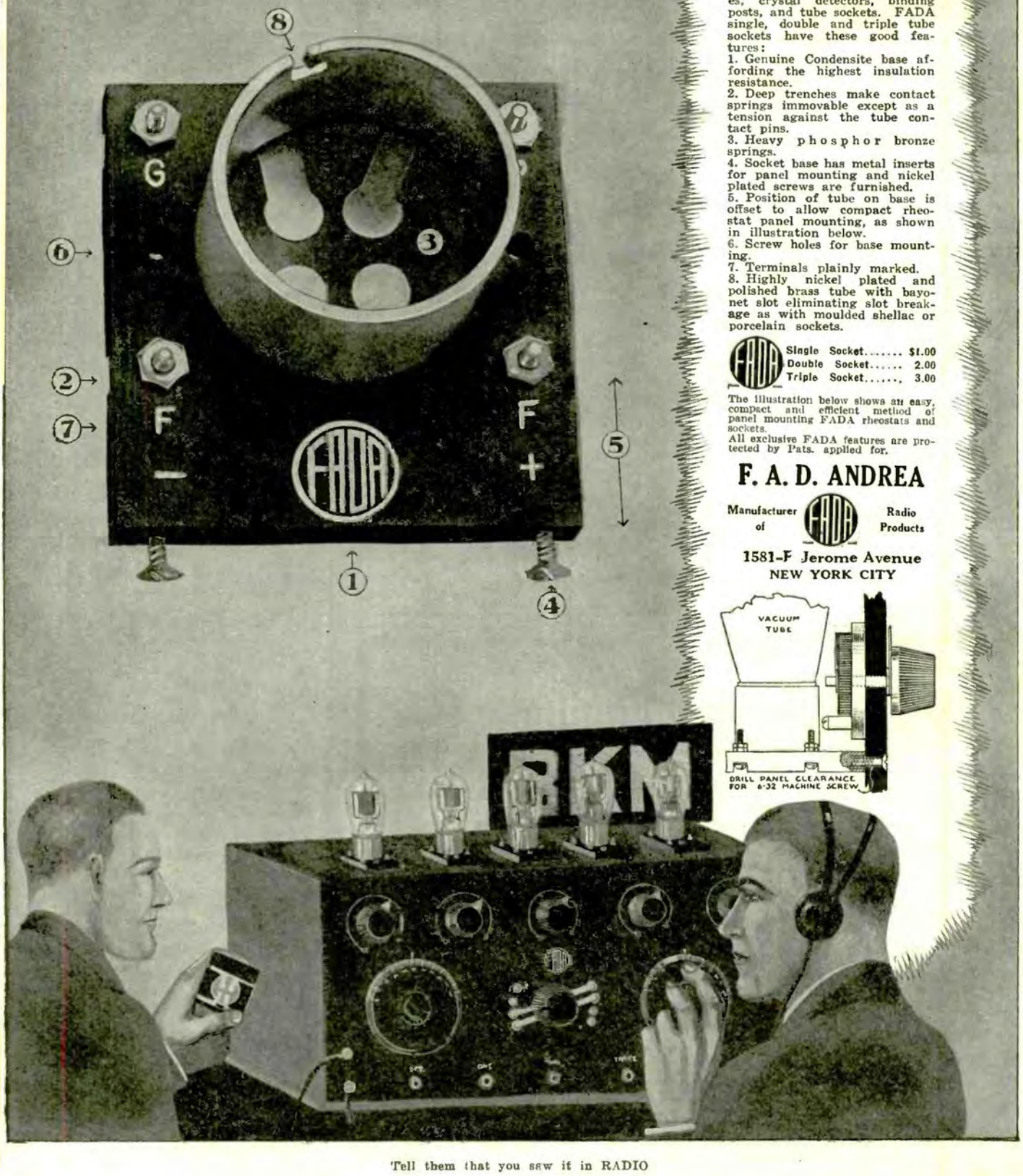

NEW DEMONSTRATION STUDIO SHOWS PROGRESS OF RADIO DEVELOPMENT

A new studio with over 3,600 square feet of space devoted to demonstration and experimental research work has been opened at 1215 Leland Avenue, Chicago, by the Ray-Di-Co. organization. Every evening in this auditorium as many as 300 people can congregate and be entertained free of charge with the best of concerts, operas, bedtime stories, etc., from the local broadcasting station. In connection with this demonstration room is a special studio, size 15x16 feet, with special soundproof walls. This studio is equipped with a pick-up microphone. A particular feature in the Ray-Di-Co. demonstration rooms are the special booths built around the room where radio apparatus can be tested out before being purchased by a radio enthusiast.

It Is Time to Think of Service

It is time to look further than the mere equipment when you buy radio supplies, whether you're in Radio for profit or pleasure.

When you see this name "SIGNAL" on wireless and radio equipment, you may confidently expect real radio service on your problems.

SIGNAL Radio Apparatus is built entirely in SIGNAL factories, from improved designs, by our own radio engineers, working in our own laboratories.

Bear in mind that SIGNAL Equipment is not, nor will it ever be **"side-line" material.**

Back of every SIGNAL Product is a reputable company, with a record of years of successful development in Radio.

As a part of the Service offered beginners, advanced amateurs and serious experimenters on Radio, we maintain a complete engineering service department, upon which our friends are at liberty to call, at any time, regarding their Radio problems, and to aid them in getting the best results at all times from their apparatus.

When you specify "SIGNAL" you specify "SERVICE"

SIGNAL ELECTRIC MANUFACTURING COMPANY

Menominee, Michigan

SIGNAL BACK MOUNTED VARIABLE CONDENSER

One of the SIGNAL line, produced to meet the demand for a condenser for panel mounting. Comes in three models, so built as to permit mounting on panels from 1/8 to 3/8" in thickness. Machine screws are furnished for fastening the instrument to the panel; it is only necessary to drill three holes. Each instrument furnished with metal scale calibrated to 180 deg. Knob and pointer are removable. Construction is very rigid, the material in the aluminum plates being .026". The bearing plates are 3/16" black Formica.

This request-coupon makes it easy to secure all "SIGNAL" latest Wireless Bulletins, without any obligation. Simply fill out and mail now.

CUT OUT AND MAIL COUPON NOW

COUPON

Send me the new Signal Wireless Bulletin W.

Name .....

Company .....

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"K F S"

Continued from page 31

the operating engineer," I began to explain.

"Oh, that's all right then," answered Mr. H. E. Coyle, the chief of the big station. "Come right in and blaze away."

Our next picture was of the twenty kilowatt arc in the transmitter room.

"This arc set is tuned to 2,400 meters and is operated on the highest aerial," said the chief. "The ten-kilowatt spark set over there, which is tuned, of course, to 600 meters, has its own separate aerial suspended about sixty feet below the arc-transmitter aerial. The 360-foot masts carry both aerials."

"Whoof!" flared the magnesium powder as Bill shot the picture of the arc transmitter.

"I see th' fog's not rolled in yet," remarked Bill eagerly, as he looked out of the window. "While we're waitin' for the smoke to clear out, I might get up on th' windmill——"

"We're not taking anything more here in the transmitter room," I replied. "There's a fine set of generators and a splendid spark set over there, but nearly everybody knows what dynamos and spark transmitters look like. We're going into the receiving room now."

Muttering something under his breath, Bill followed us into the receiving room.

"We have two complete receiving sets here," said the chief. "One built especially for 600-meter spark signals, and the other for 2,000 to 3,000-meter CW. Each receiving set has its own loop-aerial. The loops are exactly eight feet square, and the 600-meter loop has five turns of wire and the longer-wave loop, fifteen turns. This is a Kolster hook-up."

"How are the loops connected to the receiving sets?" I inquired.

"The two ends of the loop coil are simply connected to the two ends of the receiving transformer primary, and a variable condenser is shunted across for tuning," answered the chief. "There is no ground connection whatever. The two loops are mounted on rotating shafts and are connected by means of bevel gears and other shafts to these two hand-wheels here at the operating desk——"

"I can just get half of one of them wheels in the picture," said Bill from under his focussing cloth. "I've got all the arc-control panel on the other side."

"We rotate the loops according to the direction we wish to receive from," resumed the chief. "If we want to work a ship out on the Japan coast, we have to set the loop in a different position from that with which we work southeast toward Panama, for instance. Of course, we can hear signals from either direction, no matter how the loops are set; but for the best signals, we have to adjust them."

"You must have some remarkable receiving apparatus behind those panels," I hinted.

"Yes, it's pretty good," admitted the chief, with evident pride. "I'd like to tell you about it and give you the hookup, but the chief engineer says that the circuits must be kept secret for a while yet. I'll tell you what I'll do, though. If you'll promise not to describe what you see, I'll let you look inside one of the receiving sets."

"That's understood," I replied.

The chief turned a few thumb-nuts and swung down the hinged panels.

For a few moments, I stood petrified.

"Whew!" I gasped. "I hope I'll be able to write about that some time. A description and hookup of that on paper would be worth five thousand dollars."

"We may be able to make it public later on," said the chief.

"It looks as if some of the designers of amateur apparatus could get some pointers

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"K F S"

Continued from page 88

on simplicity from your engineers. You have hardly more than half-a-dozen control knobs on each receiving set."

"Yes. You see, we simplify the tuning by having separate complete receiving sets for the two waves we do our work on. One of the receivers of the head telephone set is connected to the 600-meter spark receiving set and the other telephone receiver is hooked to the 2,400-meter CW receiver. There is no electrical connection of any kind between the two receivers. While we are working on 2,100 or 2,400 meters CW, we can at the same time hear everything on 600 meters spark, or *vice versa*. Then we have a master-switch, whereby we can put both receivers on either the 600-meter or the 2,400-meter set. We stand by, however, with one receiver on each set, as we are after all the ship business we can get hold of, arc or spark.

"One interesting thing we've discovered is that the receiving sets work better when the large transmitter aerial is open. That's why we have that big switch up above the arc set, in the transmitter room."

"The ship operators report working you four or five thousand miles right along," I said. "Do you receive those small shipboard sets over such distances with these loop aerials?"

"We certainly do," replied the chief. "We have cleared ships 5,200 miles from San Francisco; and during the winter months we handle business with the Pacific Mail passenger steamers all the way down to Panama, in the Gulf of Mexico, and up the Atlantic until they berth at Baltimore. They have two-kilowatt arc sets."

"Five thousand two hundred miles with a shipboard set," I cogitated. "Just think how few years it is since we were satisfied to cover two hundred miles on our old straight-gap spark outfits."

As I shook hands with the chief, I suddenly discovered that Bill had disappeared. Outside, where the sun blazed in July glory, I overtook him plowing through the sand on the way to the windmill.

"Th' sun's still shinin' and there's another ship out there," he pleaded. "It'd be a pretty picture——"

"Nothing doing," I said firmly, turning him around. "We're making a dash back to our dark-room and typewriter to get this ready for August RADIO."

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WITH OUR HIGH QUALITY GOODS

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We Pay Transportation Charges in the U. S. East of the Rockies

THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR

FAST SERVICE—TRY US AND BE CONVINCED

THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

PLATE CIRCUIT "B" BATTERIES

Look what you can save on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

E180 Signal Corps type small size, 15 cells, 22½ volts. Each $1.10.

E182 Navy size, 6½x4x3, 15 cells, 22½ volts. Each, $1.80.

E184 Variable Navy size, 5 taps giving range from 16½ to 22½ volts in 1½ volt steps. Each, $2.25.

E186 Double Navy size 6½x4x6, 30 cells, 45 volts. Suitable for amplifier circuits and power tube use. Two or more of these units in series may be used in C. W. and radiophone circuits. Each $3.40.

E188—Combination Tapped 45 volts, 30 cell, 6½x4x6 battery. Tapped to give voltage regulation for detector tube. Handles both detector and amplifier tubes. Each, $3.90.

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

E105 Detector, each $5.00
E110 Amplifier, each 6.50
E115 5 Watt Transmitter 8.00

FILAMENT CONTROL RHEOSTATS

Crosley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob. E130 Each 54c

Best made. High heat resisting base. Diam. 2⅛ in. 1½ amp. Resist, 6 ohms. 1¼ in. Knob with pointer. E132, each 78c

E133 Potentiometer $1.38
E135 Vernier Rheostat 1.18

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Our Special Socket. A wonderful value. Moulded entirely of Bakelite. Four binding post connection. E140, each 58c

Porcelain Base and Tube E144 Crosley for either panel or table mounting, 45c.

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Pencil mark type. Resistance may be varied exactly as needed. E160, each 24c.

GRID CONDENSER

E162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 19c
E163 Same as 162 but higher grade. Enclosed in metal case 39c

BAKELITE DIAL AND KNOB

Neat clean cut design. Clear plain engraved scale, with enameled white letters contrasting with polished black finish of dial. Fluted knob. E902 For 3/16 inch shaft. Each 79c; Dozen $7.20.

E903 For ¼ inch shaft. Each 69c; Dozen $7.20.

FIXED CONDENSERS

Moulded cases, nickeled binding posts.

E802 .005 Mfd. Each 59c.
E804 .01 Mfd. Each 79c.

RADIO FREQUENCY AMPLIFYING TRANSFORMER

This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loup aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any make of tube. Wave ranges 150 to 550 meters. Wiring diagrams included.

E995 Each $4.50

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

We believe these transformers to be the best on the market. We offer them with two winding ratios—the 10 to 1 for Radiotrons and Cunninghams—the 3 to 1 for A. P. Moorehead. These two types of tubes have entirely different characteristics and therefore require transformers of different winding ratios. As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

E234 10 to 1 Mounted, each $3.95
E235 10 to 1 Unmounted, each .. 3.20
E236 3 to 1 Mounted, each 3.90
E237 3 to 1 Unmounted, each .. 3.10

VARIO-COUPLER

E415 Price completely assembled, $3.60
E416 Not Assembled but all parts complete, $1.40.
With this loose coupler and two variometers together with the necessary other parts a highly efficient tuning set can be made. Easily mounted on panel. Windings on formica tubes. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.

VARIOMETER

E410—Completely assembled, price $3.75
Perfect in design and construction. Accurate wood forms. Correct inductive ratios. Solid baked windings. Highest efficiency. Positive contacts. Will operate perfectly indefinitely. This variometer will equal in results most of the moulded variometers selling at much higher prices.
E411 Not assembled but all parts complete $1.90

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. E732 Each 98c

PANEL MOUNTING VARIABLE CONDENSER

Notice our very low prices on this high grade condenser for panel mounting. Mechanically perfect. Guaranteed to suit you or your money back. No knobs nor dials included.

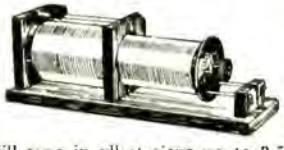
E812 43 plate .001 Mfd. $2.95
E813 21 plate .0005 Mfd. $2.55
E814 11 plate .00025 Mfd. $2.15
E815 3 plate Vernier 1.85

KNOCKED DOWN VARIABLE CONDENSERS

You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled.

E820 41 plate .001 Mfd $2.48
E821 21 plate .0005 Mfd 1.88

ARLINGTON RECEIVING TRANSFORMER



Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary, 12 point switch on secondary. Can be tuned very close. A wonderful value at our price.

E720 Price $6.95

TUNING COIL

Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length 8¾ in. E722, price **$2.45**

ANTENNA WIRE

Solid Bare Copper Wire size 14

E240 100 ft. coil 45c
E242 500 ft. coil $2.15

Solid Bare Copper Wire size 12

E244 100 ft. coil 72c
E246 500 ft. coil $2.85

Seven Strands No. 22 Copper Wire Cabeled

E248 100 ft. coil 94c
E249 500 ft. coil $4.25

HEAD SETS "PHONES"

Double sets complete with head bands connecting cord.

E751 Murdock No. 56, 2000 ohm., $4.85.
E752 Murdock No. 56, 3000 ohm., $5.80.
E756 Brandes Superior, 2000 ohm $7.60.
E758 Western Electric, 2200 ohm., $12.00.
E760 Barawik, 2000 ohm., $4.65.
E762 Barawik, 3000 ohm., $5.55.

SOLID GENUINE CONDENSITE CELERON PANELS

Notice our very low prices on this fine quality grade 10 genuine solid sheet Condensite Celeron (a product with mechanical chemical and electrical properties like formica and bakelite). Machines well without chipping. Won't warp. Waterproof. Highest mechanical and di-electric strength. Attractive natural polished. Black finish which can be sanded and oiled for extra fine work.

Panel Size	⅛" thick Art. No.	Price	3/16" thick Art. No.	Price	¼" thick Art. No.	Price
Inches						
6x7	E450	$0.50	E460	$0.75	E470	$0.98
6x10½	E451	.75	E461	1.18	E470	1.47
6x14	E452	1.05	E462	1.55	E472	2.05
7x18	E453	1.55	E463	2.30	E473	3.10
7x21	E457	1.78	E467	2.65	E477	3.60
9x14	E454	1.60	E464	2.30	E474	3.10
12x14	E455	2.10	E465	3.10	E475	4.15
12x21	E456	3.15	E466	4.65	E476	6.20

BINDING POSTS

Brass, polished nickel finish. Washer and 6/32" screw extending ⅝".

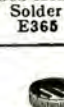
E370 Large size—barrel and knob ¾" long, dozen 95c
E372 Smaller size—barrel and knob 9/16" long, dozen 84c
E374 Large size with composition knob, dozen 60c
E376 Large size with hole for phone tip or wire, dozen 95c
E378 Small size with hole for phone tip or wire, dozen 48c

CABINETS

Fine looking cabinets, solidly built. Made of genuine solid mahoganed in elegant hand rubbed finish. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are Transportation paid.

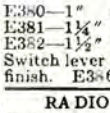
Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x7"	5½"	6½"	7"	E420	$2.48
6x10½"	5½"	10"	7"	E422	2.75
6x14"	5½"	13½"	7"	E424	3.30
7x18"	6½"	17½"	10"	E426	3.90
6x21"	5½"	20½"	7"	E425	3.90
9x14"	8½"	13½"	10"	E428	3.70
12x14"	11½"	13½"	10"	E430	4.40
12x21"	11½"	20½"	10"	E432	5.25

SWITCH CONTACT POINTS



Brass, polished nickel finish. All have ⅝" long size 6/32 screws. All prices the same.
Dozen 20c Hundred $1.40
Order by Article Number.
E360 Head, ¼"; Diam., ¼" High.
E362 Head, 3/16"; Diam., ⅛" High
E363 Head, 3/16"; Diam., 1/16" High
Solder Lugs to Fit Contact Points
E365 Dozen 12c—Hundred 60c

SWITCH LEVERS



Moulded composition knob. Exposed metal parts polished nickel finish. Wiping contact. Fitted with panel bushing, wire lug, spring and two set nuts. A high grade switch.

E380—1" Radius. Each ..... $.35
E381—1¼" Radius. Each ..... .35
E382—1½" Radius. Dozen 3.00
Switch lever stop. Brass, polished nickel finish. E386—Dozen 20c, hundred $1.40

RADIO JACKS AND PLUGS

Jacks are polished nickel finish. Mount on panels ⅛ to ⅜ in. thick. Extend back on panel only 2-7/16 in. Silver contact points.

Jacks Only
E390 Open circuit, each ... 48c
E391 Closed circuit, each .. 59c
E392 Two circuit, each 72c
E393 Single circuit filament control 80c
E394 Two circuit filament control 99c

E395 Plug. Large space with set screws for attaching cord. Each 85c

THE BARAWIK CO. 102 South Canal Street CHICAGO, ILL.

PITTSBURGH CONCERN EXHIBITS IN SAN FRANCISCO

THE Radio Electric Company of Pittsburgh, pioneers in the manufacture and distribution of radio apparatus, shipped a wonderful radio display to The Emporium, one of San Francisco's largest department stores, for exhibition in the Shriners' Radio Show. Coming over a distance of 3,500 miles, this concern displayed enough apparatus to start a small store, in addition to distributing thousands of pamphlets and circulars of different representative lines of radio equipment. They were represented by Mr. Higby, Purchasing Agent and Credit Manager, and Mr. Curley, Assistant Sales Manager, who were in charge of the company's booth at the show.

The general direction of this show, held in honor of the Shriners' convention, was in the hands of Mr. Charles S. Mauzy, of The Emporium. A very entertaining program was given daily, which consisted of motion pictures on the action of various radio phenomena, radiophone concerts, orchestra music, and fancy dancing.

Messrs. Higby and Curley will stop at various cities on the return journey, to meet their dealer patrons. It is estimated that they will be gone about ten weeks.

ARMY RADIO NET GROWS TO 51 STATIONS, INCLUDING PART OF ARLINGTON STATION

The Signal Corps radio message center in the Munitions Building at Washington now controls 51 separate radio stations throughout the country, connecting every corps area and numbers of small stations with the Army headquarters in this city. During the past few days, stations at Camp Custer, Michigan; Miller Field, Staten Island; Scott Field, Illinois; Rockwell Field, California; Camp Lewis, Washington: and Arlington, Virginia, have been added to the net of the Signal Corps.

CAN "CANNED MUSIC" WHEN BROADCASTING!

If broadcasting is to continue in its present state of popularity, the entertainment sent out by some stations must improve, an official of the Department of Commerce said. "Why is it," he asked, "that some broadcasters send out 'canned music,' particularly when the records are not very good and the transmission is poor?"

Today nearly every householder has a pronograph and a set of favorite records, but if he hasn't, he can hear "jazz" at almost any shoe-shining parlor. He doesn't want to listen to inferior records.

Except in communities where good talent for vocal or instrumental music is unavailable, there is no excuse for putting on phonograph records and cluttering up the ether, it is pointed out by radio officials.

The H. H. Eby Manufacturing Company, Philadelphia, have designed a new binding post similar to their Ensign and Junior posts which are already familiar to the trade.

This post, which they have named "Ace," has a nickel-plated brass base with solid 8-32 thread stem extending approximately ½ inch below the base. The base of the post is heavily knurled to prevent turning when mounted, and a hole is drilled through the neck sufficiently large to take a No. 15 bar wire.

This post is supplied with a black insulated knob ½ inch in diameter by approximately 7-16 inch high, and makes a very attractive post for use on certain apparatus.

An Open Letter to the Radio Jobber, Dealer, Expert and Amateur

Radio is fast outgrowing stirring articles on fanciful inventions. It has become a stable business institution which will total fully $50,000,000 this year.

The future of this industry, its welfare and growth must be safeguarded. Pirating and cut-price tactics, flooding the market with cheap, unsatisfactory apparatus is certainly bringing the gavel of discontent down on the heads of a growing throng of enthusiastic fans.

We in this industry must protect the cause we have labored to build up. To this end the Ray-Di-Co Organization pledges its support and stands "pat" as a pioneer radio institution.

We have held a sympathetic hopeful attitute during the early days of radio experimentation. We now appeal to the fair-minded judgment of practical business and professional men to aid us in rescuing this industry from exploiters of radio junk; rank fly-by-night up-starts, bootleggers and vulgar intruders who menace rather than promote a naturally promising industry.

This business has a perfectly just right to be here; a better right to grow, and in this field is legitimate room for new experiments and developments.

But there is no room for hold-up shysters who endeavor to pocket gilt-edge profits through misrepresentations, false claims and defective apparatus.

To the promotion of the cause through personal service, tested apparatus, stabilized list prices and fair profits, we as a corporate body pledge our united support. We are strongly organized to do our part to promote the cause we have labored to aid through its years of infancy.

Let the good words go forth—pull together—sit tight! Radio is now passing through a period of casual interest and enthusiasm. It will take its place as a dignified institution founded on conservative business principles because it is meeting a universal need. It is the cause to which I have personally pledged my support because I know its possibilities are unlimited

Ralph T. Drummond
President
MEMBER A. I. E. E. & I. R. E.

RAY-DI-CO ORGANIZATION, Inc.

Demonstration Rooms, Studio and Laboratory:
1215-17 Leland Ave., Chicago, Ill.

General Offices and Salesrooms:
1545 C North Wells St., Chicago, Ill.

★ ★ 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 THE SEPTEMBER ISSUE MUST REACH US BY AUGUST FIRST

RECEIVING APPARATUS

FOR RELIABLE BROADCAST RECEPTION buy a "Master Radio Broadcast Receiver." Write at once for complete circular. Master Engineering Company, Omaha, Nebr.

FOR SALE: Variable condensers: plates 4c, rotary washers 10c dozen, stationary 5c, shafts 25c, supporting rods 5c, tops and bottoms 25c pair, knobs 15c. Parts 23 plate $1.85; 43 $2.85. Assembled $1.00 extra. Tool and die work. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

MURDOCK PHONES. With each pair of No. 56 type Murdock Phones we will give as premium one Duhilier mica by pass condenser, suitable for either regenerative or crystal circuits. No. 56 Phones 2000 ohms $5.00 each. 3,000 ohms $6.00 each. Twelve hour service or your remittance returned. Postpaid and insured. The Kehler Radio Laboratories, Dept. R, Obilene, Kansas.

VARIABLE CONDENSERS. Buy them direct—save money. 23 plate, $2.25; 43 plate, $2.85. We pay the postage. Electrical Equipment Co., 113 N. Broad Street, Trenton, N. J.

FOR SALE—All new, New York Variable Condensers, 11 plates $2.40; 23 plates $2.90; 43 plates $3.65; Variometer $4.90; Variocoupler, $4.90; Amplifying Transformer $4.90; Switch Points per dozen 25c; Switch Stops per dozen 40c; large Rubber Binding Posts 9c; Metal Binding Posts 4c; Crystal Cups 9c; Mounted Radiocite 35c. Add postage. W. E. Roehl, 614½ Fannin, Houston, Texas.

FOR SALE—High grade regenerative receiving set, $30. Satisfaction guaranteed. Also have two-step amplifier. Harry Cook, Fairfield, Iowa.

MUST SELL—High grade regenerative receiver, $35. Also at a bargain a regenerative receiver with two-stage amplifier. Grebe C.R.9 type. Jay Tapp, 126 E. Anaheim St., Long Beach, Calif.

SPECIAL INTRODUCTORY OFFER—A Rapco Device with your Victrola or Sonora and a Baldwin Type C phone gives you a highly efficient loud speaker that duplicates the performance of the most expensive types. Invented by a prominent engineer, to sell at $2.50, the first 150 orders received will be filled at the special introductory price of $1.25. Money back if dissatisfied. V. S. McEntee, 2004 Times Bldg., New York.

FOR SALE—Vacuum tube receiving sets, $20. High grade material and workmanship. Receiving range equal to any. Prompt delivery. Central Mfg. Co., Fairfield, Iowa.

FOR SALE—Honeycomb receiver with 2-stage amplifier including bulbs and batteries and loud speaker, $130. A. E. Hall, 1623 Francisco St., Berkeley, Calif.

RADIO SPECIAL: Switch lever, knob, 12 contacts, 2 stops, 2 binding posts, $1.00; those excellent Eveready B Batteries all sizes, postpaid; a neat sturdy 23 plate variable, .0005, $3.75; moulded and nickel plated sockets, 90c and $1.00. Immediate delivery. Also a receiver-detector with 2 step $125.00 and a single circuit receiver-detector 1 step in same cabinet, $50. Pacific Radio Equipment Co., Box 27, Station "A", Berkeley, Calif.

KENNEDY EQUIPMENT—"The Universal Standard." Regular prices F. O. B. Reno. Westinghouse Regenerative Receivers; phones, Magnavox, V.TS., B batteries, etc. Also, Exide Storage Batteries—the one A battery that will outlive your set. Immediate deliveries or your money refunded. Satisfaction guaranteed. Send your order to B. W. Casselberry, 620 Plumas Street, Reno, Nevada.

FOR SALE—$40 takes regenerative receiver, complete with bulb, "B" battery and fones. This set has received principal broadcasting stations. Range 1,500 miles. Boex-Brazek, 514 Northern Ave., Green Bay, Wisconsin.

FOR SALE OR TRADE—$60 receiver, $40. Two variometers. R. W. Haynes, 1236 American, Long Beach, Calif.

A Few Cents Will Do It!

If you have any used or excess Radio Equipment on hand advertise it in these columns. If you want to buy used apparatus use these "RADIOADS."

A small investment may bring big satisfaction.

FIVE CENTS PER WORD

Get your "RADIOAD" for the next issue in the mail right now and turn that spare equipment into cash.

USE THESE LITTLE ADS—THEY BRING BIG RESULTS!

ARMSTRONG SUPER-REGENERATIVE CIRcuits—Wonderful results in R. F. amplification from only two tubes, instead of six or eight. These circuits will not work unless you know constants and all apparatus used. Complete tested diagrams, containing all hitherto unpublished constants and full instructions, for fifty cents. R. I. Co., Red Bank, New Jersey.

SITUATIONS WANTED

MANUFACTURERS AND DEALERS—Radio man with ten years experience as operator, manager of retail radio store and manufacturer, holding Comm'l 1st license, desires to connect with reliable concern. Will go anywhere. Address "H," 575 Gower St., Los Angeles, Calif.

TRANSMITTING APPARATUS

C. W. MEN—Double choke filter coils. Fully mounted on brass standard. Guaranteed A-No. 1. Closed core construction. Twin coils, $4 postpaid. Radio, 141 So. Commonwealth Ave., Los Angeles, Calif.

FOR SALE—½ K.W. spark set, worked 1,250 miles, $30. Lloyd West, 342 Main St., Riverside, Calif.

FOR SALE—½ K.W. type "R" Thordarson transformer, $15; Benwood gap 10 point aluminum case, $15; ⅛ H.P. 3450 R.P.M. Westinghouse induction motor, $15. All these almost new in first class shape. C. Schneider, 76 Caselli Ave., San Francisco.

MISCELLANEOUS

CABINETS. We manufacture all sizes, from any variety of wood desired. No lock-box corners. Only high grade tongue and groove or double tongue joints employed. Prices low. Prompt delivery guaranteed. Boxtoy Company, 2000 E. Vernon Ave., Los Angeles, Calif.—(2T-J&A)

AUDION RENEWALS—Tungsten filament Detectors renewed $3.00. Tungsten filament Amplifiers renewed $3.25. Tungsten filament 5 watt Transmitters renewed $5.00. We do not accept tubular Audiotrons, RAC-3 or other multibase tubes for renewal. W.E., V.T.1 with Oxide coated filaments renewed for $4.00. If in doubt write us, enclosing 2c stamp. Ten years experience, results guaranteed, safe delivery assured. TERMS, CASH WITH ORDER OR C. O. D., PLUS COLLECTION CHARGES. Trimount Laboratory, Milford, Mass. (Superseding all price lists prior to Aug. 1st, 1922.)

LIGHTNING—Wonderful new electrolyte charges discharged batteries instantly. Eliminates old Sulphuric Acid method entirely. World has waited half a century for this invention. One gallon retails $10.00, free to agents. Lightning Co., St. Paul, Minn.

RADIO BOOKS

"Arc Radio Manual," published by the engineers of the Federal Telegraph Company of San Francisco, and written in simple, interesting manner. Well illustrated with diagrams and photographs of the various types of arc radio apparatus used on shipboard and in shore stations. Price $2.50 per copy, postpaid in the U. S. For sale by Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

Build your own Radiophone. Instruction book ten cents. Radio Service Institute, No. 2000 14th Street, Washington, D. C. —3t

Send 10 cents for our new large 32 page catalog describing our course entitled "How to Learn Radio at Home." National Radio Institute, Dept. 1331, 1345 Penn. Ave. N. W., Washington, D. C.

Wanted!

Copies of the March, 1922, issue of "RADIO." We will send you "RADIO" for Three Months in return for copies of the March issue. If you are already a subscriber we will extend your subscription for three months.

MU-RAD BROADCASTING RECEIVERS

(Patents Pending)

TYPE MA-12

TYPE MA-12

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification and detector.
PRICE: With 2 telephone plugs, $128.00.

TYPE MA-13

SPECIFICATIONS

CABINET: Solid mahogany, varnished piano finish.
PANEL: Mirror polished black Radion.
DIALS: Non-warping, metal—prevent body capacity effects.
CONDENSER: 21 plate, permanent capacity.
MODIFIER: A circuit unit, dial operated from panel, for controlling signal strength and stabilizing circuits.
RHEOSTATS: Special sector wound, smooth operation, positive contact.
FILAMENT SWITCH: Special positive toggle knife-blade construction.
BINDING POSTS: Polished nickel, all in rear, plainly marked.
NAME PLATES: Extra deep reversed etched, black with satin silver high-lights.
WIRING: Tinned copper bus-wire, all interior metal white nickel finish.
CIRCUIT: Three stages radio frequency amplification, detector and two stages audio frequency amplification.
PRICE: With 2 telephone plugs, $160.00.

TYPE MA-13

THESE receivers have been produced with the deliberate idea of providing greater sensitiveness than has ever before been obtained in a commercially marketed radio receiver. Coupled with this is a beautiful sharpness, clarity and crispness of signal that is unfamiliar to users of the average highly sensitive receiver. Both sets are complete receivers, the only additional equipment required being vacuum tubes, batteries, telephone receivers and a small coil or loop to pick up the wave energy, or they may be used with an antenna if desired. A pick-up coil as small as 3 inches in diameter may be used for distances up to 200 miles from the average broadcasting station.

IN appearance these sets exemplify the art of the finest woodworkers, machinists and laboratorians. Their details of design and construction conform to the highest engineering standards. Complete instruction book is furnished with each set and each is tagged with our guarantee against defects. Bulletin No. 13 on request.

DEALERS: WRITE

MU-RAD LABORATORIES, Inc.

800 Fifth Avenue, Asbury Park, N. J.

Order Your Radio Apparatus By Radio Mail Service

Keep this issue of Radio—Order direct from this page as you need new apparatus. Write your name and address plainly giving article number and inclose money order or bank draft. Send currency by registered letter only. Postage is covered in prices listed. Send your order direct to our San Francisco office. We guarantee safe delivery. 48 hour service or your money back.

RICHMOND LOUD SPEAKER

R500—Swivel adjusting device on this loud speaker allows horn to be swung into any position—any phone can be used by simple adjustment of only one screw.

Price without phone $7.00

KING "AM-PLI-TONE"

R501—Has polished cast aluminum body with nickel plated base and horn. No sheet metal used. Double volume as two head phones are blended into one powerful tone.

Price $12.00

JEFFERSON AMPLIFYING TRANSFORMERS

R502—Is positively unequalled for audibility, amplifying power. Mounted in brass frames. Bakelite construction. Primary resistance approximately, 1800 ohms. Secondary resistance approximately, 8500 ohms.

Price $4.50

10c CHARGES STORAGE BATTERY AT HOME with F-F BATTERY BOOSTER

R503—Charges automatically and operates unattended—ammeter shows current flowing. Use with 105—125 volt A. C. current. Complete in Portable Automatic Charging unit. Bantam Type 6 charges 6 volt Battery at 6 amperes.

Price $15.00

GENERAL RADIO COMPANY AMPLIFYING TRANSFORMERS

R504—These highly sensitive transformers are in daily use in Government, Army, Navy and college and commercial laboratories as well as thousands of homes.

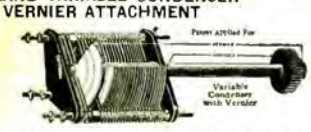
Price $5.00

SKINDERVIKEN TRANSMITTER BUTTON

R505—All you need with this ultra-sensitive microphone to install a complete detectophone in your home is a receiver, battery, and, if you wish, an induction coil.

Price $1.00

PEARLAND VARIABLE CONDENSER WITH VERNIER ATTACHMENT



Simple—efficient. Vernier attachment allows 20 times as fine adjustment as plain condensers.

R506—44 plate capacity approximately .001 Micro Farads.

Price $10.00

$507—22 plate capacity approximately .0005 Micro Farads.

Price $8.00

KLOSNER VERNIER RHEOSTAT

R508—With single knob for both rough and fine adjustments.

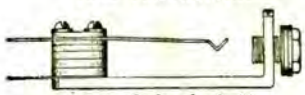
Price $1.50

FILAMENT RHEOSTAT FOR PANEL MOUNTING

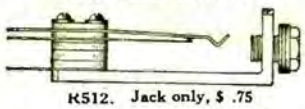
R509—All metal parts are nickeled. Smooth and noiseless in operation.

Price $1.00

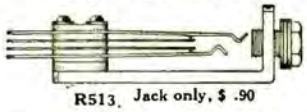
R510 Plug only, $1.00



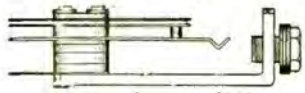
R511. Jack only, $ .65



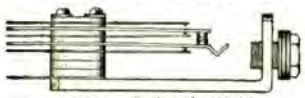
R512. Jack only, $ .75



R513. Jack only, $ .90



R514. Jack only, $1.00



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Same capacity as average 21-plate condenser.

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R530—Ball type. Diam. 2⅛", length 3¼". Mechanical strength 250 lbs. Weight ½ lb.

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R531—Strain type. Diam. 1½", length 10½". Mechanical strength 1000 lbs. Weight 1¼ lbs.

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The dial and knob are both of molded bakelite will not warp or discolor.

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A-P is one of the oldest trade terms in radio, universally recognized as symbolizing excellence, performance and quality. The A-P apparatus illustrated and described below is carefully constructed and tested to measure up to these standards fully. Designed particularly for receiving radio concerts and other broadcasted features, it enables any home to be radio equipped with dependable and attractive apparatus at moderate cost. It is simple to operate, so that splendid results should be secured from the start, even by a beginner. For further information write for A-P catalog, mentioning the name of your radio dealer if possible.

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Type AR-2 Receiver Detector and 2-stage Amplifier

Licensed under Armstrong U. S. Patent No. 1,113,149, October 6, 1914, for amateur and experimental use only.

TYPE AR-2 set combines in a single beautiful cabinet a Receiver, Detector, and two-stage Audio Frequency Amplifier. The famous Armstrong Regenerative Circuit is incorporated in the set in such way as to enable broadcasted features to be received loud and clear over long distances. The Audio Frequency Amplifier is designed to give maximum amplification without distortion, and enables the set to be used with a Magnavox or other loud speaker to secure large volume. In every detail this set is of typical A-P quality. Particularly noteworthy are the solid mahogany cabinet with a beautiful light walnut finish, and the genuine Bakelite Dilecto panel. Wavelength range 175 to 1600 meters. A neat, compact and efficient home set, quickly installed and easily operated. Blue print of circuit and instruction card with each set. Price $135, f. o. b. San Francisco.

Type DR-5 Radio Receiver and Detector

Licensed under Armstrong U. S. Patent No. 1,113,149, October 6, 1914, for amateur and experimental use only.

Type DR-5 is the same receiver incorporated in Type AR-2 combination set described at the left, but built in a beautiful mahogany cabinet by itself without the Audio Frequency Amplifier. Specifications provide highest grade parts throughout, insuring quality and performance. The Armstrong Regenerative Circuit is co-ordinated with the action of the set so efficiently that it oscillates and regenerates freely and easily over its entire range of 175 to 1600 meters. All inductances of special Pyramid windings. Circuit diagram and instruction card with each set. Price, $85, f. o. b. San Francisco.

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