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RADIO NEWS

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Over 100 Illustrations

Edited by H. GERNSBACK

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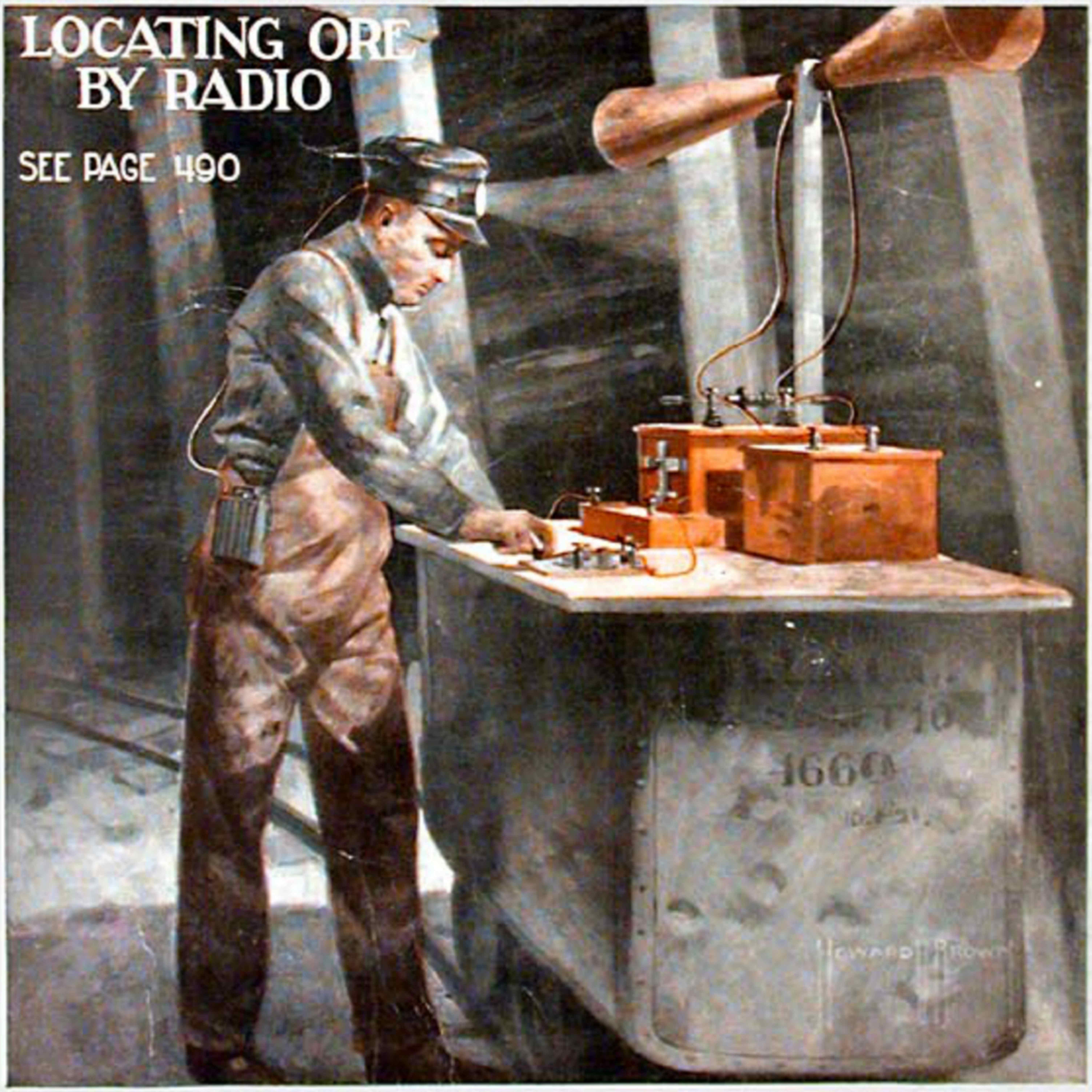

Dec'20

RADIO NEWS

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VOL. 2 FOR DECEMBER NO. 6

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CONNECTICUT RADIO

An Amateur Copies POZ With the Connecticut Variable Condenser

An amateur in Southeastern New York says in a recent letter:

> "I have purchased four of your CONNECTICUT Variable Condensers and it is possible to get better results with them than with the multiplate type of Variable.
>
> "I spent several weeks trying to get signals from the European stations. At first I was unsuccessful. I bought one CONNECTICUT condenser for trial. It tuned the radio signals so sharply (and better than other variables) that I bought three others. Much to my expectation they did remarkably well and I was soon copying POZ and other European stations without much difficulty.
>
> "Hereafter I will use CONNECTICUT Variables in all my circuits as they are actually cheaper in the long run and are far more efficient for radio receiving sets."

Your set will be a better one with the CONNECTICUT Condenser. The instrument is set at .001 mfds., adjustable either higher or lower.

There's a booklet with full information waiting for you. Send for your copy.

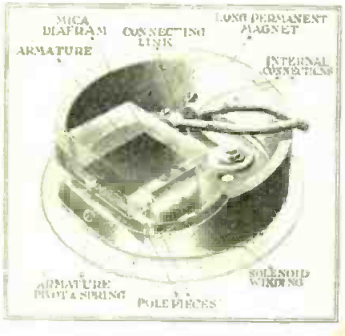
CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut

Now Dad-Hear the tenor

"I can listen in on all the radio concerts now, Dad. Those Baldwin phones you bought me for Christmas are corkers. Just listen to that famous tenor singing over the wireless telephone. Every note records just as clearly as though it were a phonographic reproduction right here in our own home."

Actually Baldy Phones reproduce in identically the same manner as do the high grade phonographs. Instead of a heavy iron diaphragm, as in most phones, a selected grade of mica is used. This is much more susceptible to distortion and as a result responds more readily to the thousands of overtones and harmonics of the human voice or any musical instrument.

Baldy's are the most sensitive phones in the world. This is attested to by the fact that the leading radio engineers, with every facility at their command for testing the audibility and sensitiveness of every make of phone, choose Baldwin for their personal use.



Study this X-Ray photo of a Baldwin ear-piece and you will see why they are world famed for their sensitiveness.

Our new booklet will give you some interesting facts about Baldwin Phones, in addition to prices. Ask your dealer for a copy. If he can not supply you write direct, giving his name and address.

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BALDY FOR LAND SEA AND IN THE AIR PHONES

AMRAD

The Recognized Symbol of Superior Performance

Our New Complete Receiving Equipment is Here

and must be seen and used to be appreciated. Ask your dealer to show it to you. It is the most compact, convenient and efficient apparatus ever offered—only 5″x5″x7″. Absolutely noiseless in operation, sensitive, reliable, scientific.

An Excellent Gift

How often have you marvelled at the mystery and wonder of "Wireless"? How often have you wished for a simple, reliable instrument complete that would bring the "magical messages of the air" right into your own home?

You need wish no longer. Produced by a nationally known manufacturer of commercial radio apparatus, the new Amrad Receiving Set admirably meets the wishes of those who have desired for so long to engage in wireless experimentation.

Hear the Voices in the Air

Near every large city there are now one or more powerful wireless telephone stations. Speech from anyone of these stations can be clearly heard with the Amrad Receiving Set a score or more miles away. Frequently, these stations give radio "concerts." By means of the Amrad Receiving Set you can easily hear these "concerts" with surprising clearness though you are miles distant and in the seclusion of your own room.

Radio telegraph messages, press reports, etc., from commercial stations and ships several hundred miles away, as well as the constant intercommunication of the amateur stations in your general vicinity can be heard any hour of the day.

Easy to Set Up and Operate

The Amrad Receiving Set is not a "mechanical toy." It is a high grade commercial product bearing the Amrad stamp of quality. Yet anyone who can use a few simple tools can within an hour erect his complete station and actually hear messages. Explanatory directions accompany each set. The operating is simplicity itself. Set the switch and detector adjustment and then turn the control knob until the desired messages are audible and "tuned" to maximum intensity.

The instrument is always ready for instant use. There are no batteries to charge or replace. The first cost is the last cost.

A Complete Unit in Our Established Policy of Standardized Design

Receiver $25.00, Telephone Head Set $3.00, Antenna Equipment $12.

Complete $40.00

Send for Descriptive Bulletin

Order from your nearest Amrad Dealer. His name was published in August Radio News.

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A Practical Receiver

By VOLNEY G. MATHISON

THE radio receiver illustrated herewith is one that I have recently designed and built with the idea in view of producing a strictly practical instrument, capable of covering all wave-lengths in use today, either dampt or CW. This receiver affords an example of what can be done through a judicious selection of materials and a careful assembling of the various units. The materials and finished pieces of apparatus were selected from among the products of seven manufacturers and while in two or three instances the exact article desired was not to be had, nevertheless a quite satisfactory result has been obtained.

As can be readily seen in the photographs, the receiver comprises a honeycomb-coil tuning system, a vacuum tube detector and a two-step amplifier. The hookup employed is of the standard, regenerative type, with one of the honeycomb-coils acting as a tickler in the detector plate-circuit. It is to be noted that no "master-switches" nor other switches of doubtful efficiency have been used in this instrument, nor have any pieces of apparatus been incorporated in it not actually necessary for best results.

The panel is 14 x 24 inches and is of ⅜ inch bakelite, making a roomy and rigid mounting for the various units. The tuning system needs but little explanation. The DeForest variometer-switch above the primary condenser on the lower left-hand side of the panel serves to switch the condenser either in shunt or series with the primary honeycomb-coil. The corresponding switch on the other side of the panel is wired to connect the detecting and amplifying system of the instrument either to the honeycomb-coil tuner of the receiver itself, or to the two binding-posts adjacent, permitting the use of an external tuner for short waves, if desired. The Connecticut pull-switch below the inductance-coil mounting is for shorting the tickler-coil and the binding-posts under it facilitate the connection of an external tickler, when using an outside tuner.

The two Corwin dials control grid and bridging condensers; above them are filament rheostats and A-battery switches. Two Federal amplifying transformers are mounted on the back of the panel between the three telephone-jacks, which are of the same make. The amplifier plug connection is worthy of note. The plug is connected to two binding-posts on the upper right-hand side of the panel by a short piece of silk-covered cord, making it possible to use any desired pair of receivers without having to chop up the phone cord and attach a plug.

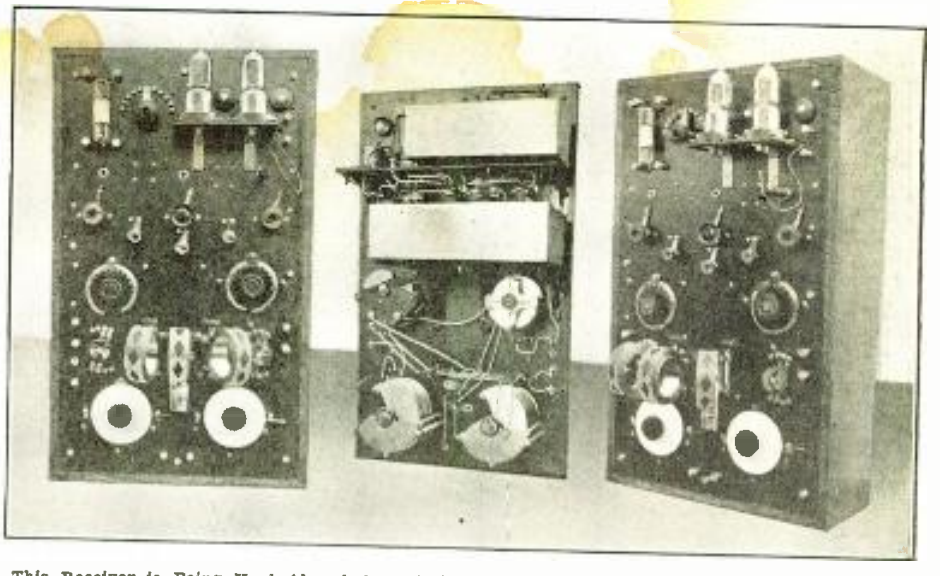
Probably the most interesting feature of this instrument is the manner in which the amplifier bulbs are mounted. Two regular V.T. sockets are screwed onto a small, bakelite shelf, which is attached to the front of the panel with two brass angle-pieces. This arrangement combines the advantage of having the bulbs supported in a vertical position, as is had with the usual back-mounting, together with the ready accessibility of the horizontal front sockets as are used in some instruments. The degree of filament incandescence may be readily observed, eliminating filament-ammeters and the mounting presents a very attractive appearance. The brass angle-pieces are 2½ by 2½ inches and similar ones may be found in most any hardware store. Those used on this receiver were nickeled in a plating shop, so as to match the other units on the panel.

Another practical feature of this receiver is the B-battery arrangement. Ordinary, round flashlight cells are assembled in a cardboard-lined, brass box, and the container then filled with hot paraffine wax. The metal box is then placed on a warm stove and the wax brought to a boil, thoroly removing all air pockets from around the cells. This battery shows little deterioration with long standing and similar types built in the past have given fairly continuous service for as long as one year. Renewal is quite easy, the wax being simply melted out and the exhausted cells replaced by fresh ones. The brass boxes are mounted on bakelite shelves attached to the back of the panel with brass brackets. Separate B-batteries are used for the Audiotron detector and the VT-1 amplifier bulbs. The detector battery contains twenty cells and is adjustable in six steps by taps taken to the switch on the upper center of the panel. The amplifier battery is of 28 cells and is not adjustable.

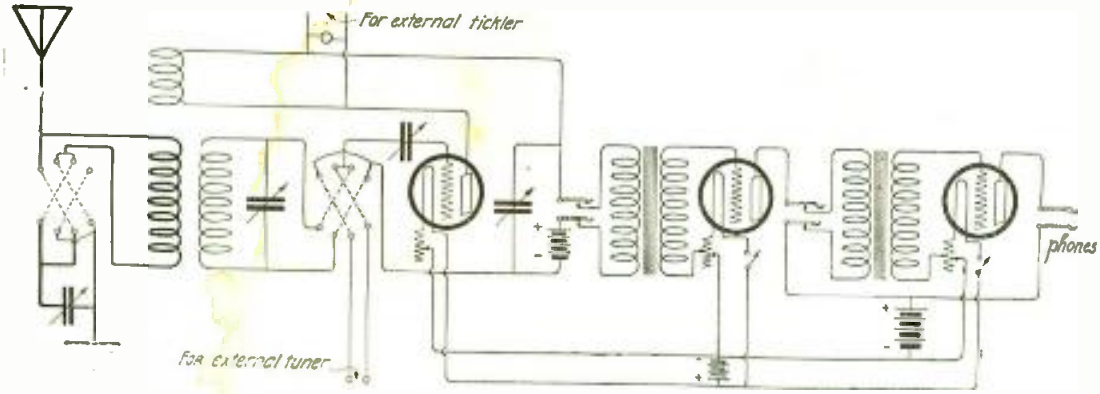
This receiver was first designed with a back-mounting for the amplifier bulbs and the sockets for this purpose may be noticed on the bakelite shelf supporting the detector B-battery. They are not connected into the circuit, however.

The primary and secondary condensers are both of .00115 M.F., the grid condenser is a balanced C.E. .008, and the bridging condenser a balanced Chelsea, .0012. Due to the large primary condenser used, together with the series-parallel switch in conjunction, only two primary honeycomb inductance coils are found necessary to cover a range of from 1,800 to 23,000 meters, one of about 40 milhenries and one of 125 milhenries (L-600 and L-1250). For the secondary circuit two coils of the same size and a third one of 11 milhenries (L-400) are sufficient to cover a corresponding range of wave-lengths. An L-600 coil is used in the tickler circuit for almost all waves.

Editor's Note: No doubt there are many other professional operators who have constructed effective receiver units. Why not let others hear about it? Such experiences should prove interesting to some of the stay-at-homes.



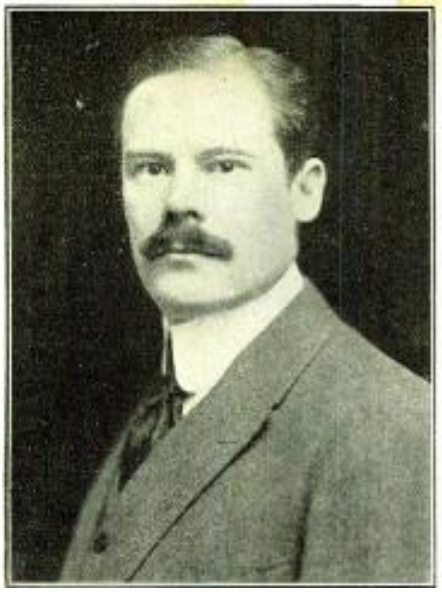
This Receiver is Being Used Aboard One of the Shipping Board Fleet for "Snailin' the Press," and, as May Be Imagined, the Ship's Complement Have Their Daily News Sheet Copied Direct From the U. S. A., With But Little Regard as to What Part of the World the Vessel May Happen to Be.



Schematic Circuit Diagram of the Hook-Up Used By Mr. Mathison in His Practical Sea-Going Receiver Which He Employs on Shipboard.

An International Radio Achievement

Mr. Alexanderson Presents a Paper to a Joint Body of Electrical and Radio Engineers of Striking and Far-Reaching Importance



Mr. Ernest F. W. Alexanderson, Who Developed the High-Frequency Alternator Making Practical Long Distance Transmission Possible.

THAT radio has been developed to that phase, where the central station is as necessary and essential as the central electric power station was pointed out by E. F. W. Alexanderson, chief engineer of the Radio Corporation of America and consulting engineer for the General Electric Company, in his paper read before members of the Radio Institute of America and the New York Electrical Society in joint meeting in New York City on November 10.

He brought out how New York is the natural communication center with Europe, South America and other parts of the world and how this geographic factor would be utilized in the building of the new high powered central radio station at Port Jefferson, Long Island. This station, to be the largest in the world, will be so constructed that the plant investment and operating force may be used to the best advantage at all times by shifting the equipment from one service to another or combining them when long distance radio is desired.

MR. ALEXANDERSON'S PAPER

Wireless achievements are often referred to as belonging in the realm of mystery and it is indeed wonderful that we are now able to speak with a voice that carries through empty space across the oceans. Whenever knowledge conquers a new force of nature for the use of humanity, it ceases to be a mystery but the pursuit of this knowledge makes an even greater appeal to the imagination.

The development of the steam engine was a triumph of the engineering art of the last century but it was not the engine itself but the steamship and the locomotive that interested humanity.

The telephone and cables no less than the steam engine have introduced a new era in human affairs. They have, to a degree, conquered space and time, but only with certain serious limitations.

An ocean cable runs only from one landing place to another and it can be cut in times of war; its use can be censored by its owners and controlled by military and naval power. When, on the other hand, you send a radio message it reaches *all parts* of the world. Depending upon whether it has been sent in code or in plain language, it may be a confidential private message or a press message intended for the world at large, but nobody can prevent the electromagnetic waves that carry the message from reaching their destination. It is thus not exaggeration to say that the emancipation of the human spirit that was begun by the invention of the printing press has found its fulfilment in Radio Communication. Radio makes the transmission of ideas from man to man and from nation to nation independent not only of any frail material carrier such as a wire, but above all it renders such communication independent of brute force that might be used to isolate one part of the world from another.

These are the ideal aims which inspire the engineers engaged in the development of the radio technique. This is also the explanation why some of the foremost lawyers, executives, financiers, officers and statesmen of this country have found incentive in the human aspects of the radio technique to devote a great deal of their time and thought to its promotion and development on a world wide scale.

The interest that is evidenced by all concerned in this subject has become much more serious since it has been establisht that the laws and forces with which we are dealing, are within the control of our knowledge, so that engineers can now proceed with the design of a radio communication system with the same deliberate accuracy as in the design of an electric power transmission from water fall to a railroad.

A LOGICAL DEVELOPMENT

This audience is constituted of members of a society of electric power and light engineers as well as members of the Institute of Radio Engineers; so I shall take the opportunity to trace the close connection which now exists between electric power engineering and modern radio engineering and will demonstrate as the specific subject of this paper, how the development of the Central Station for radio communication is as logical and inevitable as was the development of the central electric power station.

The entry of the Corporation with which I have been connected for the last twenty years upon the field of radio communication has been a gradual growth and a natural consequence of its general activities in power engineering. The engineers specializing in alternating current technique were in a natural position to take up the problem of designing the alternators and transformers needed in the radio technique. These differ from the one used in the power technique principally in the fact that the number of alternations per second is about one thousand times as great. This speeding up of the performance one thousand times involved many new problems but the most remarkable fact to record is that *the generally establisht principles of the alternating current power technique could be applied to the radio technique almost without change.* It meant that the magnetic properties of iron which had been reduced to an exact science by Steinmetz thirty years ago had to be studied again at *radio frequencies* but it was found the Steinmetz laws of hysteresis, eddy currents and skin effect were as accurate at two hundred thousand cycles per second as at twenty-five cycles.

It was furthermore found that the established conceptions of phase displacement power factor leading and lagging currents were as applicable and useful in the high frequency as in the lower frequency technique.

It is true that radically different methods had to be devised for measuring power factors of a fraction of one percent from the methods used for measuring power factor of 50 to 100 percent but the new methods of investigation verified the well known principles.

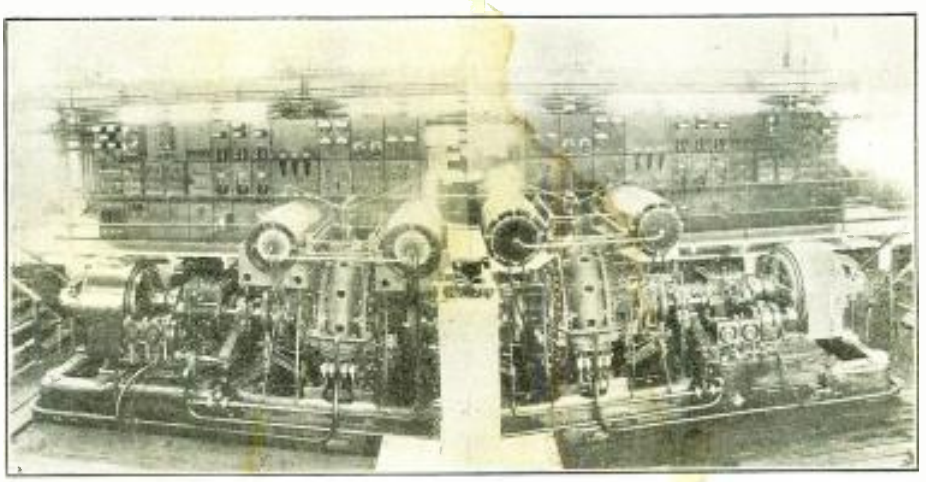
The starting point of this development work was the time when Fessenden brought out the problem of generating alternating currents for radio transmission. In doing so Fessenden realized that a practical solution of this problem could be worked out only by an organization of specialists.

SOME PROBLEMS OVERCOME

Some of the problems that presented themselves in the evolution of the radio power plant were:

1. The design of a dynamo-electric machine or alternator generating electric power in the form of alternating currents of frequencies one thousand times as great as those used for motors and lights.

2. The development of magnetic amplifying devices capable of translating tele-



Photograph of a Two-Unit Radio Station Employing Two 200 K.W. Alexanderson High Frequency Alternators.

phone and telegraph currents into corresponding modulations of the high frequency energy flowing from the power plant into the radiating antenna.

3. The development of a regulator so sensitive as to hold the speed of an ordinary induction motor constant within a few hundred of one percent, this being necessary in order to maintain the proper phase relations in a load circuit working at one-third of one percent power factor.

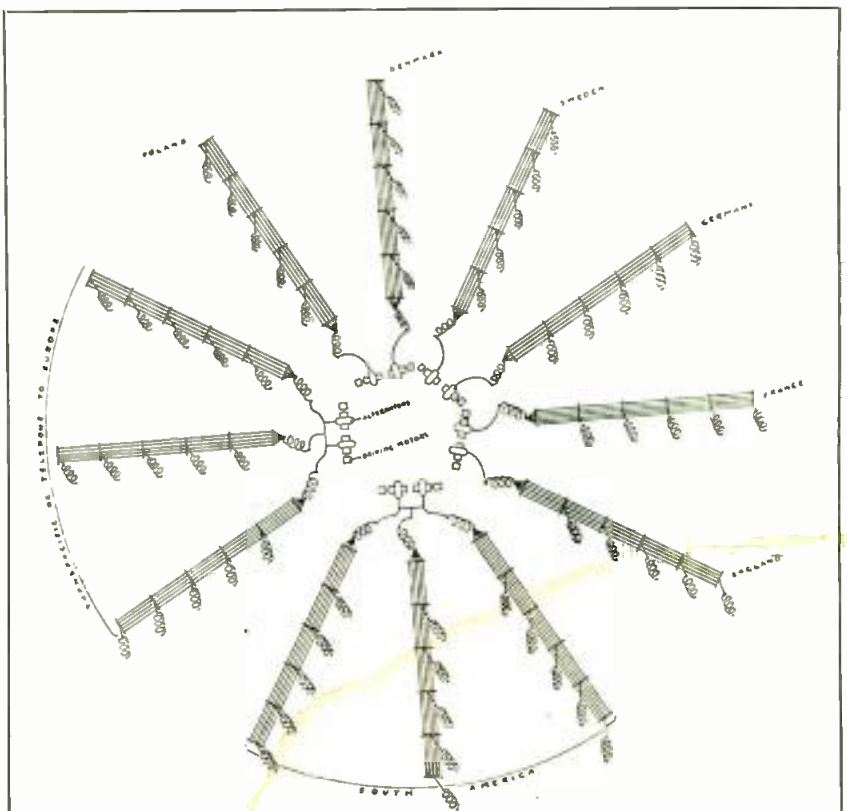
4. Improvement of the tuning of the antenna so as to transform as large a part as possible of the generated energy into electro-magnetic waves.

The realization of Fessenden's vision, the radio power plant of today, became thus the result of the combined effort of leading electrical and mechanical engineers. Among these, it is sufficient to mention W. L. R. Emmet the creator of the giant electric power stations of today.

The radio power plant which resulted from this was shown to Marconi during a visit to Schenectady, and because of his interest in its performance, it was transferred to the Marconi Radio Station in New Brunswick.

Here we had arrived at a point where two schools of engineering pursuing different aims with widely different modes of thought, had been brought before a common problem. The one had been thinking in terms of power factor kilowatts and phase displacement, the other in terms of wave length decrements and tuning.

A third school of knowledge was at that time brought into contact with this technique and added new impetus to it. As soon as such scientists as Coolidge and Langmuir began to study the remarkable little device invented by Lee DeForest and known as the audion, the foundation was laid for the vacuum tube technique which has so profoundly influenced the art of radio communication.



Schematic Arrangement of the Antennae Combination Which Will Be Installed at the Radio Central Station, Long Island, N. Y.

ELECTRICITY NO LONGER A MYSTERY

These scientists tell us that electricity is not the mysterious power fluid that we may have imagined flowing smoothly in our wires but miniature planets of comets of condensed material electricity of definite charge and mass shooting across a miniature universe inside of a glass bulb and following orbits that can be calculated as accurately as the orbits of the planets.

Keeping in mind the origin of the modern art of radio communication in these three widely separate realms of knowledge, power engineering and electro physics, we may now proceed to examine the essential parts. We find then,—first, a modern electric power plant working at high frequency; second, a network of wires a mile long, supported on tall masts; third, on the opposite side of the ocean a little glass bulb full of shooting stars. The question is: what does really happen?

Does the electricity generated by our alternator emanate from the antenna and flow in an undulating stream through the air or through the water or through both? If we search for it in an aeroplane, we find it, and if we submerse ourselves in a submarine and search for it, we find it, *and yet we are told it is not so.*

Does the little electron, as an individual, take a leap of the aerial wires and after devious paths find its home in the glass bulb on the other side of the ocean? *We are also told that it does not.*

If I knew what really does happen, and should I try to tell you, then sooner or later somebody would claim that I was altogether mistaken. Therefore, I will only try to tell you *how I imagine* that it happens, wondering if any of you will see the same mental picture of the process that I see.

We were once told by the physicists that all space was filled by a fine substance that was called ether, and that the light and heat that radiated from the sun was a wave motion in the ether. The physicists now tell us that there is no ether, but still they say that light is a wave motion. Be this as it may, for the purposes of visualizing what takes place in radio transmission, it is convenient to clung to the theory of the ether.

We are familiar with other forms of wave motion—the air waves that carry around to our ears and the water waves on the ocean. Thus the carrier of the radiated electric energy must not be likened to the flowing stream of water, or to the wind or to a bullet shot from a gun, but likened to a wave in a uniform medium where each particle of the medium oscillates around a stationary base line while the wave rolls forward.

The distance that a wave can travel before it fades out is proportional to its length. We may therefore introduce the idea of wave length, which is the distance from the crest of one wave to the next. The long swells of the ocean travel for hundreds of miles, whereas a pebble dropped on a still surface of water produces a ripple that fades away in a short distance.

In radio communication it has been observed that the distance over which reliable communication can be maintained is about 500 times the length of the ether wave that is used. It may be more than a coincidence that the distance to which a sound wave travels in air, and a wave on the surface of water will travel before it fades out is also about 500 wave lengths. The average wave length of sound of spoken words is about one foot, and we know that if we speak loud our voices will carry a distance of about 500 feet. The exceptions to this rule that will occur to anybody are also significant. We know what distances voices will carry over a lake in a quiet evening. We also know what extraordinary distances radio signals will carry sometimes on a quiet night. These are exceptions that prove the rule and the rule refers only to reliable communication under normal conditions.

HOW RADIO TRAVELS

A radio transmitting system is designed for the purpose of producing waves in the ether which we call electromagnetic waves, and for controlling the rate at which the waves are produced, in such a way that a train of successive waves will carry the meaning of articulate speech or telegraphic code. If we wish to send a message a long distance, we must select a long wave. The distance to Europe is 5000 kilometers. If this distance is to be bridged by 500 wave lengths, each wave length must be at least 10 kilometers (six miles) or as it is usually expressed a wave length of 10,000 meters.

We can produce water waves by rocking a boat. If we rock a canoe we get a short wave, but if we rock a larger boat we get a correspondingly longer wave. To rock the boat requires energy, but in order to produce a wave of suitable length, the energy must act through an intermediate member which has suitable size and proportions.

In radio transmission the energy is furnished by the high frequency power plant, but in order to transform this energy into waves there is required the intermediate member which makes contacts with a large volume of the medium which carries the *wave* motion. This medium is the ether and corresponds to the water or the air in the more familiar forms of wave motion. The member that transfers the energy to the ether is the antenna. The waves used for trans-Atlantic communication are as a matter of fact 10,000 meters or longer. The antenna corresponds to the hull of the rocking boat or the sounding board of the piano.

The analogy with water waves may be carried still further. The wave is a successive displacement of the medium and the initial displacement produced by the member acting upon the medium is proportioned to its volume. The water displacement of the boat corresponds to the effective volume of the antenna. The maximum voltage at which the antenna can be operated corresponds to the maxi-

(Continued on page 382)

The Audion—Its Action and Some Recent Applications

By LEE De FOREST, Ph. D., Sc. D.

Part 3

An historical paper of unusual interest to the Radio fraternity

POPULAR attention has been attracted to the success of the recently announced application to line wires of wireless methods of transmission, reception and tuning, whereby multiplex telegraphy and telephony have been made possible over wires already loaded down with their ordinary communication. The original ideas of such multiplex telephony date back to the early nineties, when John Stone, Hutin and Leblanc disclosed methods all involving the same principle, that several alternating currents of superaudio-frequency, each from a separate source, could be directed over the same wire or pair of wires, each be modulated or controlled by its own microphone, or Morse key, and at the receiving station each frequency taken off by its own properly tuned circuit, and there retransformed into its own original telephone or telegraph current. But none of these early investigators utilized at that time the all-necessary integrating detector which was alone capable of retransforming the modulated high-frequency wave-trains back into the original audio-frequency currents. Here again the wire telephone requirements had to await the advent of a radio-detector.

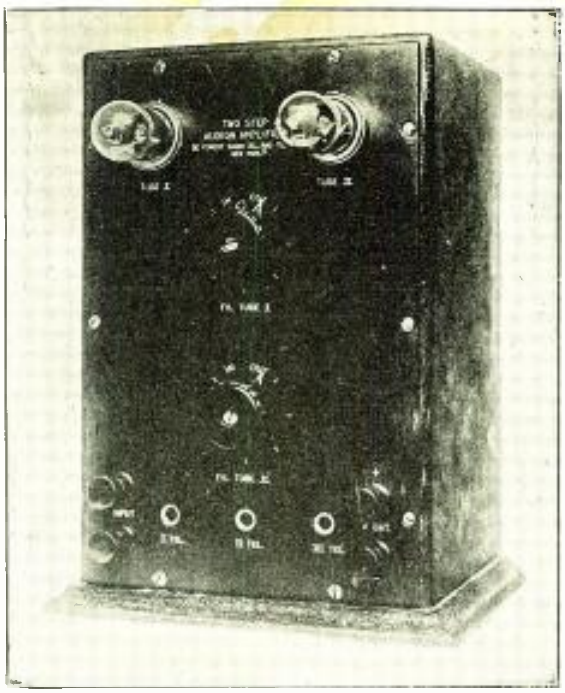


Fig. 20. A Typical Two-Stage Audion Amplifier.

WIRED WIRELESS

General (then Captain) George O. Squier in 1910 carried out certain experiments which are destined to become classic as the new art of wired-wireless attains the important commercial proportions to which it is unquestionably destined. He, for the first time, used a constant, reliable source of undampt electric currents of high frequency for the transmitter, and an audion detector between each tuned receiving circuit and its telephone receiver. By this combination multiplex telephony became at once a realized fact.

But so long as a high-frequency alternator was required at each transmitter station the wired-wireless idea could not become commercialized. Its first cost, the size and weight of it with its motor, its delicacy of speed regulation, its limitation to relatively low frequencies, all made this impossible. So again an important development was compelled to await the advent of the oscillating audion.

Supplied from a common filament-lighting battery, a common "B" battery, or d. c. generator, any desired number of tiny alternating current generators, each driving its own easily tuned circuit, can now be assembled in a small central station. The grid of each oscillator is voice-controlled from its local telephone circuit, and as many high-frequency "carrier" wave-trains superimposed upon a single trunk line pair, as it may be feasible to use without interferences between the modulated frequencies of the several conversations.

At present carrier frequencies ranging from 5,000 to 25,000 have been used commercially over a single pair of telephone wires, between Baltimore and Pittsburgh. A zone of frequencies of 2,500 is allotted to each conversation, which permits of eight simultaneous telephone conversations over the line, in addition to the usual "physical circuit" conversations. The constant frequency generated by each individual oscillion lies in the middle of each allotted zone of wave-frequencies, but the modulation of this "carrier wave" by the voice currents results in a wide band of frequencies (analogous to a spectrum band) on each side of the particular carrier-wave frequency. This means that at the receiving station it is preferable to employ, instead of a circuit attuned to the single frequency of the carrier-wave, a "band-filter," or combination of several tuning elements (inductance and capacity). This band-filter, then, is equally receptive to any wave-frequency lying within the prescribed limits, say 1,250 cycles on each side of the carrier-frequency, but offers very high impedance to all frequencies above or below the limits of the band-frequencies. By eight such band-filter receiving circuits the eight conversations are segregated, each delivered to its own proper audion detector and sent out on its own local telephone line.

But it is by no means necessary to limit wired-wireless to the use of such low frequencies as we have been considering. Certain tests were recently carried out in Canada which proved conclusively that frequencies as high as 500,000 per second can be used over telephone lines, including several miles of cable, without harmful attenuation. This demonstration widens very greatly the range of frequencies available for wired-wireless, with hope for a corresponding increase in the number of conversations, or telegraph communications, which can be placed upon a single pair of wires, or group of pairs. Moreover, with such high frequencies (say from 100,000 to 300,000 per second) the necessity for complicated band-filter receiving circuits vanishes, with obvious attendant advantages.

THE FUTURE

Wired-wireless is the youngest of the large family of methods for electrical communication of intelligence. He is indeed a bold prophet who will today attempt to foretell the limits of its application. That the great saving in line costs, the vast multiplication of available channels of long-distance communication which it makes possible will

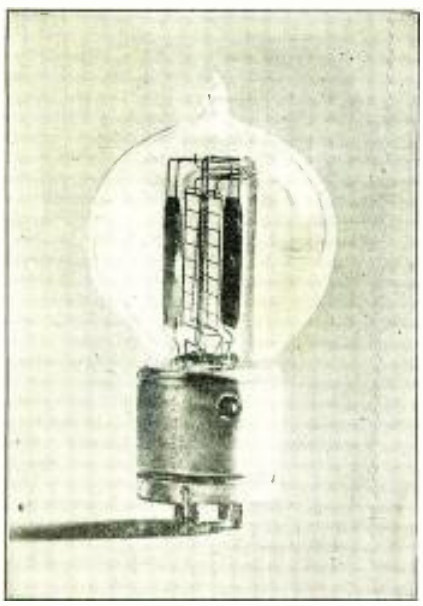


Fig. 22. A Western Electric Double-Grid, Double-Plate Vacuum Tube Used for Detection and Amplification.

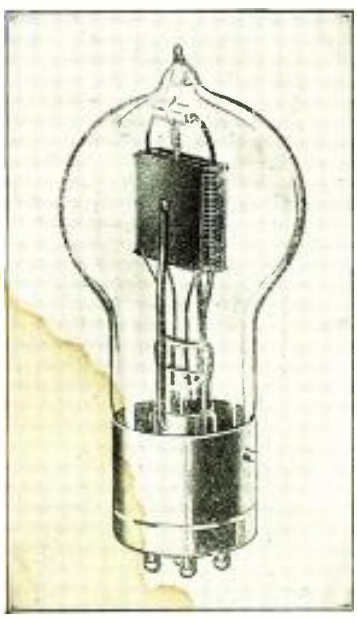


Fig. 21. A 50 Watt Vacuum Tube Used in Present Day Power Work as Met in Radio Communication.

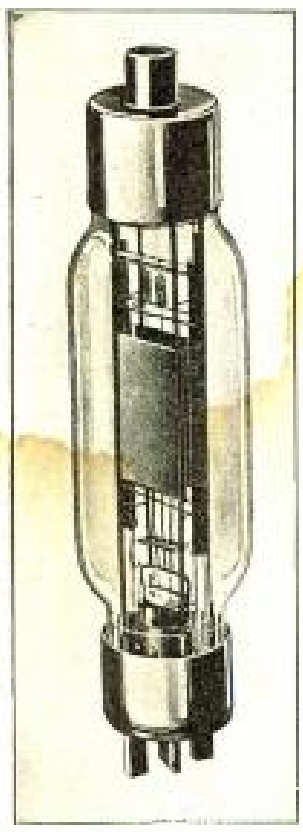


Fig. 23 a 1 K.W. Oscillion Which Has Proved a Powerful Maker of Oscillations

work profound changes in our present methods of business, cannot be questioned. Thus again it seems evident that the audion is destined to play a leading rôle in the work of knitting more closely the people of this land, and of all lands.

We have briefly recounted some of the main achievements which the three-electrode audion, or triode, has to its credit. Let us now consider some of the possibilities of its future. From its invention until 1912 it attracted an almost negligible interest in the scientific world. A year after the audion was first brought to the attention of the engineers of the American Telegraph and Telephone Company that corporation acquired exclusive license under all the audion patents for wire telephone purposes. Thereupon the research men of that organization initiated an elaborate line of investigation of the device, which about that time began to interest other scientists in America and abroad. Prior to 1914 not a dozen articles on the audion had appeared in scientific publications. Today it is impossible to pick up a magazine devoted to physics or electric communication without finding one or several papers dealing with some of what Dr. Eccles styles "the protean properties of the ubiquitous three electrode tube."

Writing in the *Radio Review* Dr. Eccles (who is affiliated with the British Marconi Co.) says: "The most important single instrument in modern wireless practice is the three-electrode thermionic vacuum valve, for it enters into every main division of the subject—it plays a dominant part in the generation of oscillations, the detection of signals, and in the amplification of feeble voltages and currents. Its arrival and development have, besides, helped greatly toward the success of apparatus and methods that might otherwise have remained almost failures."

DR. ECCLES QUOTED

Dr. Eccles has outlined the present status and forecast of the future of the audion so clearly that I am constrained to quote further his words, as those of an unbiased observer: "During the war, hints reached the civilian that a revolution was taking place in wireless telegraphy, the principal agent in which was reported to be an instrument called a 'valve,' a 'lamp,' or a 'tube.' This instrument seemed to have arisen suddenly into a predominant position among all the apparatus of the wireless experimenter and operator, and appeared to be of use in every corner of his outfit. The complete name of the instrument is the three-electrode thermionic vacuum tube. It must be emphasized that it is the three-electrode valve, and not the valve with two electrodes, that has been responsible for the overthrowing of the old methods and apparatus. That it has been a veritable revolution can be seen by comparing the common practice in wireless telegraphy of 1914 with that of 1919. In 1914 practically all the most powerful transmitting stations in the world generated waves by sparks and signals which were received at nearly all stations by means of crystal or magnetic detectors. The spark method of generating waves involved the use of very large antennæ for spanning great distances; and at the receiving stations which wisht to listen to stations more than even 100 miles away very large aerial structures were customary. But if we look at the state of affairs today we find most of the high-power stations for long-distance transmission are 'continuous wave' stations; that is, they produce uniform uninterrupted waves instead of a series of short gushes made by sparks; while at the receiving end new modes of detecting these continuous waves appropriate to, and taking advantage of, their uniformity in character have been introduced. This is where the three-electrode tube, in various adaptations, enters the arena. Taken together, the improvements at both ends of the span have made possible the use of smaller antennæ at transmitting stations, and have almost removed the necessity for any antenna at all at receiving stations. For example, under reasonable weather conditions, it is quite easy to listen to the messages coming from stations on the other side of the Atlantic by using a receiving circuit of which the receptive element is a small coil of wire, three to four feet square. Thus, so far as receiving goes, it is possible to intercept all the great stations on one-half of the globe by means of apparatus contained wholly in one room, or even in a cupboard. In accomplishing this the magnifications in use amount to several hundred thousandfold. All this is the work of a thing which looks like an ordinary electric light bulb with a few extra pieces of metal in it—the three-electrode tube."

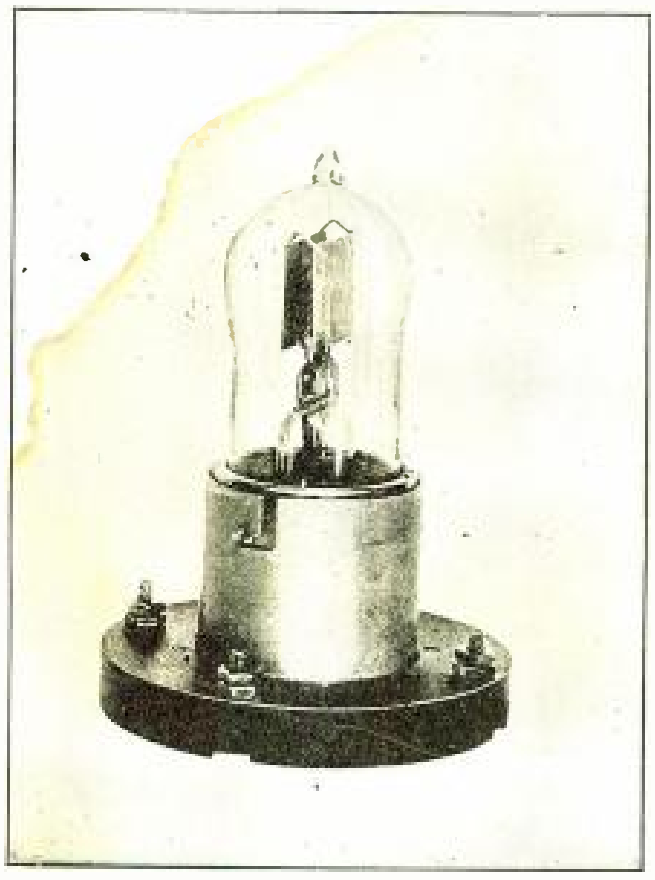


Fig. 24. A So-Called V.T.-21 and its Socket, a Tube Which Has Been Much Used by the U. S. Signal Corps.

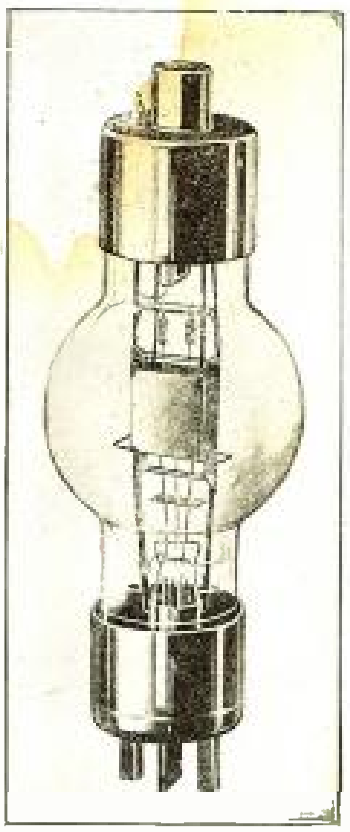


Fig. 25 a Smaller Power Tube of the ¼ K.W. Oscillion Type

Years ago what physicist did not look at the simple, self-contained, noiseless incandescent lamp, consider it as an ideal source of electro-magnetic waves of a wide spectrum—of heat, visible, and ultra-violet radiation, and wonder why it should not be made to generate also waves of any length? Today that incandescent lamp, with the addition of a metal plate and wire grid, has become such a generator. Undampt Hertzien radiations of a few centimeters wavelength can be generated by audions specially designed to give minimum capacity between the three electrodes and their lead-in wires. From these short waves, representing alternating current frequencies of some hundreds of millions, down to those of one or two per second, the electric-wave spectrum afforded by the oscillating audion is continuous. Consider this fact in connection with the almost infinite sensitivity of the device as a detector, and its unlimited power as a magnifier, or amplifier, and one realizes something of the value of the three-electrode vacuum tube to the physicist and the inventor. To the former, however, the keenest interest lies perhaps in the audion itself, because there is no known piece of electrical apparatus linked so directly with the most recent work on the structure of matter. A prominent British physicist has recently remarked: "It is probable that there is no other sphere where research work has had such a combination of immediate practical value and intense theoretical interest."

Many an early experiment in telegraph transmission or reception by wire or wireless, long since abandoned as too limited in range, can today be revived to the great benefit of man. Calculations have shown that with a littoral cable stretched for fifty miles on each side of the Atlantic, and carrying some forty amperes of 20-cycle alternating cur-

(Continued on page 386)

THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures publisht will be paid for at the rate of $2.00.

PAUL G. WATSON STATION

This Month's Prize Winner

Paul Wins the Five Berries Because He Seems to Have a Well Planned Transmitter as Well as Receiver.

This photograph is that of my amateur set, which I enter in your amateur station contest. The picture you publisht in a recent edition of your paper was the arrangement ot my staton until just a few weeks ago when the new apparatus was installed. The receiving set consists of a DeForest audion, home-made "honeycomb" coil receiver, and home-made amplifier. A "feed back" or tickler circuit is used, for arc, giving fine results. The amplifier as was mentioned above, is home-made, but was designed after a standard amplifier and works very effectively.

The transmitter is about the same as the first time my station was published, Murdock condensers, transformer, etc.

The antenna switch is home-made, I received several leters from amateurs in reference to my hearing stations on the European continent. At the present time, since installing the new set, BZR, BZQ, YN, NAT, NBA, NPL, VAL, NPZ, WSO, NDD and NSS come in fine, on long sustained waves and on spark have heard XDA, Mexico City, sending Spanish press.

I have found most amateur trouble with Honeycomb coils to be in their not tuning accurately, and as arcs are very sharp, it is necessary to tune very sharply.

As a suggestion a tuning record could be made, giving the size of the primary, secondary and tickler coils, the dial indication of the two condensers, and to give the positions of the coils three lines drawn at the angles, approximately the same as the coils, would be of great help in finding different statons and wevelengths. Let's hear from someone who thinks as I do.

PAUL G. WATSON,
214 W. Barnard St., West Chester, Pa.

FRED MAHAFFEY, JR., STATION

Fellows, what do you think of these two flashlights of my radio "studio" 5JI. It will be readily seen that one of these is a little out of the ordinary. Can you tell how this came about? At the time this photograph was made, I was making the signal — . . . My spark gap Rotor was making, I should judge, about 3,000 R.P.M. with six teeth. I'm sending you the "freak" negative so that you may see that it has not been tampered with.

The photo shows that I am in the act of transmitting as may be noted from the flash of my spark. At the same time there seems to be emanating a series of dots and dashes from the confines of the sparking. This is no fake picture for the negative has not been retouched nor was the print touched up in any way. This incident opens up a little guess work on the part of other readers as to just how this stunt was accomplisht. Let our Editor have your guesses.

My set consists of an Audion Detector and 2 stage amplifier of the Grebe Mfg., ½ kw. Thordarson transformer, Dubillier condenser, Murdock Oscillation transformer and Rotor. My aerial is 64' long, 45' high, and is composed of five No. 14 solid copper wires. My age is 13, and I attend the Y. M. C. A. Radio School. Am also a member of the Houston Radio Club and a very enthusiastic Boy Scout. Would be glad to hear from anyone to whom I can be of service. Or I should be glad to have anyone call me when they hear "5JI."

FRED MAHAFFEY, JR.,
14 Fifth St., Houston Texas.

This Bird Claims the Camera Caught the Dots and Dashes as They Departed His Transmitter. How Come?

(Editor's Note: Fred is telling the truth We have examined both the negative and the print with a magnifying glass and can absolutely not detect any so-called trick photography. But how was it done? Let's hear from you.)

Frontal View of F. M., Jr., Inventor of the New Way of Photographing Signals. He Admits the Methusalean Age of 13 Summers.

THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

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ESSEX COUNTY RADIO ASSOCIATION

The Beverly branch of the Essex County Radio Association met at the Y. M. C. A. recently where headquarters have been provided. President Estey was present and presented the club with their certificate of affiliation from the American Radio League Association. Definite plans were made for the installation of wireless equipment. The branch can accommodate twenty-five members at present and is open for membership to any male person interested in radio.

UNION COLLEGE (SCHENECTADY, N. Y.) RADIO CLUB

The Radio Club of Union College in addition to being of interest to those students who know something of wireless, is attempting to be of benefit to those who as yet know nothing of the work but who wish to learn. The club has had several lectures on wireless and is planning more. At the present time wireless code classes have been formed to meet every afternoon at 4.30 o'clock. —*Radio Club, Union College, Schenectady, N. Y.*

BOSTON TECH RADIO SOCIETY

Novelty in advertising is the slogan of the Tech Radio Society, which has adopted the scheme of furnishing correct time by wireless to students as a means of increasing its membership. An amplifier has been connected with the society's receiving set and placed in the student dining hall at Walker Memorial, so that when the Government time signal is picked up it may be heard throughout the building. The signals start at 12.55 and consist of dots every second for five minutes except the 29th and 55th to 59th, which are skipped. At 10 seconds before 1.00 o'clock the dots cease and on the stroke of one a long dash is given.

The society's officers are H. P. Field, president; H. M. Lane, vice-president; F. D. Webster, secretary; W. C. Kohl, treasurer; standing committee, H. L. R. Kurth, R. H. Shaw, C. A. Clarke and Ansley Newman.

NOLA (NEW ORLEANS, LA.) RADIO CLUB

December opened the season for the Nola Radio Club with a program combining entertainment and instruction at the club headquarters in Chartres Street. Officers of the organization are G. A. De Cortin, president; Theo Deiler, vice-president; J. Preis, secretary and treasurer.—*Nola Radio Club, Chartres Street, New Orleans, La.*

SENECA (GENEVA, N. Y.) RADIO ASSN.

The Seneca Radio Association, which was organized last fall, is about to re-commence its regular meetings. The faculty announces that the election of officers occurs in the near future, if not at the first meeting. One of the features which is planned for the winter activities is a membership drive for the purpose of boosting the club.

Many of the club mmebers are affiliated with the American Radio Relay League, messages will be transmitted, day or night, free of charge. The messages are relayed from one station to another until their destination is reached. Messages therefore can be sent to practically any point in the United States.

The purpose of the association is to develop interest in amateur wireless and to have a point at which to center and discuss the results of the various experiments which are daily being performed.

Any person interested in the development of wireless telegraphy or telephony are cordialy invited to attend the first meeting which promises to be very entertaining. They will then have the opportunity of becoming a member if they do so desire.

Due to the illness of the president the date of the opening meeting has not heen definitely settled. It will be announced in the near future.

ELECTRIC CITY (SCRANTON, PA.) RADIO CLUB

Meetings of the Electric City Radio Club, an organization of local radio experimenters, will be held during the winter on Friday evenings at the Scranton Real Estate Building, 316 North Washington Avenue.

Persons desiring information about the club should communicate with the secretary, P. D. McFarland, 802 Woodlawn Avenue.

Y. M. C. A. RADIO CLASS NEWPORT (R. I.)

Boys' Work Secretary Hobson has arranged to start a wireless class among the boys at the Young Men's Christian Association, having secured the services of Gilson B. Willets, radio operator for the New England Navigation Company, to organize and direct such a club. Boys and young men throughout the city interested in wireless are invited to telephone or call at the Association building, so that a meeting of amateurs may be called early next week for the purpose of organization. Mr. Willets has a thorough knowledge of his subject and is able to instruct others.

CLARK COLLEGE (WORCESTER, MASS.) RADIO CLUB

Clark College will greet Kalamazoo College in Michigan within two weeks by radio, providing the plans of the two colleges do not go astray for the radio clubs at both institutions have agreed to communicate by radio. The Clark club had its first meeting of the year yesterday afternoon and chose A. L. Parks as president. The radio set is being set up.

THE SENN RADIO CLUB

The Senn Radio Club was organized by a body of students March 17th, 1920, at the Nicholas Senn High School, of Chicago, Ill.

At the first meeting officers were elected and a faculty adviser obtained, making the club an official organization of the school.

The purpose of the Senn Radio Club is to promote good fellowship to gain a better knowledge of radio apparatus and to promote greater cooperation among amateurs.

The meetings are held on the second and fourth Wednesdays of each school month. They are conducted by the president.

The usual business is followed by a program. This program is usually a talk by some student. Some discussion follows on radio science, after the formal adjournment of the meeting. Those wishing code practice remain. Communication with other clubs is desired. Stanley E. Fey, president, 5800 Glenwood Ave., Chicago, Ill.

MORRIS COUNTY (N. J.) RADIO CLUB

A meeting was held recently at the home of Merritt E. Gregory on Pine Sreet, Morristown, N. J., at which the Morris County Radio Club was organized. M. E. Gregory was elected President, R. M. Lacey, Secretary, and M. W. Kilso, Treasurer.

The principal purpose of this Club is to better the condition of amateur radio in this vicinity and to act as a reliable link in a direct line of communication between cities. It is felt that with an efficient organization of this character relay messages can be more promptly handled. It is proposed to have at least one member stand watch at an official station of the Club every evening so that stations in other towns may be assured of a good route through this vicinity.

Another purpose of the Club is to co-operate with members in solving their individual radio problems, also to gather together for the benefit of the members such bits of news and knowledge as is of interest to the radio amateur.

At the meetings which for the present are held at the homes of members, it is expected to have from time to time speakers of note, or other features of peculiar interest.

Those desiring membership should apply to the Secretary, R. M Lacey, 11 Mills Street, Morristown, who will furnish blanks and explain necessary qualifications for admission.

A radio broadcast concerning the Club's activities will be sent out each evening at 7.30 sharp (Eastern Standard time) from onc of the Club's official stations which at present are 3 LY and 3 abg.

STATEN ISLAND RADIO CLUB

The radio amateurs of Staten Island have formed a radio club under the name of the Staten Island Radio Club. This club started October 1, and has a membership of ten. It also has a code practice, and a club set which have given very good results. We are working on a wireless telephone at present which will be completed in the near future. Officers have been elected as follows: President, Geo. Gropp; Vice-president, H. Hitchcock; Secretary, R. Stromberg; Treasurer, C. Barnes. Meetings are held every Thurdsay evening. The club has been organized for the purpose of getting acquainted with the amateurs of Staten Island and giving them a better knowledge of the art. All other clubs may communicate with George Gropp, 24 Osgood Ave., Stapleton, Staten Island, N. Y.

THE PHILADELPHIA AMATEUR RADIO ASSOCIATION

Two meetings in November, 1920, were held by the Philadelphia Amateur Radio Association, the first on Friday, November 5th and the other on Monday, November 15th.

On Friday, November 5th, two papers were read. The first paper dealt with the construction and maintenance of storage batteries and was read by Mr. J. R. Cushman, of the Columbia Storage Battery Co. This paper was illustrated by lantern slides.

The other paper dealt with Regenerative Receivers, with notes on regenerative reception. This was read by Mr. J. W. Wyncoop. These papers were very interesting and instructive.

The second meeting, Monday, November 15th, was a sociable evening. All amateurs were invited. Various types of wireless apparatus were exhibited. There were discussions on interesting radio subjects and experiences with circuits of various kinds and unique hook-ups. New members were received. Visitors were welcomed and radio associations were invited to send representatives who were asked to make themselves at home at the meetings. The general public was also invited.

The Third District Convention will be held in Philadelphia on February the 26th, 1921—holding over during Sunday. Banquet tickets, $2.00. Boom the Convention. Our business address is 1902 N. 11th Street, Philadelphia, Pa.

MT. STERLING RADIO ASSOCIATION

Long before the outbreak of the great World War, several of the boys in Mt. Sterling became interested in wireless. They decided to put up a set together, just why we wanted to put it upon a co-operative basis is not definitely known, but the main reason was that not one of us knew any too much about the matter and though: that this would be a good way to shift some of the responsibility for the success of it.

That was before the war. The war came. So did the Government's orders to dismantle. We did. Just as soon as the war ended we again got the radio "bug" as strong as ever in our systems. This time we decided to put up a real set. As soon as possible our stuff was unpacked, and set up. We found that our apparatus had grown sadly out of date since we last had the privilege of using it. So the crystal gave way to the audion and now the three stage amplifier

A standard 1-k.w. Thordarson transformer was purchased and the rest of the transmitting set brought up to date. We have our aerial strung from the city's water tower directly leading to our operating room.

Our call is 9-AHS and we would be glad to test with other amateurs close to our station. We have four of the numbers licensed as operators and thus have a man practically all the time.

A word to Radio Clubs about our organization would probably help them. Keep your membership down to say eight or ten or to where you can logically do good work. When there is a great number in on a set there is sure to be just a little indifference on the part of some. This causes an unrest that is not good for study or experimenting. Our plan is to assess each member a fee that will entirely cover the expenses for the following month. It is then the duty of the secretary to collect the dues and pay the bills. When any new apparatus is desired, the question is brought up before the association and it is voted upon. If passed, the secretary then proceeds to order it, and the cost is shared up among the members.

We have experimented with practically every make of bulb, we have tested many couplers using bank wound coils and others, and would say in closing that we all enjoy Radio News and *Science and Invention*. Mount Sterling Radio Association, Mt. Sterling, Ill.

UNIVERSITY HIGH SCHOOL RADIO CLUB

The University High School Radio Club was organized at the heginning of this semester at the University High School, Oakland, Calif., and held its first meeting in the Science Rooms of the School, on Sept. 21, 1920. The following officers were elected:

President, R. E. Calhoun, 6FZ; secretary, Horace Greer, 6TI; radio engineer and chief operator, Chas. Wilson, 6LF.

The Faculty advisor is Mr. McCay, of the science department of the school.

The membership has been limited to 20, thus affording each member a fine chance to study

(*Continued on page* 394)

RADIO DIGEST

CONDENSER ANTENNAE.

Experiments have recently been made at the Bureau of Standards upon a speical type of antenna for transmission and reception of radio signals. The antenna consists of a pair of metal plates. It is thus similar to the ordinary antenna arrangement, the wires of the ordinary antenna corresponding to one plate of the condenser antenna and the ground below the wires corresponding to the other plate of the condenser antenna. When the lower plate of the condenser antenna is on the ground, the two types are practically identical. It is found, however, that raising the lower plate from the ground improves the signals. This type of antenna has the advantage that it is not subject to disturbances and irregularities produced by objects on the ground.

The work done included the construction of various forms of condenser antenna and measurement of the capacity and other electrical properties. This type of antenna was compared with coil antenna which are used as direction finders. For the very short wave lengths, such as are used in radio communication by amateurs, the condenser antenna gave more intense signals than the coil antenna of the same general dimensions. Compared with the ordinary antenna with which a ground connection is used, the condenser antenna is markedly free from electrical disturbances.

MODERN THEORY AND PRACTICE IN RADIO COMMUNICATION.

By Robinson and Holland.

A need having arisen for the instruction of Midshipmen in Radio, beyond that previously provided, the authors have undertaken the production of a text suitable for that purpose.

Their endeavor has been to provide a book containing all the information necessary for the student who does not intend to specialize on radio, and at the same time to produce a book which will serve as a basis for further study for the student who does wish to specialize. The book is not intended, however, for an instruction manual for a radio operator who has little interest in the how and why of his apparatus.

Requirements of time and space have made it necessary to take for granted various statements which would be derived mathematically, or explained in detail, in a text dealing purely with fundamentals. These omissions are of such a nature that they may profitably be studied only by a student specializing on radio subjects.

To understand the work as presented, the student should have a knowledge of elementary electricity and physics.

This volume is publisht by the United States Naval Institute, Annapolis. Md., and it is understood its price is $2.25 postpaid.

SUBMARINE RADIO.

The last annual report of the Bureau of Standards states that members of the Bureau's staff have developed very successful methods of communicating with submerged submarines by radio-telegraphy. With a single-turn coil or loop attached to the outside of the submarine, signals can be received as well when the vessel is submerged as when it is at the surface. It is also possible to transmit from a submerged submarine a distance of 12 miles. Thus it becomes possible for a ship and a submarine to exchange recognition signals. A coil aerial is a satisfactory direction finder when submerged and readily receives signals transmitted thousands of miles, just the same as when used in the air. The navy has equipped its larger submarines with this apparatus.—*Scientific American.*

NEW SYSTEM OF COMMERCIAL LICENSES ALMOST CERTAIN.

A conference held in Washington on November 12 under the chairmanship of Messrs. Alexander, Secretary of the Department of Commerce, and Chamberlain, Commissioner of Navigation, as well as representatives of the American Steamship Association, the three large Radio Service Companies, The United States Navy, the Radio Inspection service, and the United Radio Telegraphers' Association and Shipping Board. An interesting discussion concerning the value of changing the present system of licensing of radio men for a system where an operator's period of service would be a determining factor in the grade of license he receives. It was unanimously decided for the benefit of the entire service to adopt this arrangement under the combined proposals made by The United Radio Telegraphers' Association and the Shipping Board. The grade of ships upon which these licenses will be valid is a matter for Congress to decide and it is thought that because of more important matters, these laws will not be passed during the short session but will be left over to the regular session.

ROBISON'S MANUAL OF RADIO TELEGRAPHY AND TELEPHONY.

The Radio Manual presents, for the use of student operators and others, the elementary principles of the art of radio telegraphy and telephony, together with descriptions of apparatus commonly used. This volume is the fifth revision of the volume originally written by Lieutenant (now Rear Admiral) S. S. Robison, U. S. Navy, in 1907. Among those most prominent in assisting in the various revisions have been Dr. L. W. Austin, Mr. G. H. Clark, Mr. G. E. Hanscom, Mr. J. A. Fried. Mr. C. J. Pannill, Mr. W. S. Lemmon, Mr. A. Crossley, Mr. H. Pratt, Mr. R. A. Ballantine, and Lieutenant W. A. Eaton, U. S. Navy. The fourth and fifth revisions were made by Captain Tood and Commander Hooper.

The volume is exceptionally well adapted for instruction purposes, for it contains elementary data of great value to the student. A general review of facts relating to high frequency currents is given, and this is followed up by production, radiation, and detection of ether waves. Sending and receiving apparatus as well as continuous wave transmitters are described. The radio telephone, the radio compass ,and aircraft radio equipment are also considered. These being comparatively late editions to the radio art, they should prove timely and of considerable benefit.

This edition is publisht by the United States Naval Institute at Annapolis, Md., and the price of the book is $1.50 postpaid.

DETERMINING AUSTRALIAN LONGITUDES BY RADIO

According to the *Scientific American*, wireless signals are to be used in marking out the boundary between South and West Australia, defined by Imperial Act as the 129th degree of longitude east of Greenwich. It is proposed to determine the initial point on the line by utilizing longitude signals from a high-power radio station located at some point between Greenwich Observatory, in England, and Sydney Observatory, in Australia, the signals to be received simultaneously at these points. This undertaking will be the first step in a comprehensive scheme involving the redetermination of the whole longitudinal system of Australia. A committee has been appointed to carry out the work in Australia, comprising the Government astronomers of New South Wales, Victoria, West Australia and South Australia, the Commonwealth surveyor-general and the director of the Royal Australian Navy Radio Service. It has been ascertained that, under favorable conditions, signals from Lyons can be successfully received in Australia as well as at Greenwich, and signals from other stations more symmetrically situated are also being tested. The cooperation of the United States, as well as the British Government, has been invited.

AMATEUR TRANSATLANTIC TELEPHONY

The recent report received from a Scotch Radio Amateur in which he reported having heard the station of Mr. Hugh Robinson located at Keyport, New Jersey, on October the 6th, 1920, received considerable notice from the newspapers as well as the technical press of this country, and many are loath to believe that the feat was actually accomplisht.

However, the American amateur immediately wrote back to Mr. Benzie, asking for more complete details concerning just whom he had heard and at what time. Mr. Robinson has just received an answer which reads as follows:

Denmill Cottage,
Peterculter,
Aberdeenshire, Scotland.
November 11, 1920.

Dear Sir:

I have just received yours of October 25th, asking how I identified your station. It was as follows, as far as I can remember. My friend Mr. Miller and I were at our "dear" when we heard the carrier wave at a station and suspecting telephony, we tuned with the results that the tune "Roamin' in the Gloamin'" came in. You finisht by saying "2QR has been speaking," repeated three times. So I looked up the calls and found your name and address and wrote to you thinking you would be interested. I will send fuller details later. Hoping next week we'll hear you again.

Yours faithfully,
GEORGE W. G. BENZIE.

Altho this does not definitely settle the matter there would seem to be a strong possibility that the Scotchman actually heard the Keyport, N. J., station which is known as 2-QR.

This trans-Atlantic feat was certainly a most spectacular record for American amateur radio and there now remains but one thing to do and that is to repeat the performance in the very near future where members of interested societies as well as other official witnesses could actually hear for themselves that such long distance work is possible even with a comparatively small power amateur unit.

Raided By Radio

In Which a Master Scientist-Criminal Is Caught

By HERBERT WARREN DODGE

WITH a careful glance at the chess-board before him, Allen Crosby threw the antenna switch into the sending position. He smiled happily as he slowly sent the symbol "D—10" into the ether. This last move, the placing of his knight marked D to the square labeled 10, had effectively blocked his opponent's lone King and ended the much-talked of "Chess Tournament by Radio" with Crosby the local champion.

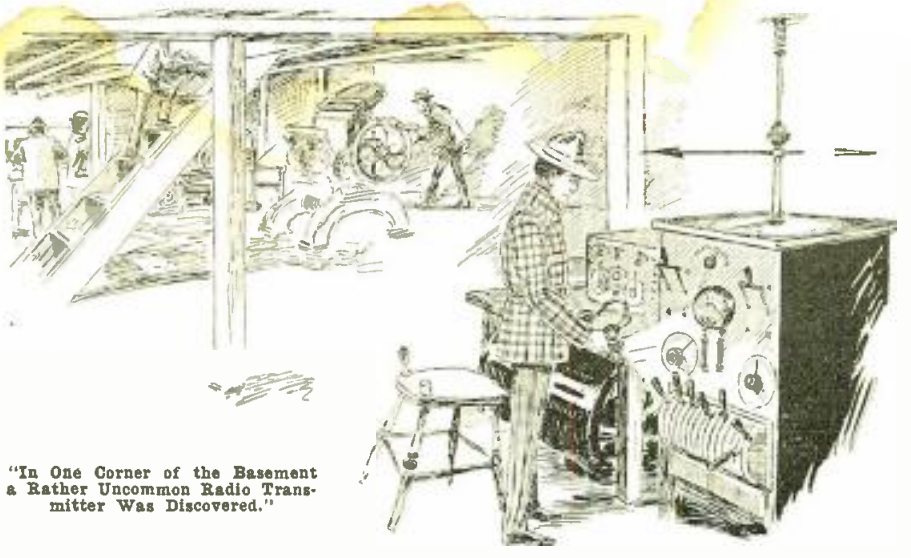
Truly the San Francisco amateurs had been "chess-mad" during the past month. The fad, begun by a local Radio Club, had become so popular that a prize was offered to the best player at the game. Crosby had taken an active interest in the rather unusual method of playing the ancient game, and this, the last night of the tournament, had found him the undisputed victor.

Acknowledging the congratulations he received from fellow-amateurs who had followed up the game, move by move,, with chess-boards before them, Crosby prepared to do some long-distance work, having several messages for the city of Seattle.

Increasing power, Crosby gave the Seattle station a long call and informed the operator that he had some messages for him. The called station responded immediately and in a short time the business was completed.

An amateur in Oakland then broke in and told Crosby that he was being called by Chicago, the operator in that city having an urgent message for San Francisco. Crosby, listening a moment, heard the feeble spark from the city in Illinois, but was undecided whether to answer or not. Would his signals reach Chicago? But certainly they must have been heard in that city otherwise the operator there would not be calling him. Emphatically it was a long jump from the city by the Golden Gate to the metropolis on Lake Michigan; Crosby's previous record being to the state of Wyoming.

Exultant, Crosby threw on the limit of his power and changed his rotary gap from the usual low tone to one of much higher speed, the latter being more suitable for distance work because of its clear-cut, musical note.



"In One Corner of the Basement a Rather Uncommon Radio Transmitter Was Discovered."

"9 ZSX, 9 ZSX," he sent unfalteringly and signed his own call, "get you o. k. Have you anything for me?"

"Yes," replied the operator in Chicago and thereupon sent Crosby a message to be delivered the next day. The man went on to say that Crosby's signals were loud and distinct except at times when he "faded" slightly and very little difficulty was encountered in copying him.

Crosby experienced the same fading out phenomena of the signals from Chicago but received every word the operator sent, and assured him that the message would be delivered early the next day and the answer would be transmitted in the evening.

. . . . .

"Good for you, Crosby, that was certainly a nice piece of long distance work you put over last night." It was the next evening and the president of the radio club was speaking. "You not only won the first prize in the Radio Chess Tournament, but you also established another distance record. As a member of this wireless organization, you are surely a progressive one and deserve to be congratulated," concluded President Terry as he handed Crosby the silver cup, the prize award of the Tournament.

"Thank you," mumbled Crosby, decidedly uneasy before the other members of the club as they gave him a rousing cheer.

Arriving home late that evening Crosby immediately called "9 ZSX." Due to local interference, however, it was some time before he came in direct communication with the Chicago station. With business-like celerity Crosby transmitted the answer to the message of the evening before and received the other operator's "o. k."

Crosby was not finisht for the evening, though, and gave one of the New York stations a call. Receiving no reply he tuned a trifle higher than the amateur wave and was surprised to hear a radio-telephone working. It proved to be a phone station in Pennsylvania conversing with a like station in Ohio. Both stations were fairly audible. When they had concluded their conversation Crosby called the one in the Quaker state.

"Hello, 6 XAD, how do you hear me out there?" came back the voice of the operator in Pennsylvania in reply and told Crosby briefly the type of apparatus he was using to transmit the voice.

Crosby replied and learned that he was loud at that station across the continent and they were only using two audion tubes to receive him! What a record achievement! Over 2,500 miles and on only one-half of a kilowatt! It seemed preposterous, yet it was a reality. He again sent out their call intending to ask them if they had any messages for San Francisco or vicinity but some local amateur with an extremely "broad" wave was "hamming" with another in Berkeley, causing too much interference to hear the far-away station.

"The Government should make stringent laws pertaining to radio communication after ten o'clock," thought Crosby, "and allow only long distance operators to work." Finally the troublesome amateur ceased and the radio phone station was called once more.

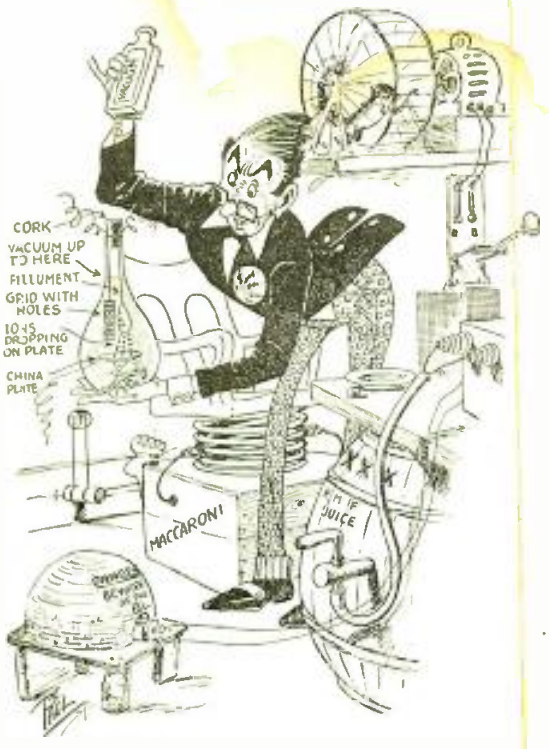
Upon throwing his switch into receiving Crosby was aware of a low rumble in his

(*Continued on page 413*)

"The Five Law-Breakers Stared Into the Muzzles of Six Wicked-Looking Automatics and Slowly Raised Their Arms."

Radio Bug-ology

One of the Craft Sends In a Letter.



"As I Experienced a Good Deal of Difficulty in Securing a Plate Small Enough to Go Into the Tube I Resorted to the Use of a Small China Saucer."

I HAVE been a wireless "ham" for several years now and consequently have had a good deal of experience It seems to me that if we old-timers would only tell each other about our stations, our experiences, and our little trials and triumphs it might do a good deal toward the advancement of the art in amateur circles.

(Echo answers. "It might—not.")

For this reason I am about to describe the more unique parts of my station and some of the little difficulties that I have overcome. In the first place, my aerial is of the well-known inverted "O" type, made of stranded doorbell wire. As the method of stranding is rather original I shall deal with it more fully. When I purchased the wire it was not stranded, but became stranded after I put it up To be more explicit, after I got it up the pulleys jammed and as yet I have been unable to get the darned thing down.

Nicely stranded, eh, what?

As for insulators, I at first used small pieces of brass rod, but finding them rather unsatisfactory, I later discarded them in favor of short sections of broom handle. Efficiency at any cost is my motto.

When I first took up wireless I experimented a good deal with crystal detectors, but am now using a vacuum tube of my own design. The following are some of the crystals I have used—galena, carborundum, radiocite, zincite, bornite, cerusite, hugmetite and settemalite, but I find my new bulb to give the best results.

This bulb, which is quite a departure from basic principles, consists of a small glass tube, open at one end, and carefully filled with vacuum. After the tube is filled the open end may be plugged up with a small cork to keep the dust out, but this is not absolutely necessary. The vacuum is the same kind as is used for vacuum cleaners and may be purchased in liquid or powder form at the nearest drug store. I have found the liquid vacuum to be rather unsatisfactory, as it has a tendency to *spill* over unless the cork is in tight. Due also to its damping effect upon the incoming waves it is rather poor for C. W. reception. By merely substituting a *good nerve tonic* for the vacuum the result will be an excellent transmitter bulb for tonic train transmission. But let us continue. As I experienced a good deal of difficulty in securing a *plate* small enough to go into the tube I resorted to using a small *china saucer*, which gave gratifying results. Whenever the bulb spilled over it spilled into the saucer, and thus nothing was lost.

As everyone knows, while the bulb is in operation, ions jump off the filament and gather on the plate, or rather saucer, which soon gets all cluttered up with them. When this happens the tube should be uncorked and the saucer taken out and washed in warro water. The other day an unusually large ion struck the saucer with such velocity that it broke it. Due to the high cost of china I have been careful to prevent a repetition of this accident. Taking last Saturday afternoon off I went out into the woods where I surrounded, and after a short struggle, captured a number of small, square holes. After carefully chloroforming these I spent all Saturday night binding them together with copper wire. The result was not unlike fine mosquito netting. I fastened this "grid," as I have christened it, around the filament, and now all the ions are strained, thus eliminating any which might be large enough to damage the saucer.

In closing I would like to add this piece of warning—don't use *honeycomb* coils with an audion. I did once and got stung. This is how it happened. Two weeks ago I bought a nice new *honeycomb* coil, all fresh and dripping with honey. As soon as I got it home every blessed bee swarmed out of my *"B"* battery and started to buzz around the coil. Now a "B" battery is no good if all the bees have left it so I started to put them back, and in doing so I got stung. Since then I have used duo-lateral coils and have had no further trouble with the bees. They sing nice *duos!*

Hoping this may be of assistance to those who contemplate building their own apparatus, I remain, undampt,

G. RIDLEAK, V.T.,
Chief Radio Eng., Toronto Lunatic Asylum.

The Spirit of Christmas

By ERALD A. SCHIVO

A MOMENTOUS problem confronted the members of the Q S A Radio Club.

Paul Knox, one of the fifty members which the association boasted of, was a very poor young man. The organization was aware of that fact. Knox would accept no charity. He was quite popular. They listened intently to all suggestions and motions he was wont to discuss

Insistent and distressing circumstances followed the wake of the young man. Both parents had died in an accident the day before his graduation from grammar school. He was left penniless. An aunt in moderate circumstances argued that Knox must continue high school. Only with the promise that he be allowed to pay all expenses incurred after he graduated, did the boy agree to finish with the upper school. He was now in his Junior year.

"Mr. Chairman."

"Mr. Clark."

"Fellow members," the young man who had asked for the floor was speaking; the chairman had inquired for new business; "this club is becoming more and more wealthy every meeting. We have a large sum in the treasury; more than we know what to do with. We have the most satisfactory set in this city. A radio telephone is about to be donated by a large company. So much for our wealth.

"There is a member of this club, he is not present tonight, who has accomplisht more for us than any other member. As chairman of the electrical committee all the interesting experiments which we had recently were due to him. He has worked for the club heart and soul. Need I mention the name of this member? No, you all know him."

A whispered name which was intelligible to everyone broke the silence. There was a slight stir as the members waited for the speaker to continue.

"Paul Knox!" the speaker now shouted the name. "Paul Knox is no doubt the only member we have who takes such great

(Continued on page 409)

"If I Only Had Such a Wonderful Set," He Sighed.

it in series with the ground lead, between the ammeter and the earth. This set when used in an open field gives good results with an inverted L single wire aerial about 80 feet long and 7 feet high. Since a directional effect is obtained by this type of low aerial it is advisable, if possible, to erect it in the direction of the receiving station in order to obtain the maximum intensity at the reception end.

Excellent results will be also secured if used with an amateur aerial having about 200 meters of natural wavelength. As will be noted the same A and B batteries are used for transmission and reception. Two switches make the necessary connections and automatically oad the filament and plates with 4 volts and 40 volts respectively when receiving and 6 volts and 160 volts when transmitting. The voltage of 160 volts can of course be changed and if a direct current dynamo delivering a higher voltage is used, the range will be greatly increased. On the other hand, if lower voltage, about 80 or 100 volts is applied to the plates, the range will correspondingly be reduced.

THE FILTER CIRCUIT

If a D.C. dynamo is used to supply the high voltage to the plates for transmission, a filter circuit must be used and connected in place of the "B" battery as shown in Fig. 3.

The filter circuit is made of two choke coils composed of an iron core ⅝" in diameter and 3½" long wound with two pounds of No. 26 double cotton covered wire, and shunted by two fixed condensers and 1 mfd. capacity each.

Using a B battery of 200 volts and a good ground connection made of a buried water pipe in a wet place, the antenna current was 0.3 amperes.

CONSTRUCTION

For the construction of the set itself, a bakelite or hard rubber panel 10" by 8½ and about ⅜" thick can be used as front panel, on which is fixed the ammeter which is of the hot wire type and graduated from zero to 1 ampere, the 0.0005 mfd. variable condenser, the filament resistance, and the 8 point switch of the loading coil and also the twelve binding posts.

Behind on a horizontal panel 10 x 6" are fixed the three tubes and change-over switch in the manner shown in Fig. 2 of the assembly drawing. Below and fixt on the bottom plate are the two audio frequency transformers, the 2 mfd. fixed condenser which is connected across the B battery, the grid leak of the audion detector and the coils placed at right angles. The two coils are wound on wooden rods 1¾" in diameter with No. 16 double cotton covered wire. The coil of the oscillating circuit is wound with 36 turns and a tap taken at the nineteenth turn. The loading coil wound with 42 turns is tapped every 6 turns.

The constructional details of the 8 poles change-over switch are clearly shown in Fig. 2. A hard rubber strip fixt to the 8 switches move them at the same time when pushed on either side by means of the handle which appears in the center hole of the front panel. Each switch is provided with three switch points. The center ones being dead points to cut out all connections and avoid short circuit of the batteries when switching over from reception to transmission position.

The question of the contacts of this change over switch being of great importance, we recommend the use of three blades fixt together as shown and sliding on the points. These blades are cut out in a brass plate 1/48 of an inch thick. The other parts of the switch can be made on a lathe by the amateur himself or to order at an inexpensive price.

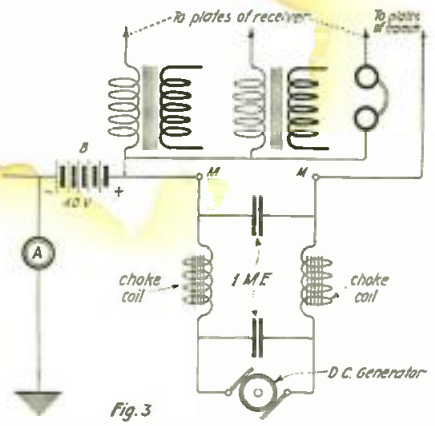


Fig. 3

Diagram of Connections When a D.C. Machine is Used Instead of a H.T. Battery for Transmitting.

In order to firmly fix the two panels and the bottom plate together, they are screwed in two pieces of wood maintaining the complete unit and allowing it to be used as a panel set or to be enclosed in a cabinet giving a neater appearance to this piece of apparatus.

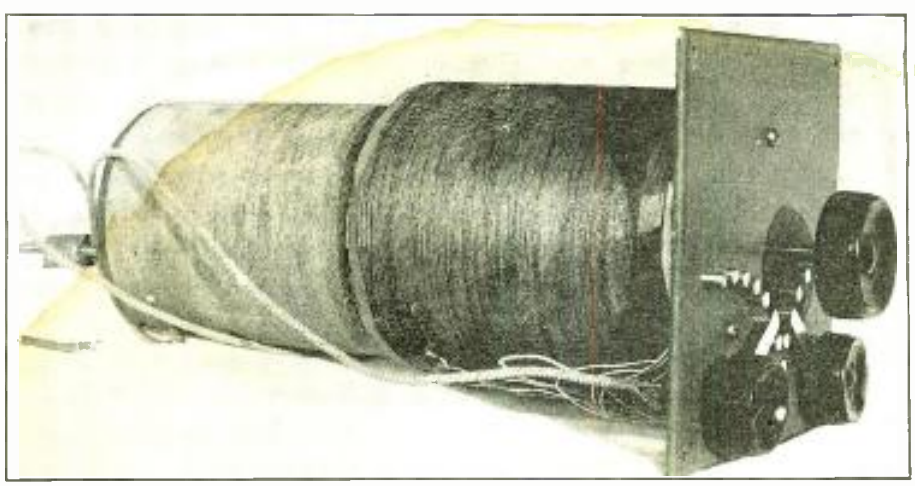
It is strongly recommended to make all wiring with No. 18 or 20 wire, the connections being straight. The set is very commercial like looking, and the contacts being soldered the resistance of the circuits is reduced to minimum; a very important factor in small power—c.w. sets. If two or more of these sets are built, the owners will be delighted with the results obtained with these portable apparatus.

A Short Wave Coupler

By GEO. MITCHELL

Here is a design for a short wave loose coupler which I do not think has been described in recent radio publications. A similar one is at present being used at my station and I find that it gives excellent results on wave-lengths up to and including 800 meters. The accompanying photograph will give other amateurs an idea of what the completed instrument looks like, and I should be pleased to have others consider this design in future panel sets.

This coupler may be mounted on a panel or cabinet as desired. The tubes are cardboard which may be procured from a grocer. The primary is about 3½" in diameter and 4" long. The secondary 3" or 3⅛" in diameter and 3½" long. This primary is wound with No. 24 S.C.C. wire tap every turn for the first twelve turns. Then tap every twelve turns for about ten taps. The secondary can be wound with No. 28 wire dividing it into about twelve taps. Solder all taps, also solder these taps to contracts. The primary is slightly longer than the secondary in order to allow for the wooden end of the primary. Turn or cut out of ¾" white wood one end for primary and two for secondary. The secondary slides inside of the primary on two 5/32" brass rods fastened into the wooden end of the primary. By placing a narrow piece of fibre across the other two ends this will hold the coil firm. This also allows the secondary to be pulled out or pushed in at the same time turning the knob. This secondary will be tuned and coupled with the same movement of hand. By placing three small wooden or fibre blocks between primary end and panel enough space is allowed for connecting taps to contacts. The two primary leads can be connected to the two primary switches and secondary leads to the binding posts on end of secondary.



A Clever Idea to Fix a Loose Coupler on a Small Unit Panel. Even in a Cabinet it Saves Space.

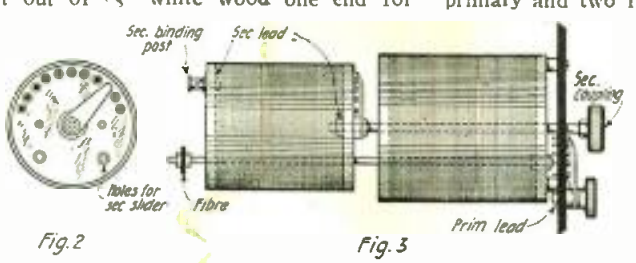


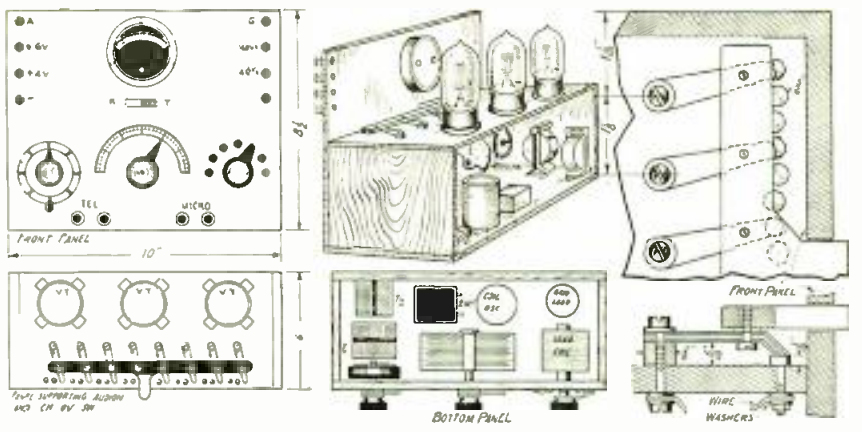
Fig. 2 Fig. 3 Fig. 1

This Shows How the Secondary Slides Inside the Primary and How the Same Knob is Used for Coupling and Varying Number of Turns.

THE RADIO CONSTRUCTOR

A Three Tube Combination Radiophone Transmitter and Receiver

By ROBERT E. LACAULT



Constructional Details of the General Change Over Switch, and Disposition of the Different Parts of the Set Inside the Cabinet.

THE great majority of the amateurs possessing only a few vacuum tubes, will no doubt be interested in this combination radiophone transmitter and receiver for short waves, using but three tubes.

In fact, owing to the price of V.T.'s many an amateur cannot afford the construction of a radiophone, for if tubes are bought, it is mostly for amplification purposes.

Many of our young "bugs" still use spark transmitters and do not realize that they waste a great quantity of power to obtain only a limited range, neither can they obtain such sharp tuning as obtained with C.W. telegraphy. Also the wonderful Radiophone experiments can be carried out and other innumerable experiments may be made with vacuum tubes.

For this reason we recommend to beginning amateurs that they read the books treating on the subject of audions, or the Junior Course publisht in this magazine and, understanding the functioning of the audion, they will take a greater interest in the branch of radio known as undampt wave telegraphy.

With only a small amount of power an American amateur has succeeded in sending music and speech across the Atlantic. This shows the possibility of undampt wave transmission.

In order to save space and money in the construction of a portable set, the writer conceived the idea of using the same audions for transmission as well as for reception and the results obtained in the French military service being most satisfactory, he brings to the readers of RADIO NEWS the data to build this short wave radiophone transmitter and receiver.

In the transmitter the three tubes are used as oscillators, and in the receiver one is used as a detector and the other two as a two-step audio-frequency amplifier. Almost all the parts for this apparatus can be found in a well equippt laboratory and the only things to make are the special change over switch and the two inductance coils. The construction of these parts does not present great difficulties and all amateurs having a little common practice with working tools may easily build this interesting piece of apparatus.

This set being very compact, may be used as a portable radiophone when placed in a trunk with a 6 volt 20 ampere storage battery and B Battery made of small flash-light cells; a range of ten miles has been easily obtained by the writer in experiments carried out in a field, using a low aerial.

THE SPECIAL-CHANGE OVER SWITCH

As will be noticed the new features in this set are the special change over switch which by a simple throw-over movement makes all the necessary connections, and the use of a simple oscillating circuit used for both transmission and reception. Of course, the three tubes being used for transmission, the use of three hard tubes is recommended, but any soft tube can be used as well, since only a small plate voltage is used.—The clearness of the speech will depend greatly upon the kind of microphone used. We found that a microphone filled with granulated carbon having consequently a greater number of points of contacts gave the best results.

The diagram in Fig. 1 shows that it is connected across a few turns of the grid circuit. The proper number of turns will be found experimentally in the following manner. The sending set being in working order, the microphone is first connected to about four turns of the grid coil as shown in the diagram. Then the filament current is turned on, and a watch or clock placed against the microphone.—Listening-in a receiver placed nearby, it is then easy to find the proper number of turns shunted by the microphone which gives the loudest reception of the beats of the clock or other faint noises made near the microphone.

If no good results are obtained in this manner, owing to the resistance of the microphone used, it is advisable to connect

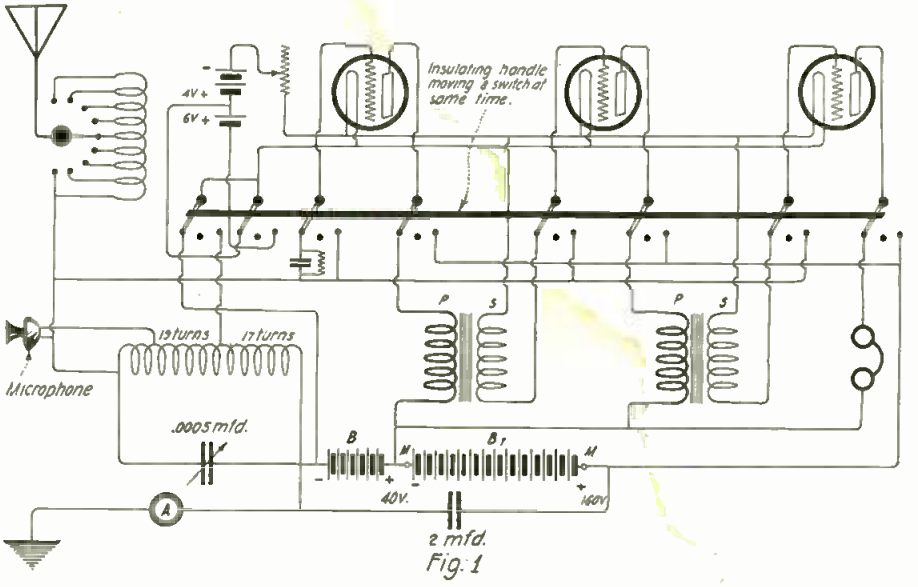


Fig. 1

Complete Diagram of a Combination Radio Phone Transmitter and Receiver: as Can Be Seen a Special Switch Makes All Necessary Connections.

Ideas—Seventh Spasm

AS I pondered tonight in the silences, fondling a triode with my thoughts meandering over the hills and valleys of man's variegated endeavors, there came sweeping across my mental horizon a flood of blinding light. In the wash of that flame there was born an idea that shall go roaring down the canons of time to reveal to all posterity the story of a full life. For there within that tiny tube of glass with its cute jiggers lay the secret of bigger and better lives, the spell to cast out all the demons of disease, the withal to reach the pinnacle of health, strength and beauty.

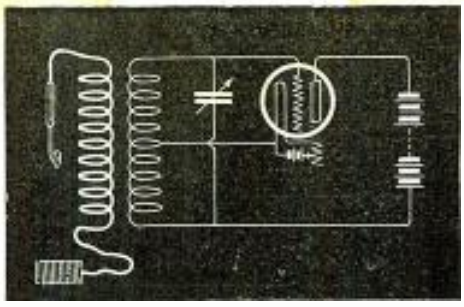
In the white heat of enthusiasm I grabbed paper and crayon to emblazon on the scrolls of immortality this wonderful idea. But in all honesty let me add to also bolster up the consumptive tendencies of a one-time healthy bank account.

Even my mind, trained and kept ready for breath-taking flights into the realm of wild imaginings cannot cover the wide field opened to the experimenter and investigator. All that is needed is a 'Tron tube and a regenerative receptor.

Far be it from me to cover in detail the chemical, physical and metaphysical effects of high frequency currents. Rather would I refer you to the thousands of advertisements gracing the back covers and inside pages of our many magazines.

The good, bad and indifferent sheets all do their share in spreading the propaganda for the good of humanity and the health of the world. There it will be found that Violetta, the dancing Ray, is ever ready to bestow on you a wave of her glowing wand and all things that mortals should inherit but too often don't. There you will see glowing health offered you, the strength and vim of high power vitality within your reach and the leadership and respect that goes with beauty, sparkling eyes and ruddy cheeks. The latter refers particularly to the female of the species, yet I have seen many of the stronger (?) sex who were not adverse to using fair means or foul to attain a similar end.

All these and more lie within the walls of the common 'Tron tube; you have but to harness these forces and turn them loose to reap the fortunes hereby sowed by my ingenuity. Ahem.



Ahem! Essentially This is a Radiophone Hook-Up, But Benson's New (!) Idea is to Use it to Cure Everything From a Toothache to a Stubborn Appendix.

Having seen that high frequency currents can accomplish many things, let us see how we can get them out of a 'Tron tube and into our ailing carcasses. Turn to any work on heterodyning and it will be noted that there are several ways of obtaining currents at frequencies exceeding a million cycles per second. There is the secret of getting the current which is more apparent than real—I mean the secret.

By taking the simplest circuit and removing unnecessary apparatus, we will have an arrangement similar to that shown in the illustration. The apparatus is essentially a radio 'phone transmitter. We ain't a'phoning just now so we connect an electrode to the aerial terminal and a metal plate to the ground terminal. By this means we can shoot the juice thru any convenient and willing sufferer to cure for all time their many ailments. Cut in all the voltage the tube will stand, a hundred honest-to-goodness volts will push a man size jolt from head to toes without trouble.

There you are, brother sufferers from freckles, automobile corns and chest contusions from high waisted coats. Get the apparatus swinging at about a million and a half cycles per second, stand on the ground plate and apply the electrode in a manner described in the instructions that can be obtained from the manufacturers of high frequency outfits. The whole thing is so simple it is a wonder it is not in common use even now.

Every radio operator could connect a switch into his set so the apparatus could be thrown from the aerial to a set of electrodes at any time. A shingle over the door offering their services as a *Radio Mechano-Therapist* would bring those shining dollars rolling in perhaps faster than they roll out these days of the H. C. of L. Provided, of course, the L. means living and not loving.

Don't get the impression because you are fairly healthy that you have no need for this device. Get one and try it on any and everything. No one to my knowledge has tried the effects of harmless high frequency currents on pearl-bearing oysters. Then again how about trying these currents for cooking purposes. Place a steak between the electrodes and shoot the stuff thru for awhile.

It would be a man immune to ridicule who would dare place a limit on the possibilities of this invention; yeah, I have hopes of curing my brain storms with something similar. So let's go, dear reader, perfect the idea and there shall be stamping of medals and engraving of names on the Rolls of Fame. Meanwhile, excuse me while I finish white-washing the cellar. Adieu.

(19th Asst. Ed. Note:—If there are any more like you in Philadelphia, Mr. Benson, we think something should be done by the Health Department to protect the lives of others from the scourge you seem to be suffering from.)

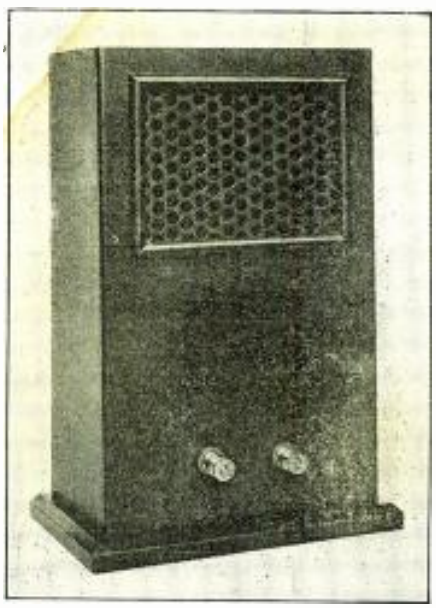
A Tone Amplifier*

The development of vacuum tube detectors and amplifiers has shown clearly that the days of the head receivers, so long associated with radio, are numbered. Makeshift horns designed for a variety of purposes have been installed in isolated cases for rendering signals audible about the station, but have not proven satisfactory either in point of appearance or efficiency.

It has remained for this concern to bring out the Amplifone, an instrument especially designed to meet the requirements of the radio station.

This instrument comprises an especially sensitive telephone receiver and an amplifying chamber or horn in which the sound waves given off by the receiver are amplified. The horn is so shaped that the sound is thrown out horizontally at approximately the height of the operator's head when he is seated at the operating table. The surprising thing about it is that while loud signals can, of course, be heard at great distances, even relatively faint signals are readable when the operator is seated near the instrument. Signals of medium strength are, of course, audible and readable anywhere in the operating room.

The Amplifone is really a necessity in the modern radio station equipt with vacuum tube amplifiers because the full advantages of these cannot be realized without it. For example, the distinguishability between various stations is increased by its use. When head receivers are worn clampt to the ears the signals come out of them in a confused sort of way. The Amplifone separates them in much the same manner as the phonograph separates the various instruments in an orchestral record. For this reason the readability of signals thru static or induction noises, which in some cases are not entirely preventable, is greatly increased, and at the same time the strain on the ears resulting from wearing head receivers from long periods is eliminated.

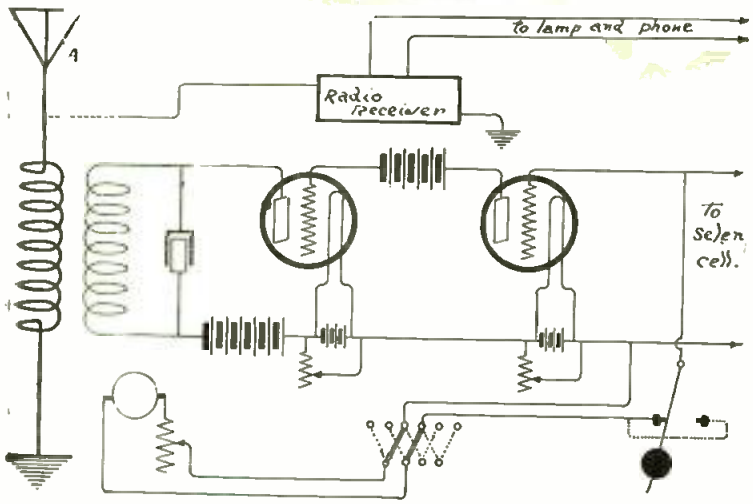


This Tone or Sound Amplifier Not Only Looks Business-Like But is a Distinct Improvement Over the Tiresome Head 'Phones.

*Photographs by Courtesy of F. M. Doolittle Co

A New Land Wire and Radio Transmitter of Photographs*

By UMBERTO BIANCHI



General Hook-Up of the Apparatus Which Can Be Used for the Transmission or Reception of Photographs.

Fig. 1

THE operation of this apparatus is based upon the photo-electric properties of the selenium cell. The superiority of this so-called "Teledeigraphio" system has been obtained by the following:

(a) The creation of an ultra sensitive selenium cell.

(b) The utilization of the marvelous electron relay, having no inertia and possest of a great amplifying power.

(c) The invention of a new synchronous system, simple and steady in operation.

The extreme sensitiveness of the selenium cell used in this "Teledeigraphio", is due first to the great ratio between the surface of the selenium electrode contact, and the free surface of the selenium; secondly, to the small value of its ohmic resistance when the cell is struck by light, and thirdly to the insignificance of the sensitive surface not exposed to light.

This particular cell is made up as follows: On a transparent sheet of paper of 6" by 8" a Greek line 2" high is drawn with Chinese ink on the whole length. The broadness of the line being equal to the white space between two lines. This drawing is reproduced to the size of 1-1/5' by 4/10' on a sheet of paper coated with silver chloride and then fixed in a solution of 200 grams of water; 0.10 gram of gold chloride; 4 grams of sulfo cyanide ammonium; 6 grams of glycerine, until all the silver chloride impresst by the light is transformed into metallic silver.

The prepared surface is then fixed into a solution of 15% of hyposulfide and dried, after which a part of it measuring 3/5' by 2/5' is cut out and plunged into an electroplating solution in order to reinforce the thickness of the metallic silver. The selenium cell armature is then ready and after a preparation of grey crystallized selenium obtained by cathodic pulverization, is plunged with the print in a solution of 2% of glycerine heated to 40" centigrade, the print being applied on the preparation in order that the metallic lines stick strongly to the selenium, avoiding air bulls.

After five or ten minutes of drying, the whole thing is plunged into hot water until the paper comes out alone, the silver remaining on the selenium.

After this the preparation is washt and dried. In order to improve it, it is submitted to a strong pressure by mechanical means or in a gas compresst at 200 atmosphere.

The selenium element thus obtained, whose armature is made of two metallic coats separated by a Greek line in two distinct sectors will possess the property already explained.

The "Teledeigraphio" itself is made of a steel disc fitted with teeth moved by a pinion run by clockwork, the latter being regulated by a close adjustment of a micrometer screw, acting on the pendulum.

The center of the disc is made of glass and in the steel crown is engraved a spiral line in the manner of a phonograph record.

A needle fixed to an aluminum frame runs into the spiral and makes the frame on which is fixt an incandescent lamp on the top and a selenium cell at the bottom to move slowly.

The lamp and the cell are enclosed in two boxes fitted with a small hole facing each other and on the same optical line in regard to the disc. The selenium cell is then connected in the grid circuit of the audion. Fig. 1 gives the complete diagram of the apparatus which by means of a few switches can be used for either transmission or reception in a radio system.

OPERATION: OBTAINING SYNCHRONISM.

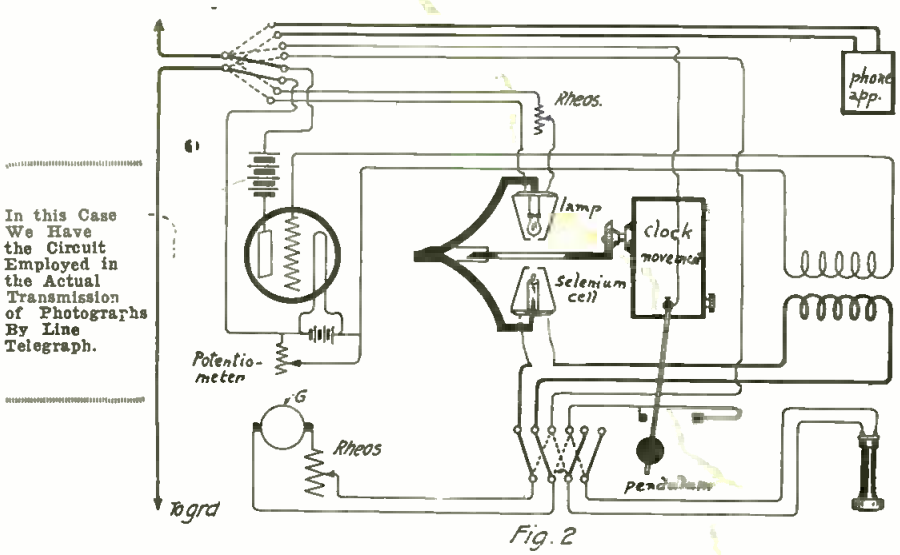
To adjust the set, some dots, receiv d in a telephone are sent automatically by the pendulum contacts of the transmitter. The operator at the receiving station, adjusts the speed of the clockwork until the frequency of the beats is the same as that of the frequency of those he receives in the phones. The various switches are then placed in the proper positions and the picture to be sent is placed on the glass disc. The variations of luminous intensity produced by the clear and dark parts of the picture causes the intensity of the electric current passing thru the cell to fluctuate and consequently the system responds accordingly.

At the receiving station the lamp glows according to the current received by the telegraph line or radio system, as the case may be, and impresses more or less, a photographic plate of the subject placed on the disc of the receiver. Fig. 2, gives the diagram of the various circuits when the apparatus is used to send photographs by land line.

FUTURE OF TELEPHOTOGRAPHY PROMISING

Concerning the possibility of a system which can be used in a commercial manner for the transmission and reception of photographs by land wire or by means of radio it would seem that this important art will soon reach a position where it will be as practical and effective as our present systems of telephony and telegraphy.

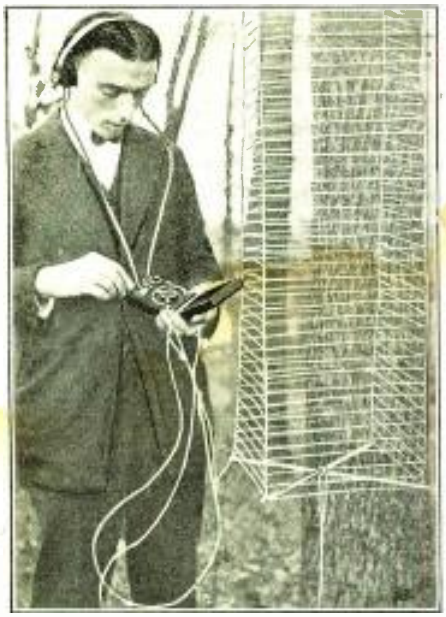
Much work and research is being done along these lines by various investigators particularly in Europe. Of late considerable attention has been directed by communication engineers of this country to the Belin system of telephotography. A recent line test between St. Louis and New York City proved entirely successful and very good photographic reproductions were transmitted.



In this Case We Have the Circuit Employed in the Actual Transmission of Photographs By Line Telegraph.

Fig. 2

*Abstracted from Revue General d' Electricité.



Photograph of Mr. J. B. Armstrong Using His Little Receiving Set With a Special Type of Cage Aerial.

DETECTOR

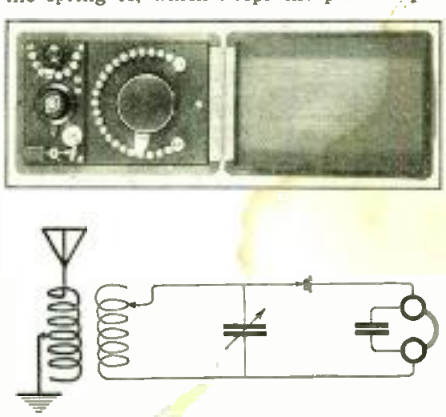
The operation of the galena detector used with this set is as follows: By pressing down on the hard rubber button S, the lever W, will move downwards, raising the other end carrying the bar R, to which is soldered a helical spring of No. 32 bronze wire which rests on the crystal when the lever W, is in horizontal position. A spring C, causes the lever to remain in a horizontal position when no pressure is exerted on S. It will now be understood that the idea in raising the bar R, and its contact spring, is to prevent scraping this delicate spring over the surface of the crystal when the whole detector assembly is rotated about its axis, which is thru the center of the supporting post. To obtain a new point of adjustment on the galena, the bar R, is also rotatable—about the screw, which secures it to W. A tiny wire spring with washers and a clamping nut cause this to be a friction joint insuring good contact between W and R at all times. Brass 3/32" thick was used for constructing W and R.

VARIABLE CONDENSER

The variable condenser used is of the two plate variable-separation type with mica dielectric H, .0005" thick. The plates are of 1/8" aluminum, the lower being screwed to the flange on the threaded pillar G, while the upper one is held with 2-56 flat head screws to the four pillars at the corners. A hole in the center of this plate is large enough to give clearance to the spring X, which keeps the plates separated. The pillar G, is 1/4" diameter with 24 pitch threads with keyway thruout its length. A pin L, fits into this keyway and prevents rotation of the lower plate when the knob V, is turned to vary capacity.

The bushing J, is threaded internally 1/4"-24 to engage with the pillar G, threads at the lower end, and 6-32, to receive screw D, at the upper end. This bushing J, also has a flange which bears on the similar flange of the bushing K, on the lower face, and provides a stop for the circular scale U, (of hard rubber) and knob V, clamped on the upper face by the screw D, and washer F. The ears of F fit into notches in the rubber knob V, and keep it from turning, while two pins E, forced into J, keep the washer proper from turning about J. The washer F, has two holes which fit over the pins E, so that by loosening screw D, the scale U, may be set for any separation of

(Continued on page 412)



The Photograph is a Top View of the Receiver Showing the Disposition of the Various Switches, While the Diagram Shows the Connections of Same.

SOMETHING TO TALK ABOUT AT LAST

HERE, indeed, is a really practical portable set which will readily fit in one's coat pocket and which has been constructed with the forethought and care of a highly jewelled watch. Needless to say it wins first prize in our "Portable Radio Prize Contest." Mr. Armstrong has really accomplisht something worth talking about. He has shown an unusual amount of originality, which may be noticed from the clever manner in which he varies the mutual inductance of the primary and secondary where he employs a telescopic arrangement similar to that of a folding camera.

Another original feature is the secondary variable condenser which employs two aluminum plates separated by a dielectric of thin mica and where the capacity is either increased or decreased by simply varying the space between each plate thru a micrometer screw arrangement fitted directly to a knob.

Not only that, but the most standard and up-to-date method of wiring, machine work and coil winding has been employed, for both the primary and secondary coils are wound in the efficient bank system.

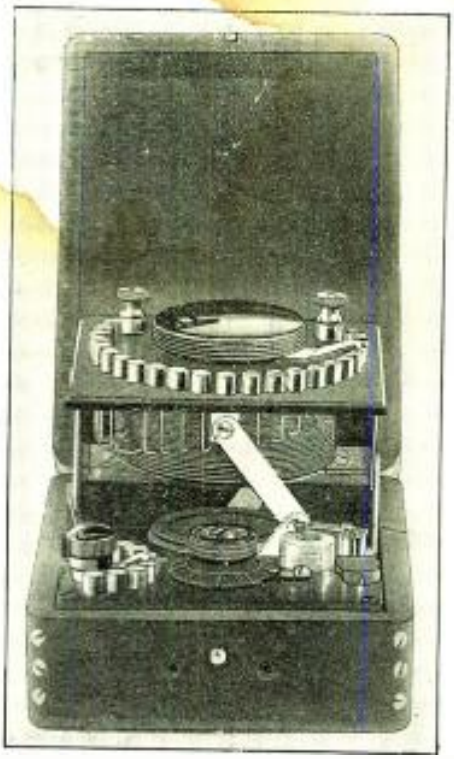
The detector adjustment also shows originality and one must actually operate this set in order to be impresst with its effectiveness.

Rest assured that we are not over enthusiastic in this instance, for we had the instrument sent to us in order that we observe for ourselves, just how it was built. This young man has not simply built a portable receiver. He has done more than that. He carefully planned every detail which entered into its construction. Judging from the forethought of even the most minute and unimportant details, the builder must have spent hours, perhaps days, in designing the various parts, which enter into the make-up of the unit. Above all, every piece of material, be it rubber or metal, was milled and machined to FIT to an almost astonishing degree of accuracy. In fact, we were both delighted and astonisht, at once, with what Mr. Armstrong calls his "young treasure," and so would you, fellow amateurs, were you given the opportunity to personally examine this interesting and above all efficient piece of workmanship.

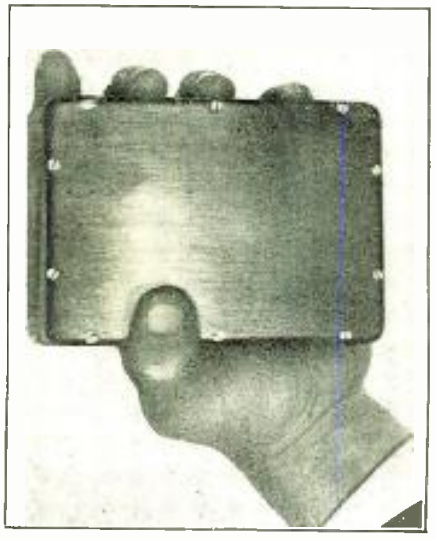
Briefly, this young man has at last departed from the usual cut-and-dried method of doing things. In other words, he has stepped out of the "beaten path." Does this not suggest some ideas to others who are contemplating the building of receiving or transmitting apparatus?

This time the editors received 53 entries and were much pleased to note that some really constructive workmanship was attempted in this second call. In fact, there were so many really good specimens that they have decided to publish several additional descriptions besides the prize winners. These will be given honorable mention and will be published within due time in the pages of RADIO NEWS. *The efforts of these young men will be paid for at our regular space rate upon publication.*

The Editors.



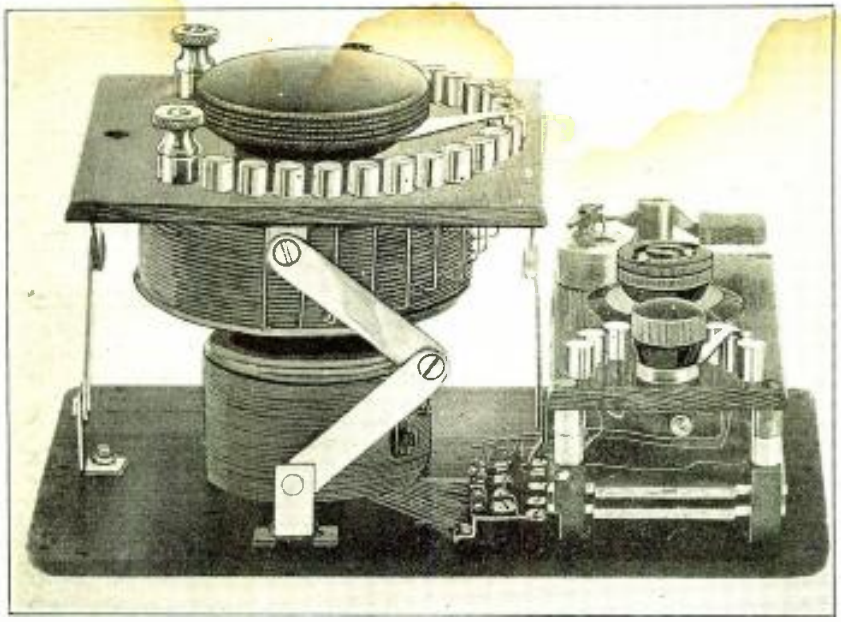
Photograph of the Pocket Radio Receiver. Note the Clever Arrangement of Coils and System of Coupling.



In This Little Box is a Complete Receiving Set, Tho it is Small Enough to be Carried in the Pocket.

Awards of $100 Portable Radio Prize Contest

First Prize Winner



Full Size View of Mr. J. Blanchard Armstrong's Portable Receiver, Showing the Variable Condenser With Mica Dielectric, Which Consists of Only 2 Plates. The Capacity is Varied by Changing the Distance Between These Plates.

Prize Winners

First Prize, $50.00 in Gold
Mr. J. Blanchard Armstrong,
15 Bradford Road, Newton Highlands, Mass.

Second Prize, $25.00 in Gold
Mr. James L. McLaughlin,
Box 288, Fairhaven, N. J.

Third Prize, $15.00 in Gold
Mr. Robert I. Toran,
871 Cambridge Street, Cambridge, Mass.

Fourth Prize, $10.00 in Gold
Mr. Raymond M. Moore,
252½ N. Main Street, Tucson, Arizona.

Honorable Mention

Mr. William F. Marquardt,
Chicago, Ill.

Mr. Kenneth Richardson,
Fort Lauderdale, Fla.

Harold B. Dick,
Springfield, Mass.

Phillip J. McManus,
Central Falls, R. I.

Mr. Arthur L. Osborne,
Brooklyn, N. Y.

A Practical Pocket Receiving Set

By J. Blanchard Armstrong

THE case for this receiving set was made of hard rubber 4½" x 3" x 1⅝" inside dimensions for the lower part, and 4½" x 3" x 3/16" for the cover. The top and bottom are of ⅛" hard rubber. 2-56 screws were used to hold all parts together. A catch, B, was provided to hold the cover down when the set is being carried about, and velvet ribbon was glued to the edges of the cover to exclude the dust. A fine grain polish for the entire case was obtained by rubbing down with emery cloth and oil.

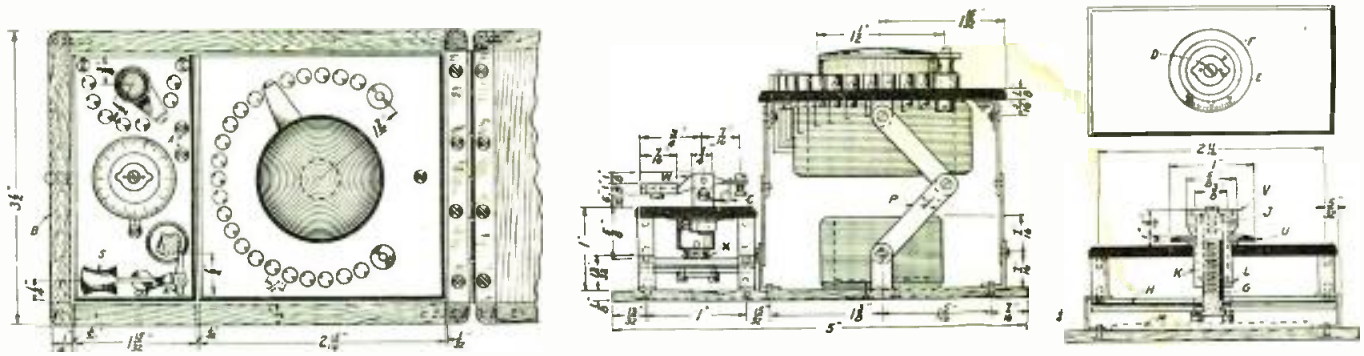
PRIMARY

The primary core is turned from hard rubber and measures 2" outside diameter with a ⅛" wall, and ⅞" high. It has a three layer bank winding of No. 22 S. C. C. (66 turns) shellacked in place and tapped at every top turn (which makes every three turns) by soldering a short length of No. 22 bare copper wire to line up with the contact screws. This was accomplisht by cementing the wound primary to the large panel and soldering the leads to their respective turns in such a position as to line up with the proper contact point screws. A soldering iron filed from No. 12 copper wire did the trick without charring the insulation of adjacent turns. The last contact point is left dead so that the aerial may be switched in or out to test the detector adjustment. This method of testing has been found by the writer to be very satisfactory, as a loud click is heard in the 'phones when a good adjustment is secured.

The primary panel is fastened to the base by four friction hinges, P, which hold it in any position relative to the secondary when raised or lowered by the primary switch knob. The twenty-three switch points are secured by quarter-inch 2-56 screws and may be obtained from Clapp Eastham Co. The binding posts for aerial and ground are a standard post, shortened slightly to allow the cover to close down without interference. One binding post is connected to the beginning of the primary winding; the other to a bent spring-brass strip under the nut which secures the primary switch knob. By means of a 2-56 set screw in the nut itself, the knob can be adjusted to turn smoothly, without wobbling, and locked in place.

SECONDARY

The secondary core is 1⅜" outside diameter with a ⅛" wall, by ⅞" high and is fitted with a hard rubber disc which is screwed to the base to secure the coil. The winding (bank) was four layers of No. 26 S. S. C., tapped in eight places by the same method used for the primary. These taps should be of No. 36 S. S. C. brought down and shellacked to the outside of the coil and along the base of the set to a tiny connection block, where they are soldered to lugs secured by 2-56 screws. (See photograph of set out of its case.) Another set of lugs have wires soldered to them which go to the eight contacts on the small fixed panel, for tuning the secondary.



Constructional Details of Mr. F. B. Armstrong's Receiver, Showing How the Variable Condenser and the Little Detector are Made. The Four Arms Supporting the Primary Allows a Very Loose Coupling When Extended.

Radio Taste Reception

By ALFRED N. GOLDSMITH* and EDWARD T. DICKEY†

AN interesting paper was recently read at a meeting at the Institute of Radio Engineers, New York City, having to do with the reception of radio messages by means of taste. During the experiments two silver electrodes were employed which were separated by a piece of insulating material and so spaced that the tongue could be placed between the electrodes.

Much information is disclosed concerning the physiological effects of this method of reception upon the operator, as well as electro-chemical phenomena in connection with mouth electrodes.

Altho the method does not preclude the possibility of abolishing the present sound method, it was pointed out during the discourse that the results warranted further investigation, as under certain conditions this manner of reception would prove beneficent, such as in the case of airplane work where attendant noises make it extremely difficult for the radio operator to receive signals of low audibility.

Fig. 1, illustrated on this page, will serve to give a general idea of the circuit employed in tests described by the authors. A general resumé of the method follows:

"The purpose of this research was to determine the feasibility of reception of radio telegraphic signals by the sense of taste.

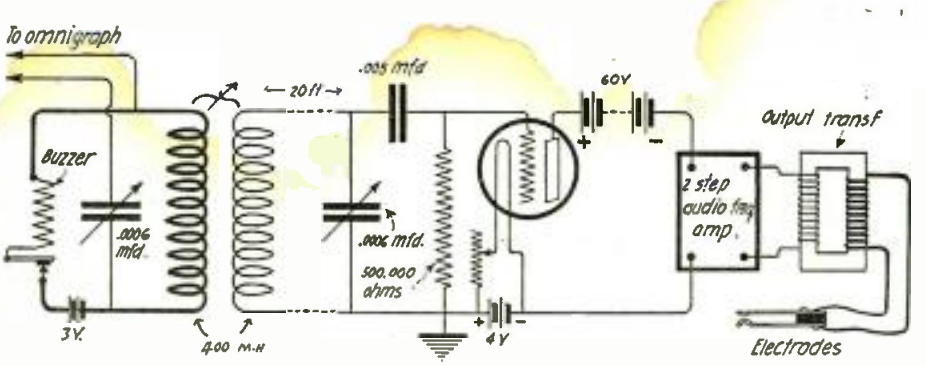
"Electrodes were made which could be placed against the tongue in such a way as to cause a taste sensation when a source of potential was connected to them. Tests were made, using low potential direct current and 60-cycle alternating current to ascertain the amount of energy and potential necessary for taste reception.

"Tests were then made, using signals from a buzzer source. By employing a two-stage transformer-coupled audio-frequency amplifier it was possible to obtain taste sensations from a signal having an audibility of 500 in the detector circuit. The possible speed of transmission appeared to be limited to a maximum of about 10 words per minute because of the characteristics of the taste organs.

"Finally, the reception of actual signals from an antenna was tried. It was found possible by using four stages of amplification to obtain taste sensations from all signals whose audibility was greater than 500 in the detector circuit.

"The results obtained thus indicate that from an electrical standpoint it is possible to receive radio telegraphic signals by the sense of taste. When compared to the sense of hearing or even of sight, however, the sense of taste is inferior as a means for receiving intelligence." *Data furnished by courtesy of I. R. E.*

*Director, Research Department, Radio Corporation of America. †Assistant Research Engineer, Radio Corporation of America.



General Circuit of the Method Employed by the Authors in Their Experiments on Taste Reception.

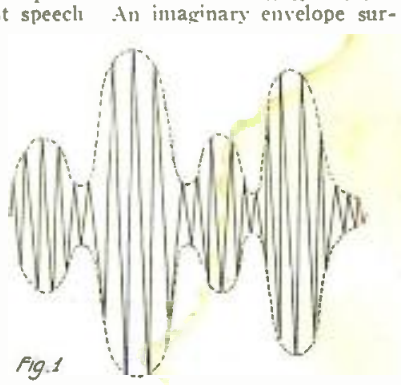
A Method of Producing Musical or Other Audible Notes

BY VICTOR H. LAUGHTER

THE accompanying method relates to a means for the production of audible tones. That every spoken word, musical note or any audible tone produces a certain vibratory effect is a well-known fact. This vibratory action can be registered by various means, the best known being the phonographic method.

(A) In radio telephony a wave is radiated which bears changes in the wave form according to the words imprest on the transmitter. This "change" usually occurs in the form of an amplitude variation, altho in some cases the frequency is varied to secure the same effect.

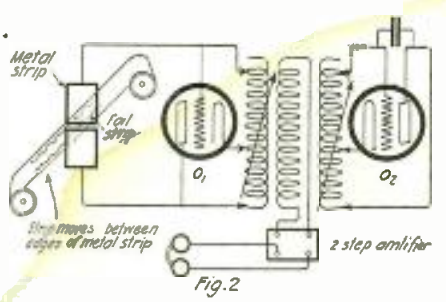
A wave form modulated by speech is shown in Fig. 1. As will be noted this consists of a high frequency wave with the amplitude varied according to the imprest speech. An imaginary envelope surrounds the wave components. The path of the envelope represents the variation caused by the spoken words. In radio telephone reception one-half of this wave is lost by rectification and the remaining half causes the desired reproduction in the telephone receivers.



Illustrating a Wave Form Modulated by Speech.

By means of an oscillograph connected to a radio telephone set we can photograph the radiated wave current. The resultant will be a formation similar to Fig. 1. Thus we have a record of the tones, the "hill and dale" of the phonographic record being represented by the imaginary envelope. So far as known no method exists for reproducing this type of photographic record. A capacity variation method is suggested.

(B) The sensibility of certain types of vacuum tube circuits to a slight change in capacity is well known. In Fig. 2 is shown two independent oscillation generating circuits associated with a middle circuit. The tertiary circuit is connected to a two step amplifier and receivers. The generating circuits are connected so as to oppose one another, or 180 degrees out of phase. No current will flow in the middle circuit under these conditions, but if either circuit becomes unbalanced a corresponding current will flow in the middle circuit. Under the above conditions the circuit is ultra sensitive to a capacity change.

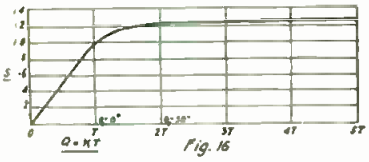


A Circuit Ultra-Sensitive to Capacity Change.

(C) Consider that we have a photograph of a certain series of spoken words as represented by Fig. 1. A piece of tinfoil is cut to correspond to the photograph. The foil is pasted between two thin sheets of insulating paper. The foil strip is so arranged that it can be rolled from one spool to another. Two thin metal strips are so mounted that one rests underneath the foil, and the other is mounted above so that its edge rests on the one underneath with the foil strip between. The metal strips are connected up as the condenser of one of the oscillation generating circuits. The insulated foil strip becomes the dielectric. A small variable condenser is placed in the opposite generating circuit. Adjust the foil strip by moving thru, until the lowest peak of the wavy line is between the two metal strips. Now adjust the variable condenser and inductances until no tone is heard in the receiver. If the foil strip is moved it will vary the dielectric separating the metal strips thereby varying the capacity in a like manner. This variation unbalances the circuit and results in a current flowing through the middle circuit of the same proportion.

might be expected that the grid modulation of case 3 would give superior results to these on the assumption that the output of the two tubes would be alternately increased to maximum and then decreased to nearly zero by swinging the grid potential at the modulating frequency; but when it is remembered that the output cannot be increased above a certain maximum, it will be seen that the results obtained by this method place it at once on a par with the absorption methods.

It must be remembered that the measure of the effect in the distant detector is the value of the product AB of the carrier and modulated component of received electromotive force, and this depends not upon the relative energy components in the transmitting antenna, but upon the currents. That is, the A and B of the transmitting antenna refer to current amplitudes therein. Two tubes in parallel, therefore, while they may give twice the energy of one, deliver only $\sqrt{2}$ times as much current as a single tube, so that if complete modulation is obtained in cases 1 and 2 above, we may expect the conditions to be those represented in Fig. 6.

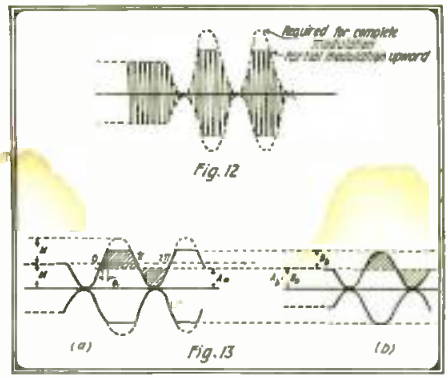


On This Curve is Plotted the Relation Between the Fundamental Radio Constituent and Q.

Inspection of this figure shows that for 100% modulation in both cases the constant current or power modulation system is twice as good as the absorption modulation, or that 50% modulation on the constant current system is equal in effect to complete modulation by absorption. Another way of looking at the matter is to note that four times as many oscillator tubes are required to give the same result on the absorption method as on the power modulation method, when the latter gives complete modulation. If the latter gives 75% modulation, the absorption method requires three times as many oscillator tubes. These conclusions cover in a broad way the comparison required between these two general systems of modulation.

There are, however, certain practical points that must not be lost sight of and unless due regard is taken of these it may not be so easily possible in every case to correctly make the above statements. The practical limitations imposed refer to the percentage modulation actually obtainable by the two methods. It is not difficult to get practically complete modulation by the distortion, diverting, or detuning method, but usually a smaller variation is obtained by the non-absorption methods, such as grid and constant current modulation. This is always the case when the electron emission of the vacuum tubes, particularly of the oscillator tube, is insufficient to give the increased output required on the positive modulation swing. Another difficulty is often found in the fact that the power available from the microphone transmitter is too small to swing the grid potential to the required positive value. In this case it is necessary to amplify the microphone output by means of an additional tube.

Both of the above limitations result in radiation of the form shown in Fig. 7 which is characterized both by distortion and incompleteness of modulation. The oscillogram record Plate E shows the result of inadequate filament emission. The modulation is much greater downward than it is upward. Distortion



In Fig. 12 Average Operation is in Center of Curve, While in Fig. 13a and Fig. 13b is Shown the Output Currents Under Two Given Conditions.

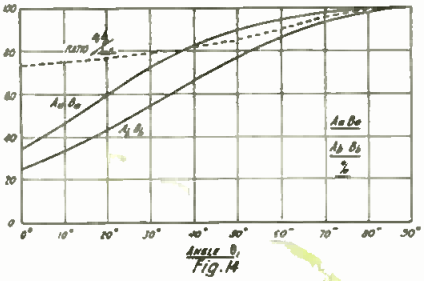
is present, altho in this particular case the speech was still quite intelligible.

AMPLIFICATION OF OSCILLATOR OUTPUT

When increased output is desired it is most satisfactorily obtained by means of separately excited tubes. This method is exemplified by the circuits of several different sets now designed by the Signal

Plate E. This Oscillogram Record Shows the Result of Inadequate Filament Emission.

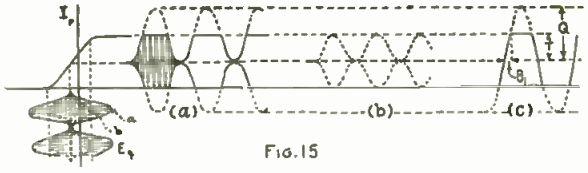
Corps, for instance the pack set SCR-127. These sets are, however, intended only for telegraphing and it is found that certain difficulties are encountered when attempt is made to adapt the circuits of these sets



Illustrating the Ratio of Effectiveness of Two Specific Cases.

to the telephone problem. A typical circuit is shown in Fig. 8.

The radio frequency voltage impresst on the multiple tube amplifier from the low power master oscillator is sufficient to drive the grids of the amplifiers positive so that current flows in the grid circuit. This grid current passes through the leak resistance R and the voltage drop produced therein is utilized to bias the grids of the tubes. The amplitude of this grid current and hence of the bias voltage is controlled by adjusting the coupling condenser C and the leak resistance R itself, but in any case remains practically constant for any given

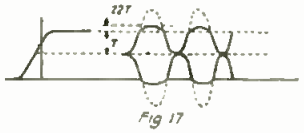


In This Undesirable Case the Smooth Undistorted Curve Produced by Reduction of the Impresst Voltage is 73% as Effective as the Flat-Topped One.

set of conditions at approximately the mid point of the characteristic curve of the amplifiers so that maximum amplification is obtained (see Fig. 9). In all of the present telegraph sets thus far developed the input voltage is of relative large amplitude; it is in fact always so large that the extremities of its oscillation carry it well over the top and bottom flat portions of the curve.

Let us now consider what happens when we attempt to apply this power amplification principle to the telephone case. The first method of doing this that occurs to us is to modulate the output of the master oscillator and impress this modulated output on the amplifier, wherein it must be amplified and then radiated in its original character from the antenna. Difficulties at once arise, however.

Let us suppose that any scheme of modulation is employed at the master oscillator and that the modulation is complete (shown in Fig. 10).



As Compared to Fig. 15a the Envelope Curve Should Be Increased to the Point Shown Here.

This modulation voltage is impresst upon the amplifier of Fig. 8. The point on the characteristic curve about which amplification takes place depends upon the grid current flowing thru the leak resistance. This in turn depends upon the amplitude of the impresst oscillation. Therefore, at instants in the neighborhood of A (Fig. 10) when the impresst voltage is small the grid current will be small and the operating point near zero grid potential, while with larger oscillation amplitude corresponding to instants near B (Fig. 10) a larger grid current will flow, making the grid more negative. Thus, during an audio frequency modulation cycle the operating point on the characteristic may vary between 1 and 2 (Fig. 11a). The grid voltage and plate current may then vary as shown in Fig. 11. The plate current variation will of course depend upon the shape of the characteristic curve. For the condition shown the ultimate plate current will have a form similar to that of Fig. 11b, while if the characteristic curve were moved bodily to the right the result would be practically reversed as shown in Fig. 11c; or if the cut-off and saturation effects were more widely separated or the range of operation (1-2) occurs more nearly in the center of the curve the plate wave will approximate that shown in Fig. 11d.

In any case, where the oscillation impresst on the amplifier is of sufficient amplitude to pass over the ends of the characteristic curve distortion will result and the original completely modulated wave will emerge from the amplifier with complete modulation downward but only partial modulation upward. This is illustrated in Fig. 12 for the favorable case *d* above where the average operation is at the center of the curve.

The above discussion refers to operation with the bias voltage obtained by a leak resistance. It holds, also, however, in its broad aspects for the case where a negative grid battery is used. The only difference is that in the latter case the bias voltage is held fixed regardless of the amplitude of oscillation. This is obviously a more desirable condition.

The quality as well as the completeness of the radiated modula-

(*Continued on page* 388)

is complete. It is then ⅓ of the fundamental frequency term, and can, therefore, generally be ignored. Approximately, therefore, the receiving telephone current is

$$\frac{i}{e} = \frac{b_2 \times AB}{\sqrt{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Obviously it can be increased by increasing either A or B—that is, either the constant amplitude radio frequency carrier or the modulating component immaterially. Also, it appears that for a given value of the product AB the relative values of A and B are of no importance: a large radio frequency carrier weakly modulated will give the same detector response as a smaller radio term more completely modulated. It is important to notice that for a given modulation amplitude B the response is increased proportionally with increases in A, the carrier. The physical reason for this, of course, resides in the curvature of the detector characteristic; the rectification is made more efficient by the "riding" of the radio frequency e.m.f. on the detector.

We note finally that what is desired for good detector response is as large a value of the *product* AB of the components of the transmitted wave as is possible.

TRANSMITTER MODULATION

We have to consider several methods for producing the modulated radiation just considered, keeping always in mind the requirement just stated that the product AB shall be as large as possible; and that the measure of effectiveness of the modulated radiation will therefore be indicated by the value of this product as representative of the components of transmitter antenna current.

DIVERTING, DETUNING OR ABSORPTION MODULATION

A number of well known methods of modulation may be collectively handled under the heading of absorption, diverting or detuning modulation and all such methods are characterized by a reduction in antenna current when the modulator is in operation below the value obtainable were the modulating device removed. Fig. 3 shows the result of this type of modulation.

It is seen that although the oscillator is capable of supplying a radio frequency oscillation of amplitude A_1 to the antenna alone, the presence of the modulator and the absorption therein reduces the effective carrier amplitude to A_2 and the peak current never exceeds the maximum obtainable from the oscillator.

Examples of absorption or diverting modulation devices are those using the transmitter microphone directly in the oscillating circuit thereby varying its resistance, or else inductively coupled with the oscillating circuit; or the use of a three electrode vacuum tube to absorb energy in its plate circuit, the absorption being controlled by speech e.m.f.s. impressed in its grid circuit. All such devices reduce the effective value A of the carrier to the A_2 of Fig. 3 above.

An exactly similar operational effect is obtained with modulation by detuning as with a vacuum tube, microphone or condenser telephone shunting a part of the oscillation circuit.

NON-ABSORPTION MODULATION

This type of modulation is characterized by the alternate increase and decrease of radio output above and below the value normally supplied by the oscillator, and is illustrated in Figs. 4 and 5.

When this type of modulation is most effectively employed the output of the oscillator which is normally A_1 is equally increased and decreased, by the action of modulation as shown in Fig. 4. Frequently, however, the condition shown by Fig. 5 is obtained where the oscillator output is caused to decrease more than it increases, thus lowering the effective value of the radio frequency carrier (A_1) to (A_2) and giving a less effective radiation (value of the product A_2B). More or less distortion is also present.

An example of this type of modulation is that obtained by the now extensively used W. E. Co. circuit and known as constant current or power modulation. Grid modulation may also, under certain circumstances, produce this type of radiation. On plate C is shown an oscillogram, taken as described above, of the output of a telephone set modulated at 500 cycles by the constant current method. It is seen that the modulation is very nearly equal upward and downward. The oscillogram Plate D shows a case of grid modulation. There is some slight modulation upward in this case but most of it is downward and there is some distortion present.

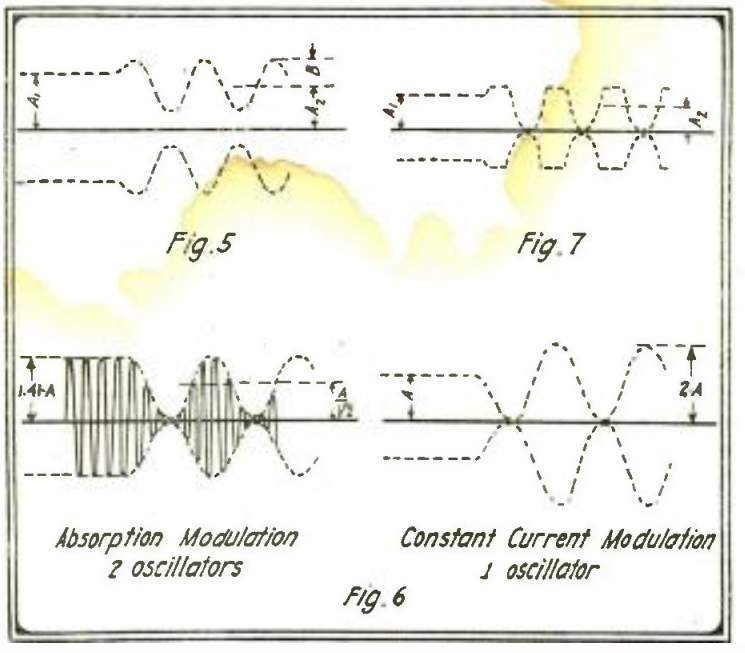


Fig. 6

More Interesting Curves Having to do With Various Types of Modulation.

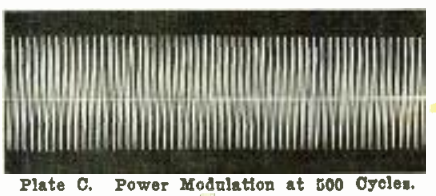


Plate C. Power Modulation at 500 Cycles.

COMPARISON OF ABSORPTION AND NON-ABSORPTION METHODS—GENERAL

In order to illustrate the real necessity for comparing the two general types of modulation just defined let us take a concrete example. Suppose we have a certain given number of exactly similar vacuum tubes, this number being limited by the amount of power available, or other engineering considerations. Suppose, to make the matter quite definite, that we have two tubes. The question at once arises "How shall we use these tubes so as to get the maximum modulated output, i. e., the maximum value of the product AB?" Shall we use one of the tubes as oscillator and one as modulator or both as oscillators and modulate the total output of both?

The answer is not at once obvious. There are several ways in which the two tubes might be used under the above two general schemes but broadly speaking we may discard as obviously inferior all save the following:

1. One oscillator and one modulator with connections for constant current modulation.
2. Both tubes oscillating in parallel modulation by absorption of output.
3. Both tubes oscillating in parallel modulation by impressing speech frequency on grids.

At first sight it might appear that methods one and two would give exactly the same result. In the first case the output of the two tubes might be caused to vary by the absorption device between the total available output and zero with an average value equal to one-half this variation: while in the second case, there would normally be half the output of the two tubes of case 1 but the action of the modulator tube would increase this output to double value and then decrease it to zero with the average the same as in the first case. It

Typical Circuit Employed in the Signal Corps Pack Set for Radio Telegraph Operation.

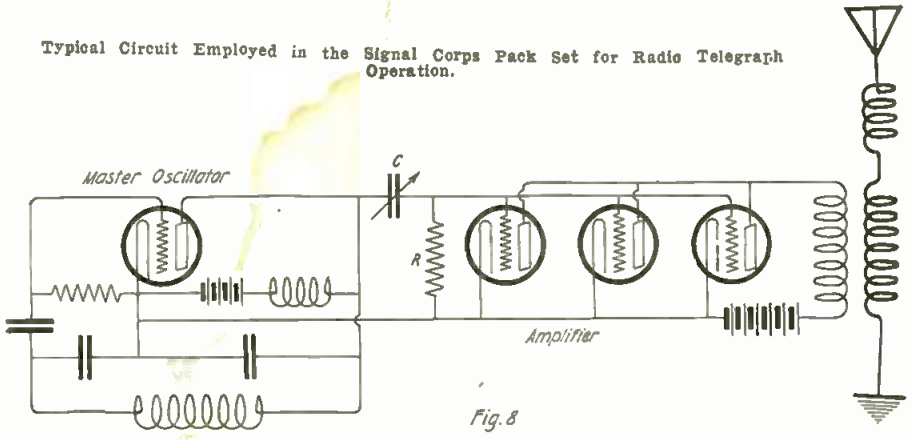
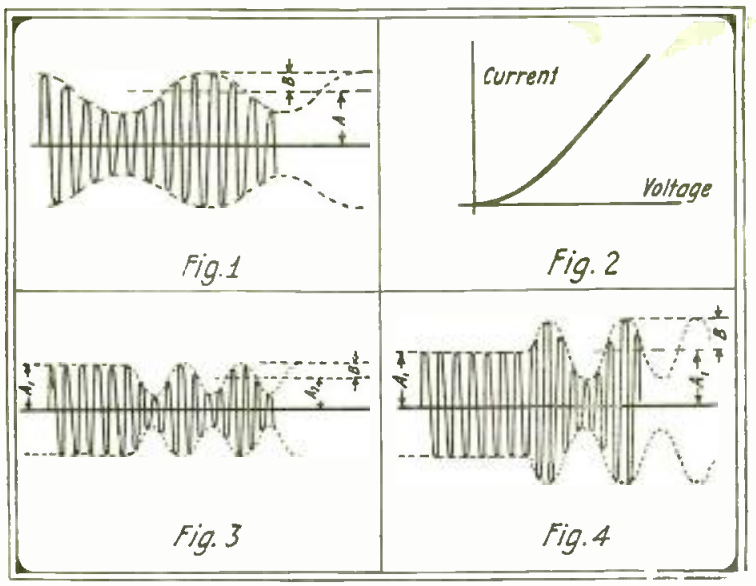


Fig. 8

Comparison of Modulation Methods in Radio Telephony

By A. S. BLATTERMAN*

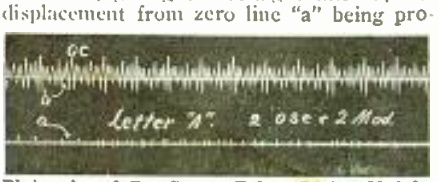


These four Figures Represent an Explanation of the Theory to be Considered in the Detection of a Modulated Sustained Wave.

THE modulation of sustained waves for purposes of radio telephony has now assumed such an important place in the design of apparatus for this kind of communication that it is very desirable to clarify our conceptions of the various phenomena occurring in some of the more useful circuits. Several years ago we had the arc and spark with high power granular carbon microphones in the oscillating circuits, and liquid microphones, condenser telephones, etc. Today the high frequency alternator, and much more extensively the three electrode vacuum tube supply the energy for radio telephone equipment and the speech control may not only be affected by the previous arrangement of microphone, and other factors in the oscillation circuits, but the vacuum tube itself may be employed in various ways for molding or modulating the high frequency carrier according to the voice wave it is desired to transmit. The methods for securing modulation are fast becoming legion and the engineer is confronted by the necessity of selecting from the great number available the ones which are best suited to the particular problems he has in hand. In all cases a large percentage of modulation is desirable and good quality is not less important.

In this paper comparisons are made between various methods of modulation and conclusions are drawn with reference to vacuum tube apparatus giving the comparative effectiveness of the several types discussed. Not all of the known methods have been considered in detail, but because many of the systems suggested can be classified under general headings such as absorption modulation, power modulation, etc., a comparison has been made between several general types of modulation which it is believed will serve to make the entire discussion fairly complete.

Several oscillograms of the modulation actually obtained with different circuit arrangements appear in the course of this paper. These were taken by coupling the oscillograph vibrator through a rectifier to the antenna of the telephone set as shown in Fig. A. The rectifier consisted of several three electrode vacuum tubes in parallel with their grids and filaments connected together to form effectively a single cold anode. A zero line "a," Plate A, was first taken with the radio set inoperative. The radio set was then caused to oscillate without any modulation being applied. The energy then picked up and rectified in the vibrator circuit caused a deflection of the latter, giving the straight line "b," its displacement from zero line "a" being proportional to the amplitude of the radio frequency antenna oscillations. The oscillations were then modulated, causing their amplitude to alternately increase and decrease according to the curve "c." In the case shown, modulation was obtained both upward and downward, altho it was far from being complete. For complete modulation the wavy line should have increased to twice the average value "b" and decreased to the zero line "a" alternately.



Plates A and B. Curves Taken During Modulation Tests.

DETECTOR RESPONSE TO MODULATED WAVES

Since the primary concern in the use of modulated transmissions (radio telephony) is the value of detected telephone current, it is desirable first of all to formulate the theory of the detection of a modulated sustained wave. This, as will be seen, gives very fundamental information as to the requirements of transmitter characteristics.

Consider the modulated voltage wave of Fig. 1, which depicts a sustained wave of radio frequency periodicity ω varying in amplitude at an audible frequency periodicity p.

The equation of this wave is,

$$e=(A+B \sin pt) \sin \omega t$$
$$=(A) \sin \omega t+(B \sin pt) \sin \omega t \ldots\ldots (1)$$

indicating a radio frequency component of constant amplitude (A) and another component of equal radio frequency but of varying amplitude (B sin pt). The significance of the quantities A and B will appear by inspection of Fig. 1. Complete modulation is obtained when A = B and under any condition the percentage modulation is B/A.

For the sake of simplicity, as well as definiteness, let us assume that the receiving detector is a vacuum tube connected in one of the usual circuits without a blocking condenser and leak in the grid circuit. We might equally well assume the use of a crystal detector; but in any case the detector action is to be considered as resulting from operation on a curved characteristic of the typical form shown in Fig. 2.

Such a characteristic as that illustrated may be represented by the power series

$$i=b_1e+b_2e^2+b_3e^3+\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

wherein it may be shown that for the usual detectors and in particular the three electrode vacuum tube, terms beyond the second may be neglected. The detected current can therefore be expressed as function of impressed voltage as

$$i=b_1e+b_2e^2\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In detection of the modulated wave under consideration we have to substitute for e in this expression the value (1)

$$e = A \sin \omega t + B \sin pt \sin \omega t$$

This gives

$$i=\frac{b_2}{2}\left(A^2+2AB \sin pt+\frac{B^2}{2}+\frac{B^2}{2}\cos 2pt\right)$$
$$+ \text{Radio Frequency terms}\ldots\ldots (4)$$

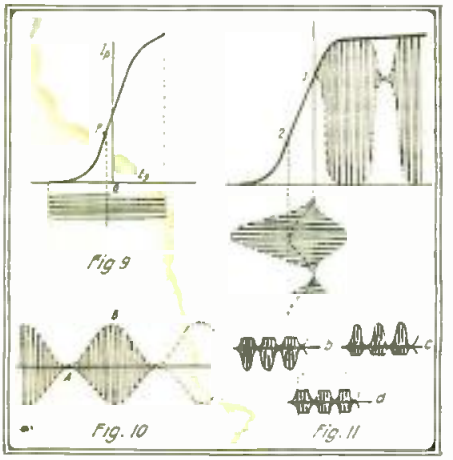
This is the detected current. The only part of it effective in producing telephone response is the variable audio frequency component

$$i_a=\frac{b\,B}{2}\left(2A \sin pt+\frac{B}{2}\cos 2pt\right)$$

The effective value of this is

$$i_e=\frac{b\,B}{2}\sqrt{2A^2+\frac{B^2}{8}}\quad\ldots\ldots (5)$$

The second term is obviously one of double the signal frequency "p" and has maximum amplitude when the modulation



Curves Met With in the Amplification of the Oscillator Output.

*Radio Engineer Camp Alfred Vail, N. J.

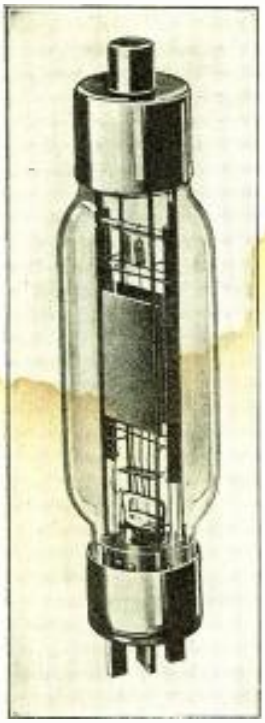


Fig. 23 a 1 K.W. Oscillion Which Has Proved a Powerful Maker of Oscillations

work profound changes in our present methods of business, cannot be questioned. Thus again it seems evident that the audion is destined to play a leading rôle in the work of knitting more closely the people of this land, and of all lands.

We have briefly recounted some of the main achievements which the three-electrode audion, or triode, has to its credit. Let us now consider some of the possibilities of its future. From its invention until 1912 it attracted an almost negligible interest in the scientific world. A year after the audion was first brought to the attention of the engineers of the American Telegraph and Telephone Company that corporation acquired exclusive license under all the audion patents for wire telephone purposes. Thereupon the research men of that organization initiated an elaborate line of investigation of the device, which about that time began to interest other scientists in America and abroad. Prior to 1914 not a dozen articles on the audion had appeared in scientific publications. Today it is impossible to pick up a magazine devoted to physics or electric communication without finding one or several papers dealing with some of what Dr. Eccles styles "the protean properties of the ubiquitous three electrode tube."

Writing in the *Radio Review* Dr. Eccles (who is affiliated with the British Marconi Co.) says: "The most important single instrument in modern wireless practice is the three-electrode thermionic vacuum valve, for it enters into every main division of the subject—it plays a dominant part in the generation of oscillations, the detection of signals, and in the amplification of feeble voltages and currents. Its arrival and development have, besides, helped greatly toward the success of apparatus and methods that might otherwise have remained almost failures."

DR. ECCLES QUOTED

Dr. Eccles has outlined the present status and forecast of the future of the audion so clearly that I am constrained to quote further his words, as those of an unbiased observer: "During the war, hints reached the civilian that a revolution was taking place in wireless telegraphy, the principal agent in which was reported to be an instrument called a 'valve,' a 'lamp,' or a 'tube.' This instrument seemed to have arisen suddenly into a predominant position among all the apparatus of the wireless experimenter and operator, and appeared to be of use in every corner of his outfit. The complete name of the instrument is the three-electrode thermionic vacuum tube. It must be emphasized that it is the three-electrode valve, and not the valve with two electrodes, that has been responsible for the overthrowing of the old methods and apparatus. That it has been a veritable revolution can be seen by comparing the common practice in wireless telegraphy of 1914 with that of 1919. In 1914 practically all the most powerful transmitting stations in the world generated waves by sparks and signals which were received at nearly all stations by means of crystal or magnetic detectors. The spark method of generating waves involved the use of very large antennæ for spanning great distances; and at the receiving stations which wisht to listen to stations more than even 100 miles away very large aerial structures were customary. But if we look at the state of affairs today we find most of the high-power stations for long-distance transmission are 'continuous wave' stations; that is, they produce uniform uninterrupted waves instead of a series of short gushes made by sparks; while at the receiving end new modes of detecting these continuous waves appropriate to, and taking advantage of, their uniformity in character have been introduced. This is where the three-electrode tube, in various adaptations, enters the arena. Taken together, the improvements at both ends of the span have made possible the use of smaller antennæ at transmitting stations, and have almost removed the necessity for any antenna at all at receiving stations. For example, under reasonable weather conditions, it is quite easy to listen to the messages coming from stations on the other side of the Atlantic by using a receiving circuit of which the receptive element is a small coil of wire, three to four feet square. Thus, so far as receiving goes, it is possible to intercept all the great stations on one-half of the globe by means of apparatus contained wholly in one room, or even in a cupboard. In accomplishing this the magnifications in use amount to several hundred thousandfold. All this is the work of a thing which looks like an ordinary electric light bulb with a few extra pieces of metal in it—the three-electrode tube."

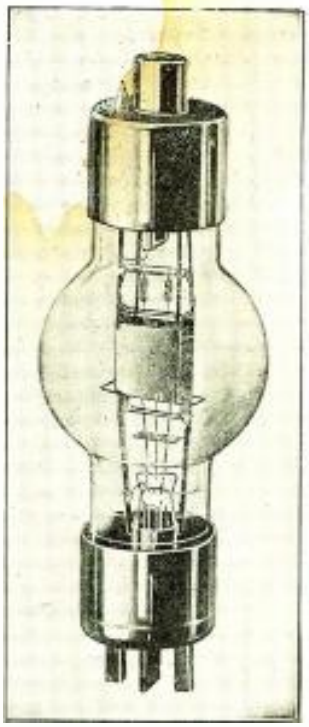


Fig. 25 a Smaller Power Tube of the ¼ K.W. Oscillion Type

Years ago what physicist did not look at the simple, self-contained, noiseless incandescent lamp, consider it as an ideal source of electro-magnetic waves of a wide spectrum—of heat, visible, and ultra-violet radiation, and wonder why it should not be made to generate also waves of any length? Today that incandescent lamp, with the addition of a metal plate and wire grid, has become such a generator. Undampt Hertzien radiations of a few centimeters wavelength can be generated by audions specially designed to give minimum capacity between the three electrodes and their lead-in wires. From these short waves, representing alternating current frequencies of some hundreds of millions, down to those of one or two per second, the electric-wave spectrum afforded by the oscillating audion is continuous. Consider this fact in connection with the almost infinite sensitivity of the device as a detector, and its unlimited power as a magnifier, or amplifier, and one realizes something of the value of the three-electrode vacuum tube to the physicist and the inventor. To the former, however, the keenest interest lies perhaps in the audion itself, because there is no known piece of electrical apparatus linked so directly with the most recent work on the structure of matter. A prominent British physicist has recently remarked: "It is probable that there is no other sphere where research work has had such a combination of immediate practical value and intense theoretical interest."

Many an early experiment in telegraph transmission or reception by wire or wireless, long since abandoned as too limited in range, can today be revived to the great benefit of man. Calculations have shown that with a littoral cable stretched for fifty miles on each side of the Atlantic, and carrying some forty amperes of 20-cycle alternating cur-

(*Continued on page 386*)

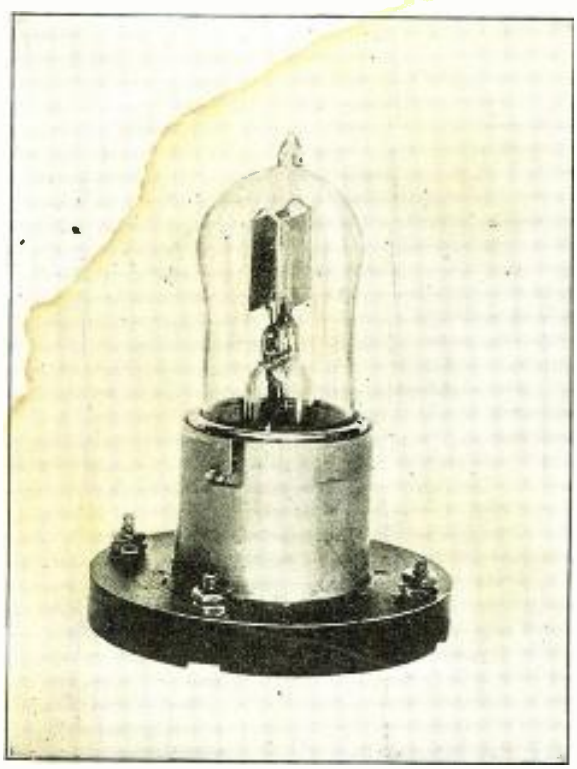


Fig. 24. A So-Called V.T.-21 and its Socket, a Tube Which Has Been Much Used by the U. S. Signal Corps.

ROY HAYNES STATION

Here is my new receiving set which I have recently completed and which I thought might interest other readers of our magazine, RADIO NEWS.

The set consists of detector and two step amplifier with ammeter on each tube. I have installed a full set of honeycomb coils wired for the regulation tickler hook up and I secure excellent results with it. These coils are certainly *there*.

By using the Magnavox sound amplifier apparatus I can hear all stations worth while, both dampt and undampt all over the room, and besides I get local radiophone music loud enough to dance by.

Am an old timer in the game, having started in the days of your pioneer magazine, *Modern Electrics*. Then I had a silicon detector and a one slide tuner, and oh, my! what results compared to our long distance work of today. But then this radio game has been a constantly rising art and we amateurs have played our share in its progress.

A Modern and Effective Station You Have Mr. Haynes. We Are Always Glad to Meet An Old-Timer.

ROY HAYNES,
16939 S. May St., Chicago, Ill.

W. COOLEY STATION

It is a pleasure to submit a photograph of my station and also one of myself. My set consists of the following, ½ K. V. A. Thordarson Transformer, Thordarson Oil immersed condenser, Murdock oscillation transformer, Murdock line protector, Murdock rotary spark gap and a Bunnell key.

Cooley By Name But Not Cool When it Comes to the Fun He Gets Out of Amateur Radio.

The receiving set consists mostly of De Forest Unit Panels and includes a one-step amplifier. I have two pairs of phones, one Brandes the other Meteor.

My aerial is 64 ft. long ,40 ft. high and consists of Nos. 12 and 14 gauge areial wire spaced two feet apart.

I have had fairly good results with the receiving set I have heard NAA. NAJ. NAR. and NAT. As I have not tried for "dx." with the sending outfit I do not know how far I can send but I expect to cover 500 miles in the near future of the cold and crispy winter nights.

W. COOLEY,
1336 19th St., Granite City, Ill.

DONALD ATHERTON STATION

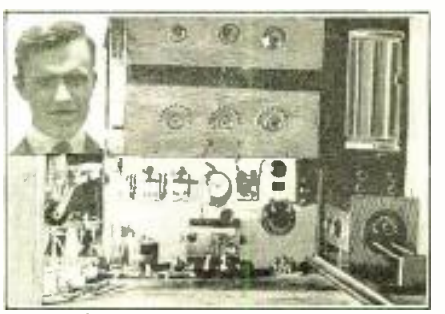
ATHERTON STATION

Here is a photo of my radio station and myself. By way of explanation, I may say the following:

I am seventeen years of age and live on a farm. I made all the instrument except the condensers. receivers, clocks and switches in my work shop, which I have rigged up in the hog house.

My aerial is 150 feet long and 40 feet high at both ends. The outfit consists of a 4,000 meter loose coupled, loading coil, cabinet receiving outfit, two variable condensers, four detectors. aereal switch, pair of Murdock .2000 ohm receivers, twelve switches and automobile clock.

I have had excellent results with my station, getting N. A. A. every night and noon during the summer months when static is troublesome. The Great Lakes Naval Station and other large stations are also on my list.



He Lives On a Farm in Iowa and He's Seventeen. Farmer or City Dweller, They Have a Common Stamping Ground in Radio.

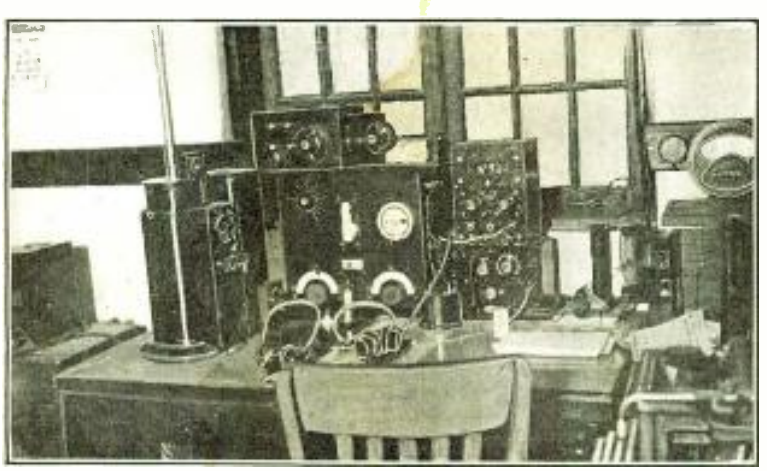
I will be glad to furnish a complete diagram of my station to any other amateur interested.

DONALD ATHERTON,
Mt. Vernon, Iowa.

HENRY M. HARRIS STATION

The following is a description of my station:

For transmitting I have ½ K.W. Packard transformer, three sections Murdock moulded condenser, Murdock rotary gap, and Murdock O.T., which is mounted on the end of a cabinet. All instruments are mounted inside an oak cabinet. All connections are short and made with heavy copper ribbon. I have had excellent results with this set, and there isn't any noise to the gap.



The Boys in Waco, Texas, Seem to Be Going Strong With Their Radio Stations of Late. Pretty Good Lay-Out, "Hen,"

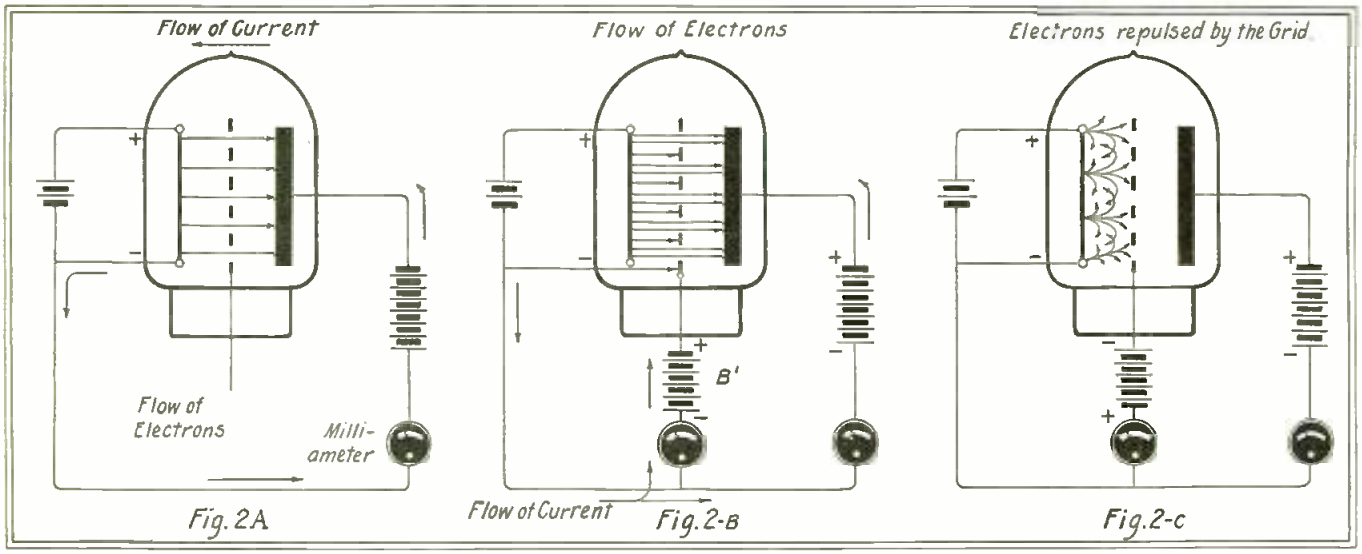
For receiving, the picture speaks for itself, as it were. Radio apparatus undamped receiver and loose coupler. Home made audion control panel. including two variable condensers. Two step amplifier, and a set of Baldwin 'phones. I have since added a short wave regenerative set. I have no reason to kick about the work of this set except when local QRN is very bad.

The aerial consists of two 35-foot poles on the roof of a two-story building. Total heighth 65 feet. Six wires 2 feet apart, 80 feet long. Wishing you all the success in the world for your magazine I am, Yours for Radio.

HENRY M. HARRIS,
Waco, Texas,
Box 427.

Junior Radio Course

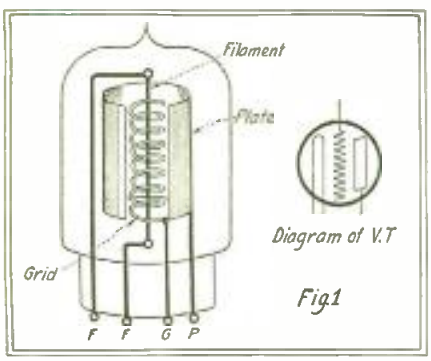
The Three Element Vacuum Tube



Here Are Three Simple Diagrams Which Will Readily Show You Three Basic Facts You Should Remember About the Operation of Vacuum Tubes. Note Well, How the Electrons Flow in a V.T. and the Role of the Grid and Plate. It Will be Noticed That the Current Flows "on" the Electrons Which Act as a Conductor.

IN our last lesson we described the principle of the vacuum tube, and the first apparatus built along these lines, in other words, the Fleming valve. This time, we will speak of the three electrod vacuum tube known as the audion, which is the present day adaptation.

After many experiments, Dr. Lee de Forest conceived the idea of introducing an auxiliary electrod in the ordinary valve of the Fleming type. This electrod placed between the filament and the plate is known as the grid, and is composed of a little solenoid surrounding the filament as shown in Fig. 1. It is sometimes made in the shape of a ladder placed on both sides of the filament as in certain transmitting tubes, but its rôle is the same in all cases.



The Disposition of the Various Elements in a V.T. is Shown in This Figure as Well as the Representation of Three Elements V.T. as Used in diagrams.

FUNCTION

Now to study the functioning of the three electrode vacuum tubes, we will use the hook-up shown in Fig. 2. As already explained in the last lesson a plate-filament circuit is secured by the electrons traveling *from the filament to the plate,* since they are attracted by the plate positively charged; and allows the current from the battery B to flow in this circuit *from the plate to the filament* as in Fig. 2A. Thus the electrons act as a conductor. If we connect the grid to the common point O including in the circuit a battery and a milliammeter, as in Fig. 2b, it will be seen that a current flows in the grid circuit because a certain number of electrons are stoppt by the positively charged grid and allows the current of the battery B1 to flow in the circuit, in which case we have a grid-filament current.

Now, if we change the polarity of the grid, what will happen? In Fig 2c, the flow of electrons from the filament, when the grid is negative is repulsed, for in this case the electrons are negatively charged. since we know that two polarities of the same name repulse one another. Therefore, the current from the plate, having no electronic support to travel on, is then quite suddenly stoppt.

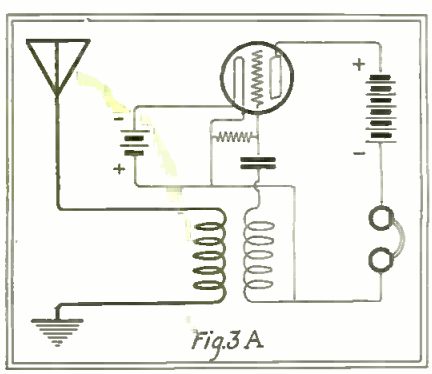
One can understand from this explanation that the grid acts as an automatic interrupter. but since no mechanical parts are to be moved it has no inertia. and it can therefore open and close the circuit of the plate a tremendous number of times per second.

THE THREE-ELEMENT VT AS A DETECTOR

By properly connecting a three electrode vacuum tube in a receiving circuit, it may be used as a detector which is of the most sensitive type. We shall therefore explain its functioning as a detector.

Since we know that changing the polarity of the grid from positive to negative opens and closes the plate circuit, we can easily accomplish this by means of the alternating current received in an aerial, as shown in Fig. 3A, and at the same time rectify this current for reception purposes.

The receiving set which employs a crystal detector and a telephone receiver has been described in a former lesson and reasons were given, why a telephone cannot respond to radio frequency oscillations. In order to make the vacuum tube function properly at all times as a rectifier of oscillations, you must introduce additional and



The Simplest Form of Receiver—By Comparison With the Analogy the Functioning of a V.T. detector is Easily Understood.

necessary appliances in the grid circuit. These are the *grid condenser* and the *grid leak* which you no doubt have already seen described. In the case of Fig. 3A, when no oscillations are being received in the grid circuit, the grid potential is therefore at a zero value and the result is that no current flows in the circuit; that is to say, none of the electrons are stoppt by the grid but instead flow straight thru from the filament to the plate without interruption.

When radio frequency currents are induced upon the grid circuit from the aerial, the grid is made first *positive*, then *negative*, for only alternating current can pass thru the condenser. When the grid is positive, electrons are drawn over it, but when it is negative, the electrons are repelled, thus for each succeeding half oscillation electrons are drawn to the grid, placing a charge in the grid condenser which is negative on the grid side.

Since an increasing negative charge on the grid acts to reduce the plate-to-filament current, then, while a group of oscillations are rectified the telephone current is reduced, but the grid leak comes in to play its rôle, which is to slowly discharge the condenser and allow the grid and plate to come back to their normal state. These variations which occur at each *wave train* causes the diafram of the telephone receiver to vibrate.

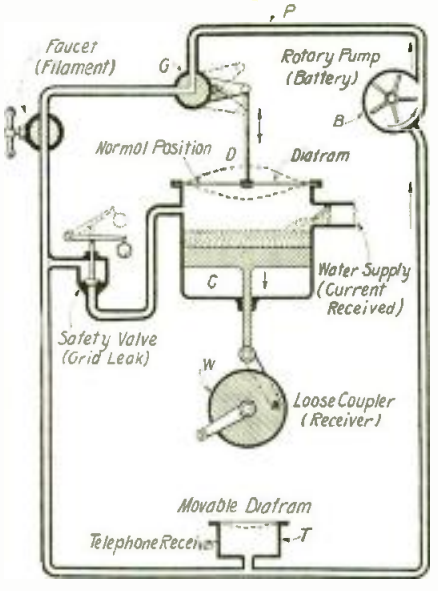
Altho this explanation is simple enough to be understood by most students we will further illustrate the phenomena which occurs in a vacuum tube detector, by means of a simple analogy.

ANALOGY

In Fig. 3B, the endless water pipe P represents the plate filament circuit. The rotary pump can be taken to be the B battery, and the faucet F is the filament which, when open, represents the lighted filament. It will be noticed, too, that the telephone is shown in that circuit as a little tank having a side composed of a movable diafram and connected to the main circuit.

The cylinder having a movable diafram top in the center of the diagram is the *grid condenser;* while the safety valve on the left is the *grid leak*, the grid itself being represented by the faucet moved by the diafram of the cylinder.

The functioning of this apparatus representing a VT detector may be explained to you as follows:



Simple Anology Illustrating the Phenomenon Which Happens in a Vacuum Tube Detector.

When nothing disturbs the water it flows continuously in the endless pipe providing the faucet F representing the *filament* is open.

WHEN OSCILLATIONS ARE RECEIVED

When we turn the crank W this causes the piston C to move up and down within the cylinder. Since this causes a suction & compression, it will operate the diafram D and cause it to open and close the faucet G which in a radio circuit would be the grid. It will be noticed that at each down stroke of the piston a certain quantity of water will flow into the cylinder. This would be what would take place in a regular radio receiver which in that case we would call the amount of current received from the aerial system.

Each stroke of the piston represents a high frequency oscillation and you will therefore understand that after a certain number of these strokes, the cylinder will become filled with water in such a manner as to force the diafram D to close the faucet G. This is also what would happen in a radio receiver system where after each wave train the condenser would become charged and the grid having been made negative it will stop the flow of current between the plate and filament. Therefore, each time our water system moves up and down the movable diaphragm T, which normally would be the telephone receiver, is forced to move back and forth in a similar manner.

The safety valve of our system, which in the case of a radio system would be the grid leak, permits the compresst water of the cylinder to run in the main water circuit. This same process occurs at each wave train of a radio receiver.

In the next lesson we shall explain the vacuum tube used as an amplifier.

Dictionary of Technical Terms Used in Radio Telegraphy and Telephony*

Static Transformer—A transformer having no moving parts. Same as an Induction Coil but without hammer break in primary. The alternating current being sufficient to produce A.C. in secondary.

Stator—The stationary part of an induction motor.

Stays—Ropes permanently fixed to support a mast. Compare with Guys.

Step—On a winding, refers to width of coils of drum armature. Also called Pitch and Throw. "In Step" refers to two or more machines running in phase with each other.

Step-Down Transformer—One which has many more turns of wire in the Primary than in the Secondary, thereby *increasing Amperage and decreasing Voltage.*

Step-Up Transformer—One in which Secondary has many more turns of wire than the Primary, thereby *increasing Voltage at the expense of Amperage.*

Sticking of Coil Contacts—See Sparking of Coil Contacts.

Storage Battery—A number of Secondary Cells capable of being charged or discharged at the same time through the same circuit. A quantity of cells used as one. Also known as Accumulators.

Storage Cell—Secondary Cell or Accumulator. One which stores up electrical energy in form of chemical energy. See Secondary Cell.

Strain Rod Insulators—Two ebonite rods joined together by a link, one of which has a zinc cone at one end. Used for guying downleads, etc.

Stratum—One layer of a number of materials laid one on the top of the other.

Strays—See X's, and see Static.

Strop Insulator—A cord covered with rubber and vulcanized, having at each end an eye fitted with a thimble and shackle.

Stuffing Box—A hollow casting holding asbestos rings through which tube of Bradfield Insulator passes.

Sulphate of Copper—See Copper Sulphate.

Sulphating—Lead sulphate working out to surface of plates of an accumulator in form of almost insoluble crystals, which are poor conductors and very difficult to remove. Caused by a discharged cell being left inactive. When not very bad may be remedied by prolonged charging.

Sulphur—S. Brimstone. Pale yellow nonmetallic element. Excellent Insulator. A.W. 31.83. S.G. 2.07. Mlt. Pt. 239° F. S.I.C. 3.8 to 4.7.

Subpermanent Magnetism—Partially permanent magnetism.

Supplement—Amount necessary to be added to an arc to produce two right angles, i. e., 180 degrees of a circle.

Susceptibility—Ratio of intensity of magnetization produced in a body to the field producing that magnetization.

Surface Resistivity—Resistance between the two opposite edges of a Cm Square of the surface film which is deposited upon the material.

Suversed Sine—That part of diameter of an arc not contained between Sine and Arc.

S. W. G.—British Standard Wire Gauge.

Swiss Commutator—One used in high power sets, by means of which different series parallel, or parallel arrangement of the separate units may be readily made up in the condenser battery.

Switch—Apparatus for readily connecting and disconnecting two wires.

Sylvanite—Graphic Tellurium. A Crystal Rectifier. Tellurium in combination with gold and silver (Ag Au) Te2.

Synchronous Disc Discharger—One so arranged that its electrodes approach, and discharge takes place in syntony with the alterations of the generator. The number of studs is equal to number of poles of generator which gives a spark at each half period or in other words a spark frequency of twice the alternator.

Synchrondus Motor—One which runs perfectly "in step," "phase," or synchronism with the supply alternating current.

Synthesis—The building up of a complex compound from its component elements.

Syntony and *Syntonization*—Two circuits are said to be in syntony when they have the same natural period of electrical oscillation.

T. Aerial—One having its downleads tapped off from the *middle* of the horizontal span.

Tails—Name given to small iron wires forming core of Induction Coils.

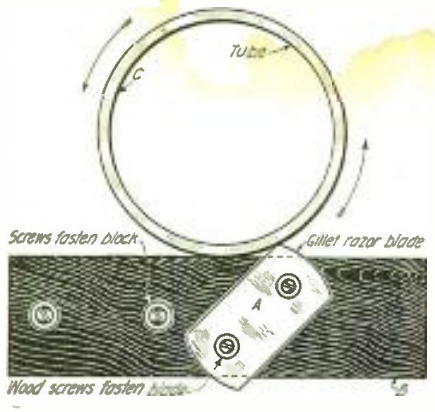
Tangent—Line drawn perpendicular to end of diameter passing through end of arc and produced until it meets the other

(Continued on page 411)

*This Dictionary was started in our March issue.

Junior Constructor

A TUBE CUTTING DEVICE



A New and Effective Way of Using Old Safety Razor Blades.

The sketch herewith shown is the method devised by the writer for cutting tubing for variometers, etc. Thus far he has not found one that would work any better or quicker.

It is simplicity itself, and needs very little explanation. The base "B" is made of any scrap piece of wood, the thickness of which is determined by the width you want your tubing cut. If one piece is not thick enough, you can build it up in numerous ways that will suggest themselves.

"A" is a Gillette razor blade which has rounded ends as per the drawing and two holes as shown. The blade must be so placed that enough of the corners project to go all the way thru the carboard tubing and a little beyond to make a clean cut. It is then fastened on with two short wood screws with washers under the heads, as the holes in the blade are fairly large. Two holes are drilled in the remaining part of "B" to fasten the device to the work bench. This finishes the construction.

In operation, the tube, which should have, and usually has, one end square, should be placed on the bench as in the drawing, bearing against the block and the blade. The operator pushes down on the top of the tube while rotating it, as the blade has a tendency to turn up and make the cut uneven. Care must be taken that not too much of the corner of the blade extends, as it is very thin, and will bend up as above mentioned.

You will find that once around will cut thru the ordinary run of tubes, while thicker tubes surrender to two turns.

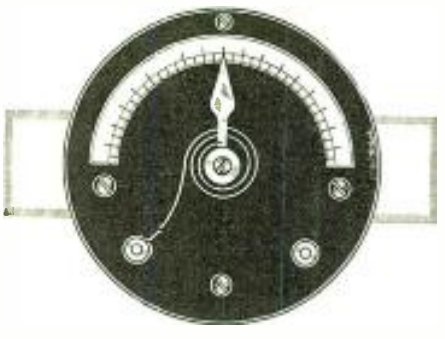
Contributed by
HOWARD C. STORCK.

CONDENSER NOTE

Some makes of variable condenser which employ for connection to the rotary plates a brass strip bearing on the lower end of the plate assembly, cause much annoyance while being adjusted due to poor contact to the rotary plates thru the brass strip.

This is often made evident by the scratching noise heard in the telephones. It can be easily remedied by soldering a short length of wire to the indicating arrow and then bending the wire in the form of a spiral, bringing the free end to the proper binding post, as illustrated.

Contributed by CHAS. BURSON.

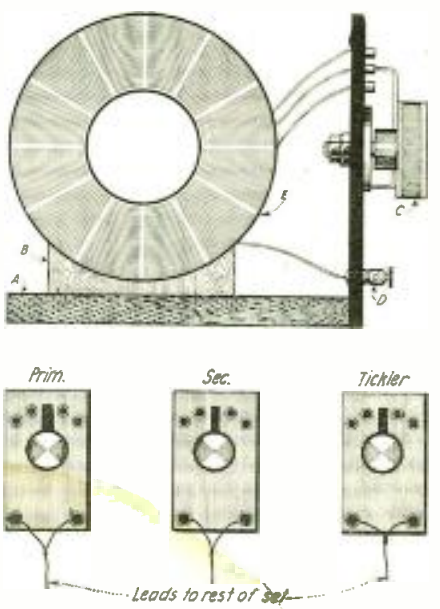


Be Certain of Proper Connection in Variables. A Little Hair Spiral Spring Does the Stunt.

AN EFFECTIVE COIL MOUNTING

The mounting illustrated here is a very good one for the hand and machine wound honeycomb coils having taps.

No dimensions of the length and the width of the base are given in this case as these will be governed by the diameter and the width of the coil.



Any Degree of Coupling Can Be Effected by Changing the Position of the Coils to one Another.

The base is of ⅜" hardwood about 1" longer than the diameter of the coil and ½" wider than the width of the coil.

The support which holds the coil is cut out of wood and is as wide as the coil. It is cut to fit the coil as shown and secured to the base by two flat-headed brass screws as shown. The coil is glued to this.

The "panelette" is of hard rubber or "Bakelite" ⅛" or more thick. It is the same width of the base and as long as the diameter of the coil. and is secured to the base by two small round-headed brass screws.

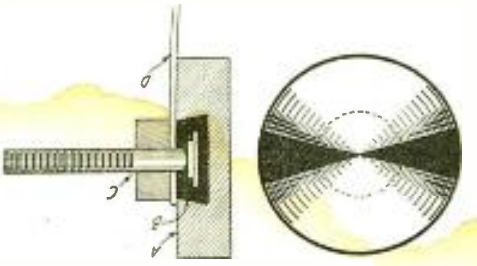
The switch is a DeForest small type. Contacts are ¼" x ¼". Binding posts are any of the small set screw type on the market today.

If desired the coils may be completely housed in and the box thus made given a polish, making a fine looking piece of apparatus.

They may be connected to the rest of the set by means of a flexible double conductor.

Contributed by CHAS. BURSON.

A SWITCH KNOB



Get Your Writer Friends to Save Ink Bottle Corks—They Make Good Knobs.

Anyone desiring a number of switch knobs and who has not the price to buy them can make very neat knobs himself. The knobs are made from the corks of empty ink bottles. For a neat knob I used the cork shown as A, from a quart bottle of Higgins India Ink. I cut away the cork and removed the staple, this leaves a hole in the rubber in which the bolt C is fastened. A low fusion alloy may be used in fastening the bolt in place, most anything will do, such as melted sulphur. After this has cooled the switch arm D may be fastened in place.

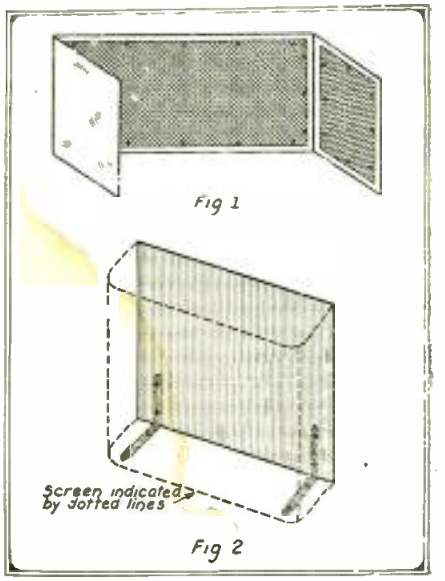
For smaller knobs smaller corks may be used instead.

Contributed by
FREDERICK H. GRAENING.

METAL SHIELDS FOR C. W. RECEPTION.

Amateurs now building cabinet sets had better start right by lining the back and sides of their cabinets with fine metal mesh wire, as illustrated in Fig. 1. This mesh wire should be grounded. Amateurs who own panel sets can improve operation by banking their panels with a similar wire mesh or metal plate, grounding it to a water pipe or other convenient ground lead. Fig. 2 shows a good method of accomplishing this.

Contributed by L. ZIMMERMAN.



Use These Shields to Prevent Interference Caused By Magnetic Disturbance in C.W. Work.

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can only publish such matter of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editor a personal favor if you make your letter as brief as possible.

A SMALL AMATEUR LOOP

(128) Mr. P. B. Arnar, of Reykjavik, Iceland, asks:

Q. 1. What kind and what size of wire is best for a 1 Meter square loop antenna This loop is to be used to receive wavelengths of about 600-1,800 Meters.

A. 1. We suggest that you use No. 20 bare wire wound on insulating material and with turns spaced about ½".

Q. 2. Could same be used for transmission?

A. 2. You may try the same for transmission, but we do not think very good results will be obtained with such an aerial using spark transmitter, owing to poor radiating properties.

Q. 3. Please give hook-up for same.

A. 3. You will find a suitable hook-up on this page.

TRIANGULAR AERIAL

(129) A. L. Beyler, of Philadelphia, Pa.

Q. 1. Sends a diagram of his special type of aerial which is a system of three aerials arranged in a triangular spread, and asks what results could be secured with it?

A. 1. We think that good results can be obtained with the aerial you intend to experiment with, but only three wires in each of the aerials will be sufficient, otherwise your capacity will be too great.

TRANSMITTING VARIOMETER

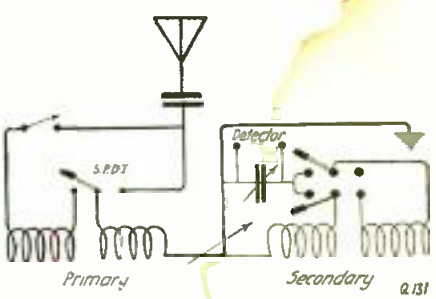
(130) S. Posen, Syracuse, New York, asks:

Q. 1. What are the dimensions of coils and size of wires to use for a Telefunken type transmitting variometer suitable for a one inch spark coil set?

A. 1. To build such a variometer you may use No. 18 double cotton covered wire wound on an outside frame 4" by 3" and 2½" long and an inside frame 3½" by 2" and 2" long. In order to have good insulation, it is advisable to coat the frames and winding with shellac.

Q. 2. Can a small Mazda bulb be used instead of a hot wire ammeter in the aerial circuit?

A. 2. Yes, a little incandescent lamp may be used for this purpose, but when the circuit is tuned, this lamp should be short circuited by means of a switch.



A Simplified Hook-Up of the Loose Coupler Receiver Mentioned By Mr. Clement in the August Issue.

RECEIVING SET HOOK-UP

(131) Thos. K. Lewis, Albany, N. Y., asks:

Q. 1. What effect would shellac or lacquer have on variable air condenser plates?

A. 1. This would increase the effective capacity of the condenser.

Q. 2. Will you please publish a good diagram of a loose coupler for the set published on page 76 of the August, 1920, issue of RADIO NEWS? and which pertained to the article "Design of a Radio Receiving Set."

A. 2. You will find a suitable diagram on this page.

Q. 3. Where may I find an article in RADIO NEWS on winding an amplifier transformer?

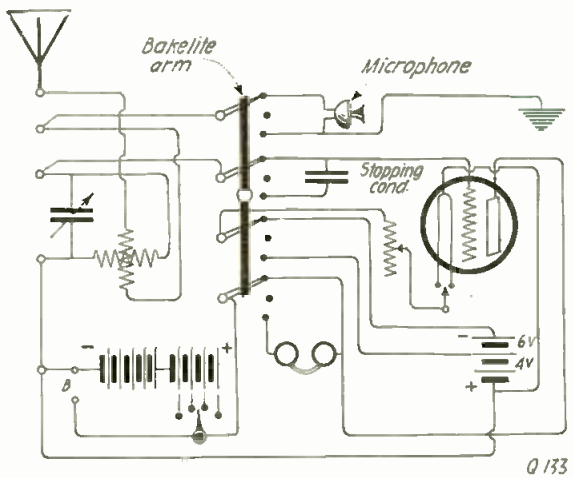
A. 3. For information on this subject we refer you to the book entitled "Design and Construction of Amplifying Transformers," by E. T. Jones, the price of which is 25c, and which is publisht by the Experimenter Pub. Co., New York City.

USE OF SKINDERVIKEN MICROFONE BUTTON

(132) Jr. R. Roach, of Bronxville, N. Y., wishes to know:

Q. 1. Can you give me the size of the variable condenser used in the simple radiophone circuit described in the July number of RADIO NEWS, on page 21?

A. 1. The capacity of this condenser is about .0005 mfd.



A Hook-Up for Utilizing the Same Vacuum Tube for Both Radiophone Transmission and Reception. A Switch Does the Trick.

Q. 2. Is this condenser necessary for the successful operation of the set?

A. 2. Yes, this condenser is useful for the tuning of the oscillating circuit and cannot be dispensed with.

Q. 3. Would the Skinderviken button make a suitable transmitter for this radiophone?

A. 3. Yes, this microphone may be used with this set with success.

COMBINATION SENDING-RECEIVING V.T. HOOK-UP

(133) Le Roy T. Rix asks:

Q. 1. Will you please publish a diagram showing the means of quickly changing from sending to receiving which could be used with Mr. Rumford's panel set published in the July issue of RADIO NEWS?

A. 1. You will find on this page a diagram suitable for these two functions.

Q. 2. How much current will be drawn from the B battery when using this set for transmission?

A. 2. The plate current may be from about 30 to 40 milliamperes.

Q. 3. May I use a little dynamo delivering 150 volts to supply the current to the plates?

A. 3. Yes, this voltage would be effective for this purpose, for the higher the voltage, the better results you will secure.

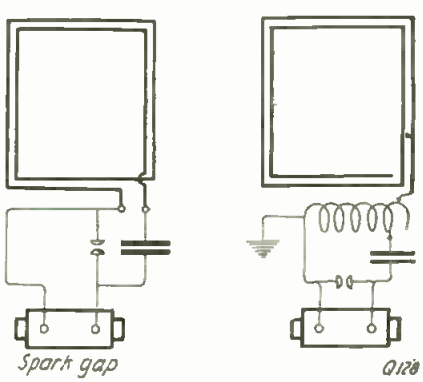
DUO-LATERAL VERSUS HONEYCOMB

(134) L. R. Jewell, Kansas City, Mo., wants to know:

Q. 1. May the *duo-lateral* coils be substituted for the regular honeycomb coils in receiving set using the latter?

A. 1. Yes, the duo-lateral coils may be used without any alteration in the receiver providing they are of the same inductance and that you make provision for mounting.

(Continued on page 394)



Suggested Hook-Ups Employed a Loop in a Transmitter Circuit.

CORRESPONDENCE FROM READERS

WHY NOT LET V.T. MANUFACTURERS DO A LITTLE PRICE EXPLAINING?

Editor RADIO NEWS:

If the Editor will permit me I would like to add a few words on the subject which Carl Masson has opened in the October issue, namely "Why the High Cost of Audion Bulbs."

It is a well-known fact that most of the bulbs manufactured in the United States are produced in quantity lots and the most up-to-date labor saving methods are used, thereby reducing the one item. labor, which is always a large factor in determining the final selling price to a minimum.

The writer has recently returned from a considerable sojourn in Europe and while in France purchased a quantity of Audion Bulbs of French manufacture, the same bulb that is used by the French and Belgium Governments. In no case was the retail price over 20 francs, which normally is $4.00, but actually was about $1.75 on account of the exchange condition.

These bulbs are practically all hand made, consequently the cost of labor is the largest item in the cost per unit. Labor in France is cheaper than in this country, but considering the greater amount of manual labor involved in the making of the French bulbs and the increased wages paid the American worker, it is hard to understand why the American bulb manufacturer should charge almost double for their product.

Some may say the difference is occasioned by the difference in the cost of materials in the two countries. In this connection, I had reason to inquire what the cost of a variety of raw materials was and found that raw material averages *higher* in cost in France than in the United States.

Of course we all know that the patent squabbles which the several patent holders and manufacturers have been having, have been very expensive and we, the amateurs, are being unwillingly forced to pay the bills.

By why not reduce the price. The demand, great as it is, will increase enormously, because every amateur, who now can only afford a 25c chunk of galena, will have one or more bulbs. The greater quantities that are manufactured the smaller will be the cost to the makers and the manufacturers will still be making their profits with the result that everybody is satisfied. Possibly the matter could be cleared up considerably if the manufacturers did some explaining.

W. R. HOFFMAN,
Radio Operator on S. S. Saboatao.
Charleston, S. C.

HE LIKES OUR COVERS

Editor, RADIO NEWS:

Regarding the letter signed by J. F. Maher, in the November issue, relative to the cover of RADIO NEWS, it seems to me to be a difficult matter to understand such criticism.

Since there is always an abundance of excellent scientific matter between the covers of each issue of your magazine, which is not "ridiculous" why object to the means used to attract readers of such matter? I do not mean that I think the covers of your fine magazine are ever ridiculous in a strict sense, for if I did I would have to agree with Mr. Maher. I think they are funny, but even if they could be termed ridiculous, do we not laugh at the ridiculous? And is a man who interests himself in reading technical matter supposed never to laugh? The better term for the covers in question should be "humorous."

The human interest which is apparent in the way you treat each subject is fine. It raises it above the dry or sordid and keeps one interested to the end. And it seems to me that the same quality is strongly manifested in your alternate covers, namely one of human interest.

If you change and make each cover one only of "RADIO" interest, you will have at least on disappointed reader in-so-far as the cover is concerned.

I do not see how any radio man, especially one who has come up from the ranks, starting as a "ham", could decide to stop taking RADIO NEWS because he considers the covers ridiculous. I should think it would take something greater than that, such as a consistent misstatement of facts or articles which would not interest the technical man.

I think your comment on Mr. Maher's letter is very well taken, and I think many of your readers will think so too.

Wishing your magazine a long continuance of its well-earned success, I am,

JOHN B. DOWDEN,
Glen Cove, N. Y.

SHALL WE MAKE IT A BI-MONTHLY?

Editor RADIO NEWS:

What do I think of RADIO NEWS? Well, I'll say that it is a gosh-darn long time between copies. Why not issue it twice a month? It surely is the only magazine for the amateur and thirty days is a long time to have to wait for it.

F. L. WOOLSEY,
San Francisco, Cal.

FROM A 61-YEAR-OLD "BUG."

Editor RADIO NEWS:

Regarding the complaint of the radio instructor of the K. of C. school, at Savanah, Ga., which appears on page 300 of your November issue, please tell him to "tumble to himself" and *please* don't discontinue your "human interest" pictures.

I'm a 61-year-old "bug" and am proud to acknowledge that it was one of your covers that caught me, and I can find something interesting in every one of them. I'm afraid there is something wrong with our friend's digesting outfit.

WM. W. CRANE
Terminal Hotel, Atlanta, Ga.

THANK YOU, MR. DUNNAM.

Editor RADIO NEWS:

This is to be considered as a "bouquet-brickbat," prompted by J. F. Maher's criticisms of cover illustrations of RADIO NEWS, and your frank invitation for further opinions along the same line.

Let me say that I, and I believe the majority of your readers thoroughly agree with Mr. Maher on the subject, both as to cover illustrations and "genuine technical worth" of the magazine, tho he may have been a little less "blunt" in phrasing his views. This would never have been written but for his letter, which struck me very forcibly due to the fact that I had already criticised, and very emphatically, both mentally and to some of my radio associates, the cover illustrations of RADIO NEWS, especially the one made issue of by Mr. Maher, the September number. They are decidedly "off color" and "out of tune," in my humble opinion, with the idea expresst by the publication.

Furthermore, to the real "radio bug" radio is not "dry" reading by any means. If all, or the majority of enthusiasts are to be judged by myself, and I think I am of the typical variety, the fiction, "jokes" and human interest elements of the magazine are passt over without a second glance, and every line of technical matter devoured eagerly. As to the "jokes," the majority of them are only funny because of their ridiculous attempt at humor!

I also beg to differ with you as to such cover illustrations attracting the outsider to the game. If the skin of an apple made it appear rotten, would you eat it? Of course, even with the apple, outward appearances are deceiving, at times, and such is the case with RADIO NEWS, for without doubt, it is the premier publication among the radio fraternity and we, the "radio fraternity" are expressing our opinions freely because we would like to feel proud of our publications and do not wish the dignity that is justly due the art, offended in the manner under criticism. Amateur radio has graduated from something for the kiddies to play with to real scientific experimenting. The outsider who notices our covers will pass them over as still a "kid's plaything." Most boys of a "tinkering" talent, will *naturally* turn to radio. It's the *older* outsider we want especially to attract to the game.

Now I don't wish this to be considered as a "knock," but simply as a friendly and interested criticism, and let me add my suggestion to Mr. Maher's that our covers be more of a technical, business-like nature. for instance, views of big high powered stations or up-to-date amateur installations, in which we are all interested. Let the general outline of the cover stand—it is good—but substitute for the pictures.

Sincere wishes for continued success of RADIO NEWS, the best of its kind, from

L. M. DUNNAM,
2375 Champlain St., N.W., Apt. 301,
c/o The Associated Press, Star Bldg.
Washington, D. C.

SHOULD A RADIO MAN FALL IN LOVE?

Editor RADIO NEWS:

I read with considerable amusement the letter of J. T. Maher in your November issue concerning the cover on the September RADIO NEWS. He seems to be under the impression that "radio bug" is a cold, sober-minded automaton with a soul utterly dead to the pleasant side of life, who pores over volumes of technical lore twenty-three hours of the day and spends the remaining hour dreaming of logarithms on a bed entirely surrounded by scientific apparatus. Believe me, the real radio bug is just as human and enjoys a joke as much as the next fellow. You probably remember the old saying that "too much radio and no jazz will make Jack a bonehead." This is particularly true of radio bugs. I am sure, if I had nothing but dry scientific matter to read I would soon go crazy. Yet I think I am just as "bugs" about radio as anyone.

As to the September cover I thought it was as good or better than any cover I ever saw.

I have become acquainted with quite a number of amateurs and operators from both U. S. and Canada and so far have only met one who didn't have an exaggerated sense of humor and who did not relax once in a while to laugh and joke with his friends. This particular fellow was attending medical college and spent most of his time slicing up dead bodies and dissecting kidneys and livers. which probably accounts for his melancholy disposition. I would like to tell you more of this rare specimen, but I am afraid he might read these lines and understand who I refer to.

So, Mr. Maher thinks a bug should never be so "vulgar" and "common" as to osculate? But perhaps he never was young himself, in which case we will have to make allowances.

Back in my home town are several hams who are very intimate friends of mine and

(*Continued on page 408*)

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(Continued from page 357)

mum angle to which the boat be rocked before it ships water. This is e voltage at which the surrounding air breaks down under the electrostatic pressure. In electrical units the displacement in the ether is expresst in ampere meters. This is really a measure of volume as is apparent from the consideration that the amperes charging current at the limiting voltage is proportional to the two horizontal dimensions. The third dimensio or the height appears directly in the product and is expressed in meters.

The height of the antenna is the most expensive of the three dimensions by which we may create electric displacement in the ether. The tendency in stations designed for greatest economy is therefore towards structures of moderate height and great length, whereas, the tendency in the past, when dynamic efficiency was the principal consideration, was towards towers of great height. The unit of performance on the old basis was kilowatts consumed by the antenna. The unit on the new basis is ether displacement. This modern measure of antenna radiating capacity is the number of ampere meters of ether displacement that can be produced at the voltage which is limited by the breakdown of the air.

CENTRAL STATION ANTENNAE SYSTEM

The antennae of the stations of New Brunswick and Marion which are now used in transatlantic service are each *one mile* long. In the new radio central station which is being built by the Radio Corporation on Long Island there will be ten or twelve antennae, *each a mile and a quarter long*. This station is intended to communicate efficiently with all parts of the world. When very long distances are to be spanned correspondingly long waves will be used. For efficient transmission of these long powerful waves an antenna will be needed that makes contact with a large volume of ether. This will be accomplisht by combining several of these antennae into one unit. At other times the same antennae will be used for the simultaneous transmission of several messages over shorter distances.

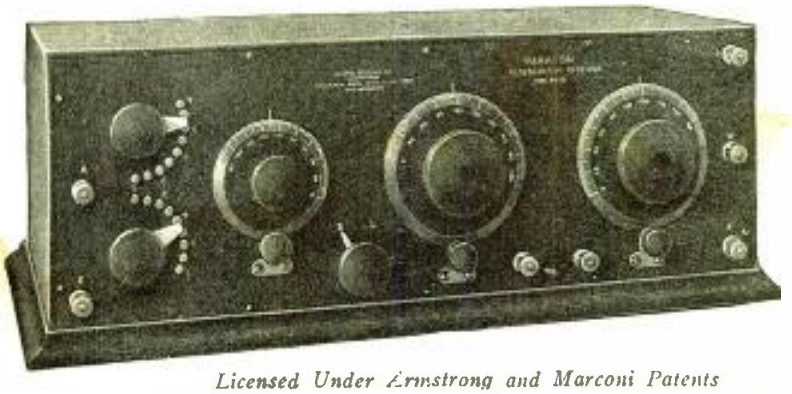
The shifting of radiation power which has been referred to is made possible by the use of the multiple tuned antenna which has been described in a previous paper before the Institute of Radio Engineers. The New Brunswick and Marion antennae are now tuned so that each acts as six single antennae operating in multiple. The combining of several units in multiple is only a further extension of the same principle.

When two such antennae groups are connected in multiple the loss resistance is reduced to one-half. Hence the efficiency of the antenna is increased so that a given power produces more radiation. Still more important is, however, the fact that more power may be utilized at this increased efficiency and so the net result is that the amplitude of the radiated wave is doubled, which means that four times as much energy is radiated.

The economical factors that point to the radio central station as the practical solution of the problem of long distance communication are practically the same as those that created the central electric power station. Broadly speaking, they provide for the utilization of the plant investment and operating force to the utmost by shifting the equipment from one service

(Continued on page 386)

Paragon R. A. TEN



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No. D-101 De Forest, Wt. crystal	2.80
No. AMCO Detector, less crystal	1.75
Tested Galena Crystal	.50

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No. R13 Signal	16.00
No. 439 Murdock	5.50

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No. US 35	1.00	No. US 400	2.00
No. US 50	1.10	No. US 500	2.20
No. US 75	1.20	No. US 600	2.50
No. US 100	1.30	No. US 750	2.70
No. US 150	1.40	No. US 1000	2.90
No. US 200	1.50	No. US 1250	3.50
No. US 250	1.60	No. US 1500	4.00

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No. 1426-W Federal D.P.S.T. 4 Springs	2.65
No. 1427-W Federal D.P.S.T. 4 Springs	2.85

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No. 55 Mesco	2.25
No. 251 Mesco	.80
No. 168 Century	2.50

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No. 156 General Radio	1.75
No. 550 Murdock	1.00
No. 81 Radio Service	1.25
No. R300 De Forest	1.50

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No. P-500	de Forest audion ultra-audion type with 45 V. "B" battery	7.00

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No. 168	Century, high frequency	2.50
No. Y-744	Clapp-Eastham, high-tone	1.75

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DL- 750	3.30
DL-1000	3.55
DL-1250	3.85
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No. ULC-200	single coil mounting	2.00
No. ULC-300	double coil mounting	4.80
No. ULC-400	triple coil mounting	5.60
No. ULC-100	Same as LC-100 but on panel	10.75

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D-102	1000	21000	.007	45.00
D-103	1000	25000	.007	50.00

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d ten cents in stamps for it.

S CO., Inc. BOSTON, MASS., U.S.A.

C

(*Continued from page 382*)

to another and combining it to meet various demands.

New York is a natural communication center and the service must extend to Europe, South America and westward. Another radio central station at Hawaii is being equipped to serve as a relay for all points on the other side of the Pacific Ocean.

POSSIBILITIES OF TRANSATLANTIC RADIOPHONY

While it is winter on the northern hemisphere, the radiating power to Europe can be much reduced but this is the season when the South American traffic requires a maximum radiation because of summer conditions then existing on the southern hemisphere. The New York radio station can then divert some of its radiating power from the European to the South American circuits. There will also be daily fluctuations in traffic load which will occur at different hours due to the difference in geographic longitude. Thus the peak load of European traffic will occur at different times than the South American and Western traffic. The central station equipment can be utilized so as to take advantage of this.

The realization of trans-Atlantic radio telephone for commercial purposes is another object of the Radio Central installation. Trans-Atlantic telephony will, no doubt, be a luxury for some time to come. The radiation intensity needed for telephony is much greater than for telegraphy, and a plant designed purely for telephony might prove prohibitively expensive. However, the flexibility of the radio central where any number of antennae can be combined when desired to produce a more efficient radiation will make an extra powerful transmitter available when needed. while the plant may be used in a more economical way at other times for telegraphy.

The Audion—Its Action and Some Applications

(*Continued from page 359*)

rent, telegraphic communication by conduction or leakage currents should be possible. using the audion as detector and amplifier. I venture to prophesy that within a few years the tall towers and the atmospheric disturbances which have for two decades been esteemed necessary evils in transoceanic wireless signalling, will be regarded with those sentiments which we now bestow upon the coherer and the spark.

But more than this. Signalling by conduction currents of relatively low frequency will soon be practiced thru the earth as well as water; and we will find the antennæ of the future thrust upside down, as into abandoned oil-well borings, and making contact with deep semi-conducting strata, at points separated by a few miles; the two inverted antennæ of such a transmitter connected by an overhead power transmission line containing the alternating current generator and signalling device; and a similar arrangement for receiving.

Then our wireless messages will go thru the earth's crust, or possibly by a more direct path, and not around the earth's surface, to be tangled up as at present with a bewildering snarl of static ravellings. The audion amplifier stands ready to lead us back to the simpler methods of Morse and Lindsay, meritorious methods long ago abandoned because of the lack of an electric ear of indefinitely great sensitiveness.

(*Continued on page 388*)

(*Continued from page 386*)

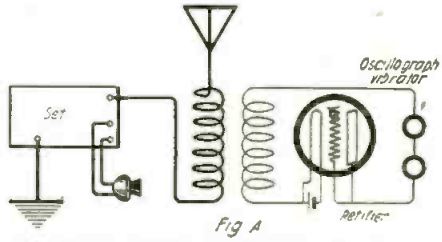
The future of radio signalling at sea lies with the telephone rather than the telegraph. The simplicity, the reliability with which the medium of an undampt wave-carrier, ideally suited for voice transmission, can now be had will rapidly limit the crudity and laboriousness of the Morse code signalling between ships. Yet today scarcely the dawn of this new epoch has been seen. Vessel owners are today almost as skeptical regarding the practicability and utility of the radiophone as we pioneers found them toward the wireless telegraph sixteen years ago!

In the future during fogs at sea a short-wave radio telephone will be used to prevent collisions, distances being determined (as well as direction) by conversation, whistled signal or bell and a calibrated stop-watch. This service will be quite independent of the long-range wireless signalling. The new radio has also a wide field of usefulness in telephoning between islands, thousands of which will never be linked by cable. Other useful fields await in sparsely peopled countries, between mines, oil wells, forest patrols, from express trains, etc. The future of aviation will be found linked with radio telephone, or a score of different purposes. Telephony by audion transmitter, receiver, and amplifier not only carries the complexes of human speech without distortion, but delivers them where human speech itself is impossible otherwise—amid the deafening motor and propeller noises of the airplane, from one to five miles above the earth.

Little imagination is required to depict new developments in radio telephone communication, all of which have lain fallow heretofore awaiting a simple lamp by which one can speak instead of read.

Comparison of Modulation Methods in Radio Telephony

(*Continued from page 362*)



This Shows How the Oscillograph Vibrator Was Coupled to the Set During the Tests.

tion may sometimes be improved by throttling down the input from the master oscillator so that the operation is held more nearly within the straight portion of the characteristic curve of the amplifier. We should be interested to know whether or not this procedure is beneficial. As extremes, the two cases to be considered are:

(a) Strong impresst oscillation over entire characteristic;

(b) Weaker impresst oscillation over straight part of curve only.

The output currents in the two cases are shown in Fig. 13a and 13b.

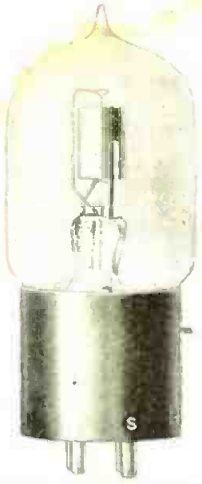
(*Continued on page 390*)

CORRECTION NOTICE

Through a typographical error in the November issue of RADIO NEWS, the advertisement of the Atlantic Radio Supplies Company of Newark, New Jersey, and the Pacific Radio Supplies Company of San Francisco, California, distributors for Moorhead Laboratories, contained the wrong price for the A-P VT Amplifier-Oscillator. The price was shown as $6.00 whereas it should have been $7.00.

-and here it is!

Licensed for use only in apparatus manufactured by the De Forest Radio Tel. & Tel. Co.



Equipped with the SHAW standard four-prong base. PRICE $7.50. Order from your dealer.

You have hoped for it. You have looked for it. You have asked for it. And here it is—a transmitting tube for telephone and telegraph C-W transmission, built right up to British and to French Government specifications. Capacity about 12.5 watts, and any number may be used in parallel—four, make telephone conversation possible over 25 miles, telegraph signals over 50 miles.

The plate of this transmitting tube is nickel, a special molybdenum grid is provided and the high vacuum permits operation on plate potentials of five hundred volts without breakdown.

By connecting the grid and plate together, the tube may be used as a rectifier for obtaining from an alternating current supply the high plate potential necessary for the generator tube.

Adopted by the De Forest Radio Tel. & Tel. Co. as the standard transmitting tube in all De Forest sets of less than ½ k. w. capacity. Licensed under the De Forest Audion and Fleming patents. Other patents applied for and pending.

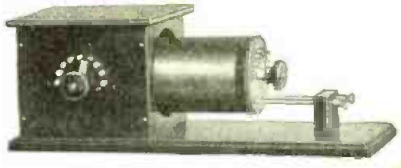
Atlantic Radio Supplies Co.
8 Kirk Place, Newark, N. J.

Pacific Radio Supplies Co.
638 Mission St., San Francisco, Cal.

Distributors for Moorhead Laboratories, Inc., Manufacturers of

The A-P Transmitting Tube

A Loose Coupler that WORKS For a Price at Which Everyone WONDERS



LC-100—Loose Coupler, $9.00

This instrument compares favorably with the high priced receiving transformers and has been built right all the way through. Not a cheap mail-order creation such as put out by some houses, but a loose-coupler that is guaranteed to work or money refunded.

Both primary and secondary are wound on non-shrinkable forms with the best quality silk-covered pure copper wire. Interior so wired as to make short circuits impossible. The primary is encased in a hard wood cabinet and the base is also of hardwood—choice of mahogany, stained oak, or green finish. All metal parts are heavily silver nickeled.

The loose-coupler tunes up to 2,500 meters in connection with the average aerial and is capable of very loose-coupling.

No. LC-100 Loose Coupler—shipping weight 8 lbs.

$9.00 add postage

A FEW MORE BARGAINS

No. 12 pure copper aerial wire, per 100 feet ..... Shipping weight 2 lbs. per 100 ft.	$ .80
Carbon grain transmitter.....	1.00
Skindervicken transmitter button.	1.00
Auditron adapter	1.75
1 K.W. sending key.....	4.00
Auditron tubes	6.00
Shipping weight on any of above, 1 lb.	

Send 15c for our big illustrated catalogue showing scores of other bargains in radio apparatus. This amount may be deducted from your first order of $1.50 or over. High printing costs make free distribution impossible.

ELECTRICAL SPECIALTY COMPANY

Dept. R, 48-50 So. Front St., Columbus, Ohio. **Dept. R, 20 N. 9th St., Philadelphia, Pa.**

(*Continued from page 388*)

The modulation envelope curve of case (a) contains a fundamental frequency term corresponding to the original modulating frequency plus harmonic multiples of this frequency and also an invariable or steady component which is the average value about which all the alternating components vary. This average value can be drawn, as in the figure, by making areas above and below it equal.

The same statements apply to the non-distorted modulation of case (b) except that in this case the wave form contains only the original modulating frequency and no harmonics.

In both cases, according to the theory already presented, the effect in the distant detector depends on the product of the average value A just mentioned and the amplitude of the fundamental frequency term of the modulation envelope curve; i. e., on AB. We have, therefore, to calculate this product for the two cases presented.

In case (a) the equation of the envelope curve may be written in a Fourier's series

$$i = Aa + Ba \sin pt + Ca \cos 2pt + Da \sin 3pt + Ea \cos 4pt + \ldots \quad \ldots\ldots\ldots (7)$$

where the subscript (a) indicates that the coefficients refer to case (a).

In case (b) the equation is

$$i = Ab + Bb \sin pt \quad \ldots\ldots\ldots (8)$$

We are interested in the relative values of the products AbBb and AaBa, in the two cases under different conditions. Evaluating the coefficients of the Fourier's series in the usual way we get

$$Aa = \frac{M}{2\pi}\left\{2\pi - 2\cos\theta_1 + (\pi - 2\theta_1)\sin\theta_1\right\} \quad (9)$$

$$Ba = \frac{M}{\pi}\left\{\theta_1 + \frac{\pi}{2} + \tfrac{1}{2}\sin 2\theta_1\right\} \quad \ldots\ldots (10)$$

The significance of M and θ_1 are shown in the Figure 13a, as is also Ba. As will be seen θ_1 indicates the point in the cycle where the flat portion of the characteristic curve is reached.

In Fig. 13b the maximum or peak amplitude (Ab+Bb) is obviously equal to

$$M(1 + \sin\theta_1) \quad \ldots\ldots\ldots (11)$$

The two products which we have to compare are therefore seen to be

$$AaBa = \frac{M^2}{2\pi^2}\left\{2\pi - 2\cos\theta_1 + (\pi - 2\theta_1)\sin\theta_1\right\}\left\{\theta_1 + \frac{\pi}{2} + \tfrac{1}{2}\sin 2\theta_1\right\} \quad \ldots\ldots\ldots (12)$$

and

$$AbBb = \frac{M^2}{4}(1 + \sin\theta_1)^2 \quad \ldots (13)$$

The values of these two products are plotted for different values of θ_1 on Fig. 14 where it is seen that the former is larger than the latter for all values of θ_1, except $\theta_1 = 90°$, where the two become equal. This result is what might have been expected. Stated non-mathematically, it means that reducing the radio frequency amplitude impressed on the amplifier so as to keep the operation on the straight portion of the characteristic, while obviously improving the quality of the modulation, reduces the net modulated antenna energy. This reduction is greater the smaller the value of θ_1, that is the greater the portion of the cycle which embraces the horizontal flat part of the curve, and is nil when the peak of the cycle just reaches the flat part of the curve ($\theta_1 = 90°$). The ratio of the effectiveness in the two cases is shown on Fig. 14; it is $\frac{AbBb}{AaBa}$ and is seen to be never worse than 75%.

(*Continued on page 392*)

(*Continued from page 390*)

In Fig. 15 is shown this worst condition. The smooth undistorted curve produced by reduction of the impressed voltage is 73% as effective as the flat-topped one.

The ratio curve of Fig. 14 gives an indication of the permissable overrunning on to the flat part of the curve. If a total of 60° is cut off from the peak of the wave the loss in signal strength at the receiver occasioned by reducing the amplifier input voltage so as to give undistorted modulation would only be 9%, hardly noticeable, and probably advantageous because of the absence of distortion.

Referring to Fig. 13 or Fig. 15, it will be understood that the radio frequency oscillations are cut off equally (usually) at top and bottom giving distortion. These distorted (flattened) radio oscillations contain components at the fundamental radio frequency and harmonic multiples of this frequency. The antenna, being tuned, responds only to the fundamental constituent, and the amplitude of this depends upon how much of the cycle is cut off at top and bottom. Obviously the amplitude of the envelope curve over the fundamental radio frequency will exceed that shown in Fig. 13a or Fig. 15a. Fig. 15c shows one of the radio frequency cycles with time axis expanded. Cut-off occurs at angle θ_1. If there were no inflection in the characteristic curve this radio oscillation would reach the value Q corresponding to grid voltage Eq. Owing to the saturation, however, it can only reach the value T. The amplitude of the constituent of fundamental frequency is given by

$$S = \frac{2}{\pi}\left\{\int_0^{\theta_1} Q \sin^2\theta d\theta + \int_{\theta_1}^{\pi-\theta_1} Q \sin\theta_1 \sin\theta d\theta + \int_{\pi-\theta_1}^{\pi} Q \sin^2\theta d\theta\right\} \quad \ldots\ldots (14)$$

$$= \frac{2}{\pi}\cdot\frac{T}{\sin\theta_1}\left[\theta_1 + \frac{1}{2}\sin 2\theta_1\right] \quad \ldots (15)$$

$$= \frac{2}{\pi} Q\left[\sin^{-1}\frac{T}{Q} + \frac{T}{Q^2}\sqrt{Q^2 - T^2}\right] \quad (16)$$

Oscillogram Obtained When Grid Modulation is Used in a Radiophone.

Equation (16) shows how the amplitude of the fundamental radio frequency constituent of plate current, which is the frequency selected by the antenna, varies with different values of Q. Q is obviously directly proportional to the amplitude of impressed grid voltage. As the grid voltage increases from zero, the value of S is equal to Q, and increases therefore in direct proportion. This holds from Q = o to Q = T. Beyond the point where Q = T the variation of S with Q is given by (16). If this latter variation differs from that for the region Q = o to Q = T there will be distortion. On Fig. 16 is plotted the relation between the fundamental radio constituent and Q. It is seen that as soon as the oscillation exceeds the saturation value T, distortion takes place. The fundamental of the radio oscillation continues to increase slightly however as the impressed grid voltage (or Q) increases, approaching a value 27% greater than the saturation value T, as Q increases indefinitely. For the case shown in Fig. 15a (Q = 2T) which is about the limit in practical cases, the peak amplitude of the envelope curve for the fundamental radio frequency constituent should be increased above that shown in Fig. 15a by 22%, giving the envelope curve of Fig. 17.

Club Gossip

(Continued from page 373)

radio. Code practice is given on Monday, Thursday, and Wednesday noons, by the chief operator or his assistant, Justin Toles, 6CF. The Club is making plans for an excursion to the Moorhead Laboratories in the near future. All further doings of the Club will be made known thru these columns. Russell E. Calhoun, 2436 Dwight Way, Berkeley, Calif.

SOUTH JERSEY RADIO ASSOCIATION

The South Jersey Radio Association is at last on its pre-war footing.

At our last meeting on October 14th, we had fifty enthusiasts present. Great spirit was shown. We had a mighty interesting talk by Mr. Mexlin, 3GW, on a simple radio tlephone that really works and does not cost much to construct.

The Association, in order to advertise itself more, furnisht Collingswood, N. J. with the election returns. We have installed a two-step amplifier. Our operators received the returns which were flasht from the station to a large screen in the street by projection apparatus. It was a great stunt. The people appreciated it and no longer make a fuss when we blow the lights now and then. Four years ago we pulled the same trick and put it all over the telegraph.

At the head of the technical committee we have Mr. J. Donald Haig, manager of the Independent Wireless Company. You can rest assured the staff is a good one.

Collingswood, N. J. is our headquarters. Men from all parts of south Jersey flock there on the third Thursdays of the month. Why don't you join the happy throng? We will make it worth your while. Write to Edward B. Patterson, 42 W. Walnut Ave., Merchantville, N. J.

HOOSIER RADIO LEAGUE

The Hoosier Radio League was organized in Kokomo, Indiana on September 15, 1920. The purpose of the League, as stated in the constitution, is "to study, obey and assist in enforcing the United States Government laws and regulations relative to amateur radio communication, and to furnish an easy means of exchanging ideas concerning radio among amateurs." The League is planning to purchase a radiophone transmitter which will be used to give public concerts and entertainments.

As the name implies, membership is open to anyone in Indiana who is interested in radio, and is not restricted to local amateurs.

At the first meeting the following officers were elected: Kenneth Schneiderman, (9RL) president; George Machin, (9EF) vice-president: Ervin Middleton, treasurer; Walter Lanterman, secretary; and Ralph Schwartz, corresponding secretary.

Examinations will be given and members will be classed according to their ability to answer the questions. The questions will follow the general outline of the Government examinations, so as to aid members who desire to do so in passing examinations for licenses.

Meetings of the League are held every Wednesday at the Y. M. C. A. in Kokomo, and anyone interested in radio is cordially invited to attend. Applications for membership will be received by 9RL or by W. F. Lanterman, 746 So. Armstrong St., Kokomo, Indiana. All communications to the League should be addresst to the latter.

I Want to Know

(Continued from page 379)

AMATEUR ANTENNA FOR SENDING

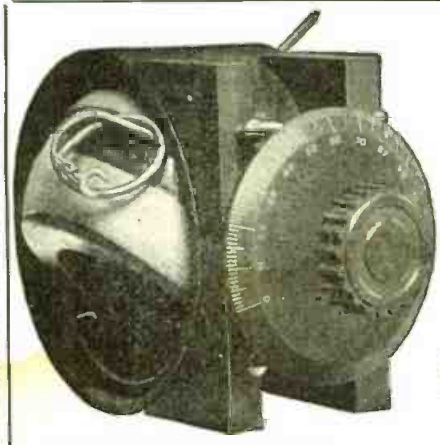
(135) Paul Grouch, of Gresham, O., asks: Q. 1. Will you please publish in your I-Want-To-Know page the dimensions for what would be an ideal amateur transmitting antenna?

A. 1. A good amateur transmitting antenna may be planned as follows: Four phosphor bronze or aluminum wire No. 14, 80 feet long, 40 feet high, with a lead-in of 25 feet and an effective ground will make a good aerial. The wire should be fixt to 8 foot spreaders at each end.

"LITZ" OR LITZENDRAHT WIRE

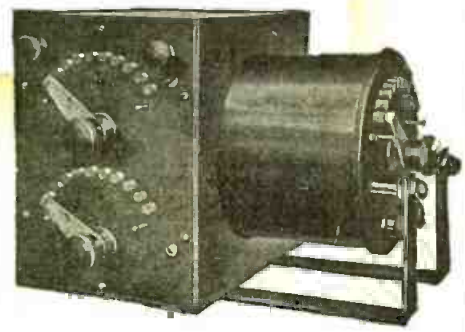
(136) Wilfred T. King, Memphis, Tennessee, asks the following:

(Continued on page 396)



Variometer complete with knob and dial.....$6.50
Without knob or dial..... 5.75
Variocouplers of same general construction 7.50

Tube Control Panel.....$12.00
One Stage Amplifier Panel 18.00
Two Stage Amplifier Panel 40.00
Amplifying Transformer.. 6.50
Amplifying Transformer without panel 4.00
Rheostat only 1.20



Radion Receiving Transformer $14.00
Detector and Amplifier Tubes 5.00

Our advertisements are not filled with superlatives but our products will be found fully equal to the best and are backed by a reputation of thirteen years of continuous manufacture.

Complete Catalogs 6c Stamps

Order from your dealer and remember it will pay you to insist on apparatus manufactured by

CLAPP-EASTHAM COMPANY

120 Main Street, Cambridge, Mass.

A NEW RADIO PRODUCTION

Turney Spider Web Inductance

EMBODIED IN A SMALL UNIT

BETTER COILS

STATEMENT	REASON
More inductance	There is no magnetic leakage in coupling. The coils being flat, the entire magnetic area of the coil is available.
Less distributed capacity	The wire runs parallel for a greater distance and crosses itself less frequently than any coil known.
Lower high frequency resistance	There being no interior magnetic field or air core, high frequency resistance is reduced to a minimum.
Occupies less space	The coils are so thin that three of them occupy less than one-quarter inch.

The winding. → ← *Coil Frame*

Note angle at crossing

This unit contains three Turney Spider-web inductance coils Two movable and one stationary. There are six binding posts permitting most any type of circuit to be used. The doors as shown in cut are capable of very fine adjustment and stay where they are placed. With two condensers .0005 and .001 mf. it will respond to wave lengths, 175 to 400 meters and give results such as you have never had before.

A compact, efficient short wave coil set.

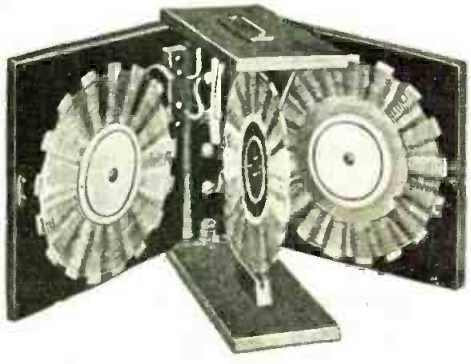


Illustration shows front of cabinet removed

Patent Pending
Dimensions, 4¼ x 5 x 1¾
PRICE, $6.00

The best $6.00 worth of Radio you ever saw.
Full information on request.

Eugene T. Turney Laboratories
Radio Hill, Holmes, New York

(*Continued from page 394*)

Q. 1. What kind of wire is "Litz" wire and where may I obtain it?

A. 1. "Litz," otherwise known as Litzendraht wire, is a stranded wire composed of a great number of fine insulated wires twisted together. We suggest that you write to the Beldon Mfg. Co., 23d St. and West End Ave., Chicago, Ill., and to the Doubleday-Hill Electric Co., 715 12th St., Washington, D. C., who manufacture this type of wire.

Q. 2. If I cannot obtain this, what may I best substitute for it?

A. 2. If not obtainable, some ordinary silk covered wire can be substituted but at a disadvantage. The "Litz" wire has *very little high frequency resistance*, and of course gives better results in receiving systems where the received energy is always so small.

Q. 3. Are the coils marked *inductive* and *regenerative* in a short wave receiver moved from one another?

A. 3. Yes, it is necessary to have a variable coupling between these two coils, and the primary.

LICENSE REQUIRED FOR RADIOPHONE

(137) Gordon A. Cooke, Providence, R. I., asks:

Q. 1. Please give hook-up of radiophone using one Marconi vacuum tube.

A. 1. You will find suitable hook-up and information on page 21 of the July, 1920, issue of Radio News.

Q. 2. Does the Government require the licensing of radio telephone stations and radio telephone apparatus? In the case of the latter, would I have to pass the code test to obtain my license?

A. 2. Yes, you must pass the code test of 10 words per minute even if you do not intend to send by means of the key. This is required by the government laws.

Q. 3. What does the abbreviation C.W. stand for?

A. 3. The letters C.W. mean continuous waves, i. e., undampt waves.

NO AGE LIMIT FOR AMATEURS

(138) Walter Stackler, Jamaica, N. Y., wishes to know:

Q. 1. Must a person be a certain age to obtain a Government amateur sending license, and if so what age?

A. 1. The Radio Communication Laws of the United States do not state any particular age for the obtaining of an amateur license. A license will be issued to anyone who is qualified by examination.

INSTALLING THE LIGHTNING SWITCH

(139) L. S. Cole, Logan, Utah, asks:

Q. 1. Should the aerial lead-in and the ground wires be insulated wires?

A. 1. The aerial lead-in only needs to be insulated when passing thru the wall and down to the station. The ground wire may consist of a bare wire or copper strip.

Q. 2. Should the lightning switch be placed inside or outside the house?

A. 2. To make an effective protection against lightning, the switch must be placed outside the house with as short and effective a ground as may be possible.

Q. 3. Please publish a buzzer transmitting hook-up.

A. 3. On page 31 of the July, 1919, issue of Radio Amateur News you will find a suitable buzzer transmitting hook-up with necessary data for its construction.

MR. PHILIP J. McMANUS

Let us have your proper address, Phil. We wrote you recently and the letter came back.

Re-Enameling Wire

By Francis McCartin, Jr.

The radio amateur who has constructed a Navy Type Loose Coupler, or a long loading coil will no doubt recall the trouble had in trying to properly insulate an enameled wire once the original covering has been removed. This was one of the problems that confronted me when I made my coupler, and after using good energy in calling upon the saints to help make the insulating tape stay, I set out to find something that would take it's place, and at the same time do a better job.

After many experiments with all kinds of adhesives I finally struck upon this idea: Why not try and re-enamel the wire? This is what I did, and it can't be beat. The following is the solution:

As each tap is taken from the coil, it is soldered with a good quality of silver solder, this is done, by making the required number of turns on the cylinder scraping the wire where the tap is to be made, then unwind two turns, fastening the remainder of the wire to the tube with a thumb tack so as it will not unwind. If silver solder is used it is only necessary that the wire be clean, then dip the connection into the solder, and allow to cool. If lead is used it is necessary that the connection be treated with a saturated solution of muriatic acid, that is place a solution of muriatic acid and zinc before the solder is applied.

If lead is used see that the connection is properly cleaned of all the acid, then apply a good coat of enamel or varnish to all bare spots on the wire. When this is done light your alcohol torch (if you have none your druggist can supply you at a cost of about fifty cents) take the wire in both hands so that the joint is in the center, and pass it thur the flame. When this is done for the first time, a flame will be seen. Take it from the torch flame, and blow the fire out, then return it to the light, taking care that you don't burn the wire, work it thru the flame from one side to the other, as fast as you can for about ten seconds, making sure that you enter the air on both sides of the torch. This gives a cooling effect to the enamel, and at the same time protects the wire from getting too hot and running the solder from the connection.

If these directions are followed you will find that all the bare wire has been covered, and while it will not be as smooth as the original insulation, it will have as good an insulating quality, and the wire will be as good a conductor, and have no chance of a short. I have used this system on a Navy Type Coupler,, and it can't be beat.

After finishing the first tap, rewind the two turns, and continue with the balance of the coil.

DO NOT FORGET TO CLEAN YOUR CONNECTION IF YOU USE LEAD SOLDER? OR THE ENAMEL WILL NOT STAY.

A GRAIN FINISH FOR A PANEL

I found that the following method of giving a panel a finish somewhat like bakelite is very successful.

First the panel is made to fit the cabinet, then all holes must be drilled. Purchase some emery cloth and about one tablespoonful of pure olive oil, and work by the following process. Place the panel so that the bottom is towards the worker, spill some of the olive oil on the surface of the panel and smear it evenly. Procure a small block of wood and tack the emery cloth around it. Take the emery block and pull away and towards you with an even pressure till all marks are gone and a grain is obtained.

I found that the method just described works best on fiber panels.

Contributed by EDWARD RUTH.

Theory of the Fading of Signals

By Michael D. Lyons

At all times since Marconi first listened in on a winter night the radio periodicals of the United States have had occasional references to the subject of fading of radio signals. The Detroit Radio Association has been for some time discussing that phenomenon at the regular bi-weekly meetings and some of the members have been making notes. The subject seemed so big and interesting that they thought they would do well by discussing it at the regular meetings. Many interesting theories were advanced to account for the phenomenon. Anything from Martian signals and Martian radio power plant inductions to movements of the ether were at length and seriously propounded by long-winded amateurs with the imagination of a Baron Munchausen or a ham with his first piece of galena. By far the best theory advanced brought into light old Sol.

The sun's terrific explosions, earthquakes (or is it sun-quakes?) and sun spots perhaps are causing the havoc with long distance transmission. The movements of almost unimaginable masses of heavy highly-heated gases may be causing the flow of surface currents on the sun which large currents might in turn be setting up enormous magnetic forces which in turn ionize our air, affect our compasses, and cause the Aurora Borealis. Prof. Taylor in a recent number of the "Scientific American" in treating of the probable connection between sun spots and the Aurora Borealis points out that the sun spots have been of extraordinary size and frequency this last winter as have been the Aurorae Boreales. The experience of the vast majority of the amateurs that the writer has spoken to on the subject has been that they have never before known such a winter in their entire experience as this last one. Signals faded in such a manner as to amaze the oldest veteran operators. There is no doubt on this point. Would not this seem to point to a connection between sun spots and terrestrial magnetic and electrical operations?

If the sun does affect radio communications it would seem that it would affect long distance stations most in the day time which it certainly does. Not that the sun spots exert much influence then and cause freaking but operators all claim that the sun's intense light ionizes our atmosphere and thereby causes the atmosphere to absorb radio waves. However, at night the light from the sun can cause no ionization of our air but what is to prevent the magnetic storms on the sun from affecting long distance terrestrial communications? What is to prevent these same irregular tho massive displays on the sun from affecting our compasses? What about the Aurorae Boreales? Does the effect of the sun affect our weather? Some scientists answer yes to the last question. They are now carrying on tests and observing the sun spots to prove it.

The writer, having no access to observations of the sun at present, cares not so much about answering such questions but about getting some one else interested. If this is done this article will have accomplisht its end and the Detroit Radio Assoc. will feel that it has added another star to the banner of Yankee amateurs.

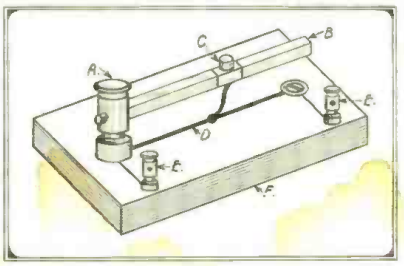
MICHAEL D. LYONS,
Sec'y D. R. A., Inst., Radio-theory Class Tech., ex-commercial, etc.

YOUR FUTURE

Don't let anyone tell you there is no great future in radio. It is something more than a pastime or plaything. Furthermore there is plenty of room in the field for real live enthusiasts who desire to make it a life work.

A VARIABLE GRID LEAK.

In using a grid leak with my VT I find it frequently necessary to vary it. The method of adding or erasing a pencil line drawn between two binding posts was too slow and uncertain, so I devised the variable leak shown in the accompanying diagram. "B" is a square rod with one end filed round to fit into the large binding post "A." An ordinary slider "C," such as is used on tuners, fits on this rod, the spring contact sliding along the pencil line "D." This line may be of India ink and will then be more permanent. Two binding posts "E" are screwed into the base and connected to the post "A" and the line "D," respectively. Contact with the line is made by a washer held down on the line by the wood screw, as shown in the drawing. I hope this may help some amateurs bothered with their grid leaks.



An Old Binding Post, a Piece of Square Rod and Slider and a Lead Pencil Line are the Essentials Here.

Contributed by

P. F. FAULKNER, JR.

Sparks From the Radio World

A NEW RADIO STATION

A new wireless station at Siasconset, Nantucket Island, Mass., has been opened by the International Radio Telegraph Company. The site is an historic one, from a wireless standpoint, for temporary stations have been located here ever since the beginnings of wireless, but permanent, commercial service is now establisht at this point.

This new station, which is the fifth to be opened by the company, is now the nearest one on the Atlantic Coast for vessels coming from Europe. Its working radius is more than 250 miles by day, and 1,000 miles by night. It has direct cable connections with Wood's Hole and is thus in touch with the entire country.

Current for operating this plant is obtained from a storage battery which is charged when necessary by means of a generator driven by a gasoline engine. The transmitter is of the spark-gap type, of 2 Kw capacity and is equippt for operating on either a quenched spark gap or a rotary synchronous spark gap. The frequency of the radio motor-generator set is 500 cycles with a sparking rate of 1,000 per second. The current in the antennae circuit for 2 Kw input is 15 amperes. The receiver is adapted for either dampt or undampt waves over a range of wave lengths of from 300 to 3,000 meters.

The radio call for this station is WSC. Land line charges will be computed from Wood's Hole.

Mr. L. R. Krumm, for many years Chief Radio Inspector, U. S. Department of Commerce stationed in New York City, and during the war Lieutenant Colonel Signal Corps, of the staff of the Chief Signal Officer, A. E. F., and in charge of the radio operations A. E. F., is now associated with the International Radio Telegraph Company as Superintendent of Marine Installations and assisting in the establishment of the new activities in which this company has entered since becoming affiliated with the Westinghouse Electric & Manufacturing Company.

Mr. C. W. Horn, recently in charge of the sales of the Navy Surplus radio material and formerly Lieutenant, J. G. U. S. Navy, during which term of service he installed radio compass stations for the Navy on the Atlantic Coast, is now with this company in the technical section of the Marine Installations.

What is believed to be a record in radio operation was accomplished on September 17th and 24th by operator Chester Underhill in the New London, Conn., station of the International Radio Telegraph Company. On the first named date he received 74 messages averaging 15 words each in one hour and one minute and on the second date received exactly 75 messages of the same length in one hour flat, between 6:25 and 7:25 P. M. These messages were received over a distance averaging 125 miles and were mostly in foreign languages, Italian, French, and Dutch, which makes the feat additionally noteworthy.

OPERATOR'S REPORTS WANTED ON LOWENSTEIN SYSTEM

The Lowenstein Radio Company, Inc., have manufactured a number of radio transmitting sets for the U. S. Navy, which have been in service on American ships for some time. Being desirous of hearing from the operators who have used a Lowenstein set, it would be a pleasure to hear from them. What they want is honest criticism from the man on the job, so that we may be guided by his experience in our future work. We shall be glad to hear from any operator who has used one of our sets.

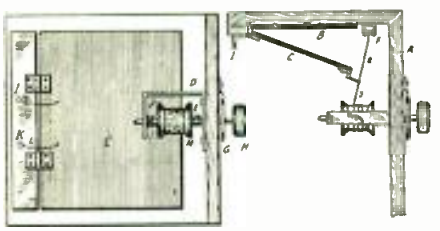
Address this publication.

A SWINGING PLATE CONDENSER

There have been many varieties of small capacity variable air condensers illustrated in the magazines for use in radio receiving sets. The following is a description of one which the writer has found to be very satisfactory either as a grid stopping condenser or as a shunt condenser across the secondary of the tuning transformer. It is also different from any he has seen described.

The material required to build this condenser is as follows: two sheets of metal (non-magnetic), the size depending upon the maximum capacity desired of it two small brass hinges, two binding posts, two small wood spools, one foot of No. 18 spring brass wire, 7" of $\frac{1}{16}$ x $\frac{5}{8}$" brass strip, 6" of $\frac{1}{16}$" brass rod, an indicating dile with pointer and turning handle, one strip of hardwood $\frac{1}{4}$ x 2" and as long as the metal plates, 10 — $\frac{1}{2}$" flat head brass wood screws, and 2 — $\frac{3}{4}$" flat head brass wood screws.

Begin the work of soldering the two hinges to the moving plate (C), along with a short piece of flexible wire (L) and a stiff short brass strip (J) on the opposite edge. In the fixed plate (B) drill four holes with counter sinks for the $\frac{1}{2}$" brass wood screws. Also solder a short piece of wire on the opposite side of the plate to that which will face (C). Now fasten (B) to the side of the cabinet in the position desired. Give both plates a coat of shellac so that when they are mounted they will not form a short circuit when they touch. Next take the strip of hardwood (O) and on it mount the two binding posts. Fasten the wire from plate (B) to one of them



Quite an Idea, Fellows. Takes Up More Room Than Some But Its Easy to Construct.

and then fasten the strip in the position shown in the drawing. This will now permit the plate (C) to be placed in position opposite to (B). The flexible lead from (C) may now be fastened to the second binding post.

The condenser proper is now complete. The controlling device will next be constructed. Bend the strip of 7 x $\frac{1}{16}$ x $\frac{5}{8}$" brass into the "U" shape as shown at (D). Drill holes for screws to fasten it to the back of the cabinet and holes for the $\frac{1}{16}$" spindle. Also drill a hole thru the panel about 7" from the corner and at a height such that the top of the spool will be on a level with (J). Now secure (D) to the panel, pass the spindle with dial (G) and handle (H) attached thru it, slip a piece of coiled spring brass (E) over the end, then the spool, and then another coiled spring (D), and finally pass the spindle thru the second hole in (R). The spool should fit the spindle tightly, and the springs should press against the spool and back of the panel with sufficient force to old the plate (C) at any point against the pull of a rubber band (R).

It still remains to connect the above controlling device to the condenser. Secure one end of a string to the spool (M) and the other to (J). To (J) also fasten a small rubber band. Pass this band behind the spool (F) and fasten below it with sufficient tension to hold plate (C) against (B) when there is no tension on the string.

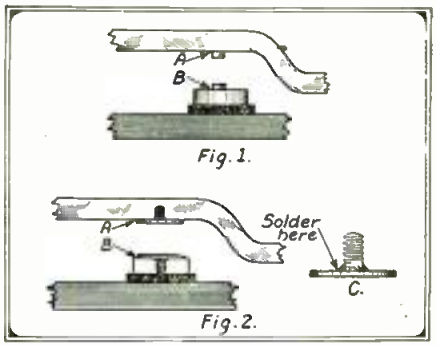
The advantages of this condenser are that it is easy to construct and requires only material that is to be found in any workshop.

KEY CONTACT LOGIC.

By Sheldon Trent

Most of us are intimately acquainted with one or more of a pesky branch of animals, called by the "hams" a sticky key. This most troublesome instrument usually makes its presence known in the middle of your most important message. When this happens, the most experienced of us "sine" off with a couple of . — . . . . and then wait until the key feels generous enough to cool off, but the majority of us keep on pounding the ether and, incidentally, making more mistakes than there are words in the message.

Perhaps it would amaze some that a key can be fixt up without sticky contacts for two thin dimes and some hard solder. The first thing to do is to fish up the old practice set you bought when you were young and foolish and remove the key from it. The contacts of this are usually very small, being supported as in Fig. 1. They may be clipped or filed off with ease; one contact being forced into the key lever proper, and the other into an insulated, brass block in the framework of the key. The surfaces of the key, Fig. 1—a and b, should be filed thoroly. Two bright dimes should be procured and hard solder applied to both



Don't Use Too Soft a Solder in this Case, As Otherwise Contacts May Loosen When Heated.

the dimes and the filed surfaces of the key. Now heat the places where solder is applied and press the dimes onto the lever and framework of the key (Figs. 1—a and b). If the dimes are uneven and do not hit squarely, heat thoroly and press firmly on the handle. If there is only a slight discrepancy, filing may be resorted to. Be careful that you don't get any soldering flux on the faces of the dimes.

If the key has renewable contacts, Fig. 2—a and b, bolts may be soldered onto the dimes and then screwed onto the key as in Fig. 2-C. This method of applying solder to both surfaces works unusually well, especially in this case.

Keys usually heat up because too much current is passed thru and broken, but with dime contacts 110 volts A. C. may be broken with not a spark. An exceedingly handsome instrument may be made if the key is mounted on a marble base with strip brass connections.

DISCARDED RUBBER STAMP HANDLES

Did any of you "bugs" ever try using sawed off handles of old rubber stamps as knobs on indicators, tickler coils, scales, etc.? I rounded up all obsolete ones I could find at the office and found them quite useful.

Contributed by WM. W. CRANE.

LECTURE ON THE RESONANT TRANSMITTER

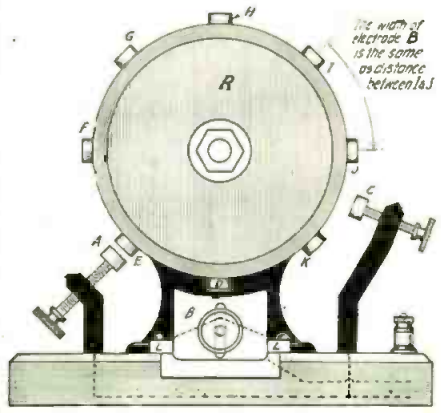
A highly instructive and mighty interesting lecture was given to members of the Radio Club of America on November 26, 1920, at 8 p. m., Columbia University, by Mr. Walter A. Lemmon, who described his invention and its application to spark and Vacuum Tube work.

AN IMPROVEMENT IN ROTARY SPARK GAPS

By Laurence G. Henke

THERE are thousands of rotary spark gaps in use, also as many owners who are looking for some cheap and reliable way to increase the number of discharges across the gap per second without increasing the number of electrodes or speed. In the following article the writer will describe a cheap and tried way of rebuilding any rotary spark gap so that it will give the same service as one revolving at twice its speed, the result being that a sharper wave may be transmitted.

The first thing to do when rebuilding a rotary spark gap is to remove one of the stationary electrode mountings, unless there is not room enough below the rotor "R" for the special stationary electrode "B" shown in the drawing. Or for some reason or other a notch cannot be cut into the base, thereby giving the electrode plenty of room for vertical motion, the motor must then be raised by placing a block of bakelite, formica or even wood under it.



A Simple Improvement for Your Rotary Gap. It Surprised Mr. Henke With Its Effectiveness.

Also, both stationary electrode mountings "A" and "C" must be made longer or one might be mounted upon a small block of the same material as used for raising the motor. The other must be made or bent, so that when the stationary electrode "C" will be just between the rotor electrodes "J" and "K," the rotor electrode "D" will be exactly in the center of the stationary electrode "B"; this is all clearly shown in the drawing.

The electrode "B" may be made of zinc and is as thick as the diameter of the rotor electrodes, the width is the same as the distance from the center of one electrode of the rotor to the center of the next, the length may be 1 inch or more, as it depends mostly upon the type of gap used. The slot cut in the center is 3/16 of an inch wide.

The support "L" may be made of the same material as that of the base; it has a 3/16-inch hole put into it for a bolt of the same size, also a washer and a hard rubber knob threaded to fit the bolt. This assembly holds the electrode "B" tightly in place.

The same binding posts are used, altho the connections must be changed around a bit; the stationary electrodes "A" and "C" being connected together to one binding post, while the electrode "B" connection goes directly to the other post.

When the high-tension current flows into the electrode "A" it jumps across the gap into "E," then it passes thru to "D" and it then jumps the gap to the electrode "B." The rotor moving in a clockwise direction,

and when it has made 1/16 revolution the electrode "J" will come opposite the electrode "C," which, being connected to the electrode "A," will pass a current thru into "J," then to "K" and again jump the gap between it and the electrode "B." The next spark will pass between "A" and "D" and "K" and "B." This cycle of operation is repeated twenty times per second with a gap having eight rotor electrodes and revolving 4,500 revolutions per minute.

In the ordinary gap each rotor electrode is used only twice per revolution, but in a gap rebuilt, as explained above, each is used four times per revolution. Thus the discharges are twice as frequent as in an ordinary gap.

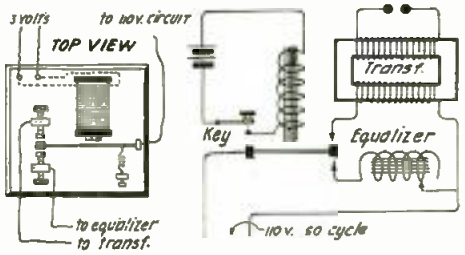
If it is desired to know the number of discharges per second with a rebuilt gap, the following formula may be used:

Number of discharges per second = $\frac{E \times R \times 2}{60}$. Where E = the number of rotor electrodes and R = the number of revolutions of rotor per minute. For example, if the revolutions per minute are 4,500 and there are eight rotor electrodes, there will be 72,000 discharges a minute, or 1,200 a second. Where the ordinary gap with the same number of electrodes and speed would only produce 600 discharges per second.

Try this on your rotary spark gap and you will be surprised with the results secured from this simple improvement.

FLICKERLESS LIGHTS

I recently found a way to keep on the good side of the neighbors and the world in general. I put my rotary in a sound-



His Lights Used to Flicker So Badly That the Neighbors Sent in Numerous Complaints to the "Juice Foundry" to Put a Muzzle on Him.

proof box and made a little device which takes all the flicker out of the lights.

Now this idea of mine was to use a relay which closed the power circuit of the transformer on the downstroke and closed an equalizing circuit on the up stroke. A small magnetic operating on two dry cells thru a telegraph key supplies the motive force to the relay arm. An adjustable contact point is located on each side of the arm so that the gap may be closely regulated. The whole is mounted on a fiber base 3" by 2" and provided with suitable binding posts, two for the battery circuit and three for the power circuit. The contact points are made of ¼" silver and have ½ microfarad condensers shunted across them.

This relay is quiet in operation and gives a snappy break. Since scarcely any sparking is noticeable it has little chance to stick.

The adjustable reactance used as an equalizer was built of 200 turns of No. 20 wire on a laminated core 2" square with a tap taken in the middle at 100 turns, this gives it a regulation of ½ to 1 K. W. which is the capacity of my Thordarson transformer; when using this system use a change-over switch with a third blade to break the power circuit while receiving as the equalizers use considerable current. This stunt works out well in practice, taking all the "flicker" out of the lights. Of course, the lights grow dim when the load is thrown on but the objectionable flicker is entirely eliminated.

Contributed by RICHARD J. VOIGHT.

Radio Operating in the "Miniature Navy"

By Charles J. O'Shea

For the benefit of those who are not familiar with the term Miniature Navy, I will make it known that I refer to the United States Coast Guard.

It has gained this title because while in size it is not so large as our regular navy, the uniform, pay, allowances, discipline and in fact every detail is carried out as in the big "outfit," *i. e.*, the U. S. Navy.

In time of peace it functions under the Treasury Department. The secretary of this department at present Mr. Houston is the ranking officer; with the declaration of war however, it automatically becomes part of the regular navy.

Its duties are highly important to shipping, answering SOS calls being one of its specialties, then comes the destruction of derelicts, floating mines and other menaces to navigation. During the storms which swept the Atlantic Coast last winter one cutter alone saved over a million dollars' worth of shipping.

When icebergs start breaking off up north, usually during the months of April, May and June, the cutters stationed at Boston and New York go to the Grand Banks on what is termed an "Ice Patrol" which is a trip which all hands dread. This consists of about a month's cruising around in the most desolate place in the world where warm sunny weather is unknown, a thick fog is continuous and worst of all there is no place for "liberty." This patrol is kept as a preventative to another Titanic disaster. Its upkeep is maintained by several governments while the United States supplies the vessels and part of the money. It is on these cruises that the radio operator, without whom the patrol would be useless, gets corns on his fingers from broadcasting iceberg reports. The movements of these bergs are watched with eagle eyes so as to warn trans-Atlantic shipping when approaching this vicinity.

During the summer months the cutters lay up for repairs and the crew secures a well earned rest and "leaves" are granted generously. The cutters, however, even during the off season are always ready to respond to an occasional distress call which may occur during the calm months. One of the latest duties this service has acquired is to enforce the prohibition law, to prevent liquor from being smuggled from foreign countries. This promises to hold in store excitement aplenty.

The motto of this service is "Semper Paratus" and is well lived up to for when one least expects, orders come from the Division Commander that some vessel is disabled and in a short time the cutter is speeding to her assistance the "black gang" firing at top speed, the deck hands preparing the towing hawser and "sparks" is extremely busy trying to establish communication thru the mass of harbor QRM to obtain latest information for the "skipper."

Any radio operator who desires experience, sea service and excitement combined this branch of service holds forth great attractions for him. The period of enlistment is for one year and is admirably suited for a commercial operator who has just received a license and lacks practical experience, At the end of a year he will find himself well informed about "J" tubes, audion bulbs, amplifiers, radio compass and telephone sets with which he is in daily contact.

Usually three operators are carried aboard a cruising cutter. This affords a fine opportunity for practice and exchange of personal experiences in the wireless game and prepares an "op" to re enter civil life capable of filling a much better position than at the time of his enlistment.

A Surprise Party a la Radiophone

A surprise party and radio dance was held recently at the home of Mr. Joseph A. Fried at Flushing, L. I., which was rather novel in its character.

Music was transmitted from the radio station owned by E. J. Simon which was located at 40th Street and Broadway, N. Y., and the distance to the home of Mr. Fried was approximately 15 miles, air line. This station was loaned for the occasion to the De Forest Radio Telephone and Telegraph Company. The transmitter was a standard 1-K.W. radio telephone developed by Mr. L. C. F. Horle.

The receiving station consisted of a portable receiver having a wavelength range from 170 to 3,000 meters. This was a home-made affair made by Mr. Pacent. This receiver is equipped with a detector and two-stage audio frequency amplifier and very efficient thruout its entire range. The telephoning was done at 1260 meters and altho there was considerable leeway in wavelength range, considerable interference was noticed from the Brooklyn Navy Yard which was forever going with the broad spark transmitter which they are using.

After having a little trouble in tuning out the undesired signals, a point was finally located where the interference was at a minimum and the music came in very well. The receiving station was located at the top floor of the house from where two wires ran to the living room downstairs. Here a Magnavox was connected and while the music was not very loud, it was loud enough for eight or ten couples to dance without difficulty. To the surprise of the assembled guests, the apparatus worked and we received the music without the need of faking the entire matter.

Among the folks who contributed to the success of this twentieth century surprise party, were some well-known radio engineers and experimenters. A reporter disguised as a radio bug noticed several good looking young men who suspiciously resembled the following: Mr. Joseph A. Fried, Mr. L. C. F. Horle, Mr. E. V. Amy, Mr. George E. Burghardt. Mr. George J. Eltz, and Mr. Louis G. Pacent.

Correspondence from Readers

(*Continued from page 380*)

I know that on warm summer nights they are wont to abandon their scientific pursuits and to play the lover for a few brief hours. And really, a radio bug makes a good one! My friend "T.S.O." will tell you so and maybe he will write and express his opinion when he reads this.

However, let us hear what the other bugs have to say about this.

H. F. Shoemaker,
S.S. Winona, c/o Lock Postoffice,
Sault Ste. Marie, Ont., Canada.

CONCERNING DE FOREST PLANT FIRE

No doubt many of our readers noticed recent announcements in various newspapers describing the fire which took place at the De Forest Radio Telegraph & Telephone Co., New York. Most of the statements asserted that the plant was completely destroyed with a damage of $500,000. These reports were erroneous. The machine shop is practically intact. All of the departments, with the exception of the Oscillion Department, are now in operation and within six weeks it is expected that the entire plant to be operating in even better condition than before.

The loss, which totaled about $40,000.00, is fully covered by insurance.

The Spirit of Christmas

(Continued from page 370)

interest in our club. All his spare time is devoted to our advancement. He loves a radio set as our chairman loves his ——." A scowl from that individual interrupted the speaker.

"Proceed," said the president now smiling. Unruffled, the young man again broke forth in voluble speech.

"To Paul Knox a real radio set would be as a million dollars." The eulogist was quite capable of exaggeration. "What has he in the way of a set? Nothing worth mentioning. Why? You all know. Knox's aunt will not allow him to work while attending school and yet she gives him no pocket money. Except, yes, she gives him the dues for this club. God knows how she does it. Fellows, a deserving young man has for six months been a member of the Q S A. What are we intending to do in order to pay him for the enormous benefits we have derived because of that membership?"

Several voices greeted the question. The speaker wished to answer his own questions.

"Wait a minute, I will tell you. Christmas is approaching. Why not present Knox with a complete wireless outfit? He would be the happiest fellow in the city. The club can well afford it. I make a motion that Paul Knox, for reasons already stated, shall be given a Christmas present, a complete wireless set." The speaker sat down triumphantly as at least thirty members seconded the motion.

The chairman banged the table for order. Gradually the murmur of voices subsided.

"No need, fellows," the president began, "to put the motion to a vote but to follow the rules all in favor say Aye."

A clamorous yell resounded from the walls of the meeting room.

"Now we shall discuss the motion. The question is: will Paul Knox accept the present? Remember the time we tried to exempt him from dues and failed? He called it charity."

The members stared at one another. Several suggestions were offered. The chairman listened to all of them.

"I am afraid," he said, "Knox will become aware of our motive in offering him a present. I fear he will decline to accept. He might consider it as he did the dues."

"Mr. Chairman."

"Mr. Clark."

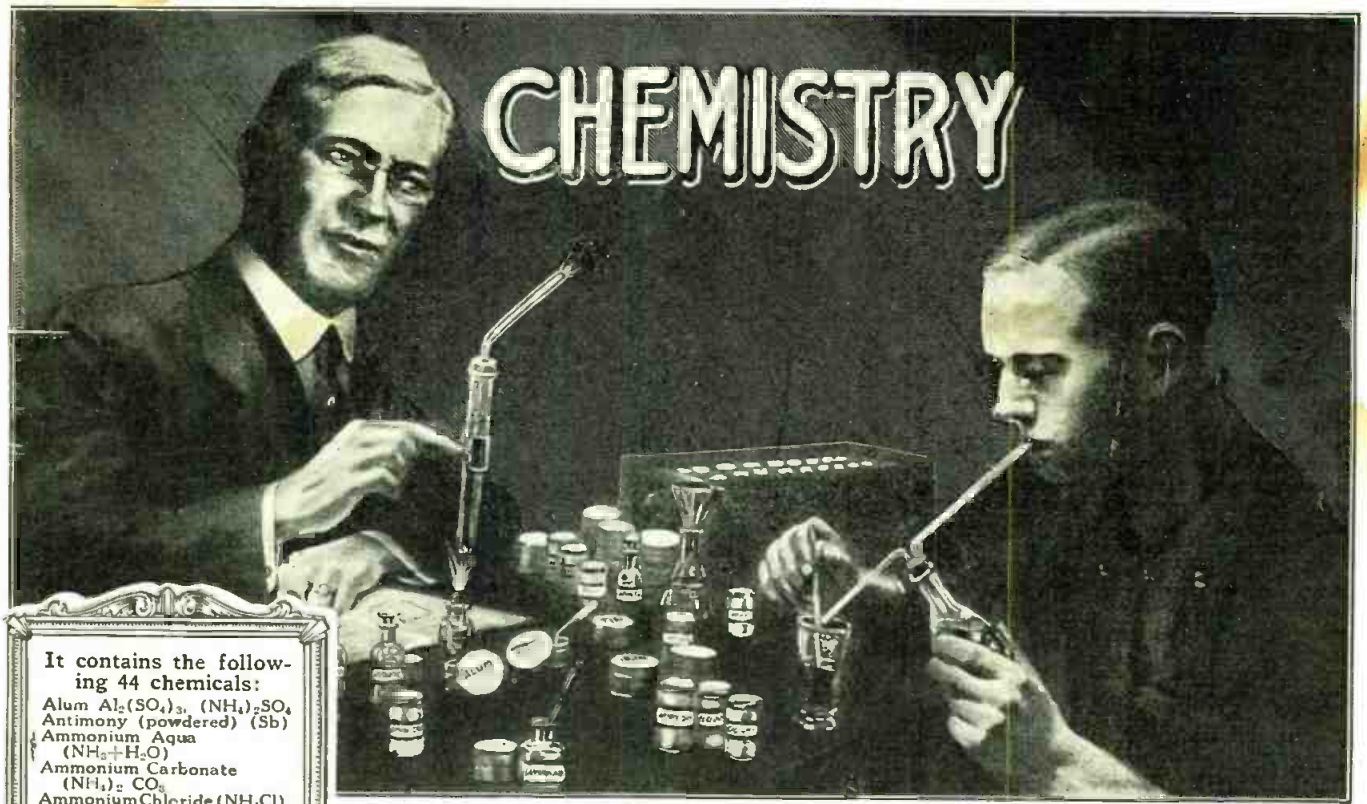
The originator of the motion rose from his chair. "I have thought this over but wished to hear what the other fellows had to say. There is only one way Knox may be enticed to accept the present. He must believe he has earned it. I will outline my plan."

Briefly the speaker unfolded a neat little plot. When he had concluded there was silence. Then loud applause greeted him. A second motion was made and carried unanimously. Five minutes later the meeting adjourned. Everyone was sworn to secrecy. Nevertheless the events of the last half hour were discusst in whispered consultation. In couples and groups the members left the club room.

The following week, in front of the largest radio supply firm in the city, Paul Knox surveyed the various instruments for sale. It was the day before Christmas. The shining apparatus clustered among elaborate decorations dazzled him with their resplendent settings. He eyed one set lovingly.

"If I only had such a wonderful set," he sighed. "The price, let me see. By Jove!

(Continued on page 411)



"The Joy of Father and Boy."

Chemical Laboratory

We present herewith to our friends our new E. I. Co. Chemical Laboratory which contains real chemicals and apparata to perform real chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.

It contains the following 44 chemicals:

Alum $Al_2(SO_4)_3$, $(NH_4)_2SO_4$
Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2SO_4$
Barium Chloride $(BaCl_2)$
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride $(CaCl_2)$
Calcium Oxide (CaO)
Calcium Sulphate $(CaSO_4 2H_2O)$
Charcoal (Carbon) (C)
Chloride of Zinc $(ZnCl_2)$
Copper Sulphate $(CuSO_4)$
Ferrous Sulphate $(FeSO_4)$
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride $(FeCl_3)$
Iron Oxide (Fe_2O_3)
Lead Acetate $Pb(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate $(MgCO_3)$
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride $(NiCl_2)$
Oxalic Acid $(H_2C_2O_4)$
Sodium Bicarbonate $(NaHCO_3)$
Sodium Borate $(NaBO_2)$
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate $(NaNO_3)$
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride $(SnCl_2)$
Sulphate of Nickel $(NiSO_4)$
Sulphate of Zinc $(ZnSO_4)$
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate $(ZnCO_3)$

The following apparata are furnished:

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One Alcohol Lamp
One Conical Glass Measure
One Erlenmeyer Flask
One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
One Test-Tube Holder
Ten Sheets of Filter Paper
One Glass Dropper
One Spoon Measure
Glass Tubing
One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

DESCRIPTION OF THE OUTFIT

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

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The Instruction Book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemcial Nomenclature:** This explains in simple language the derivation of the chemical names of the elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the 100 Experiments are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

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(*Continued from page 409*)

They are giving it away. What's this "

In his enthusiasm over the beautiful cabinet radio receiving set, he had failed to read the sign above it. For a moment he was puzzled, then surprised, the surprise turned to gratitude. The members of the Q S A Radio Club did not reckon with the quick thinking powers of Knox. He understood their motive immediately.

"Some club," thought the gratified young man. "If I could only return the gift in some way. What a fine way for the boys to present me with the set."

He read the notice again:

To Paul Knox. Winner first prize. In smaller letters followed: A meeting of the board of directors of the Q S A Radio Club, six months ago, voted out one hundred dollars to be presented in the form of a receiving set to the member who accomplished the most for the organization. The meeting remained a secret. No member was aware of the prize to be offered. The best man wins. Service was given without encouragement of any kind.

Knox was happy. Christmas would be bright for him after all. He walked erect. he inhaled the fragrance of holly branches which decorated many a store. Happiness was everywhere, he joined into it. Thus the members of the Q S A Radio Club did something to be proud of for a long time to come.

Dictionary of Radio Terms

(*Continued from page 377*)

diameter, called Secant, passing through other end of arc.

Tangent Galvo—One so called because the strength of currents passt thru it are to each other as the Tangent of the respective deflections. See Galvanometer.

Tangent of Angle—Is tangent of arc measuring or contained in that angle. It is Cotan of Complement.

Tapper—Similar to electric bell but so arranged that hammer gently taps coherer and thus decoheres filings after passage of each incoming oscillation.

Telefunken—German system of Radiotelegraphy. Translated into English is "Spark Telegraphy," or, more literally, "Far or distant Spark." Distinctive features are its Quenched Spark and Electro-lytic Detector.

Telegraph—Any apparatus for transmitting intelligence from one point to another at a distance. Literally, "writing at a distance." Generally used in conjunction with the Morse Code.

Telegraph Naut—Nautical mile of 2,029 yards or 1.1528 statute miles.

Telephone—An instrument having a disc of soft iron, diaphragm, held over and near to an electromagnet whose windings are such that very weak electric currents, whether direct or unidirectional impulses, will cause disc to be attracted. Attraction and retraction of this diaphragm producing audible sound waves. Speaking at a distance literally.

Telephone Condenser—A condenser of tinfoil and mica, variable by a plug, which is used for putting telephones in most sensitive condition.

Tellurium. Te—Semi-metallic rare element having a silver-white color with a metallic lustre. Found in small crystals and in combination with various metals. Is very brittle. The crystals are used as a rectifier. A.W. 126.6. S.G.6.27. Mlt. Pt. 452°F. See Graphic Tellurium. Nagyagite and Sylvanite.

Temperature Co-efficient—Increase in unit resistance per unit increase of temperature.

(*Continued on next page*)

Temporary Magnet—One losing its magnetism after source of supply is withdrawn. Most electro-magnets are temporary.

Telegraphy, Radio—The art of sending and receiving radiograms.

Telephony, Radio—The art of sending and receiving radiophones.

Tesla Coil—An oscillation transformer for producing high potential discharges from oscillations of low potential. Somewhat similar to ordinary transformer though much more heavily insulated. and has ends of secondary connected to a condenser which discharges across a spark gap. thus increasing rapidity of oscillations which then pass into a second induction coil. This second coil has no iron core.

Thermal Detector—One depending upon the heating of a fine wire by the passing oscillations. See Barretter.

Thermo Electricity—Electricity produced by heating two different metals, placed end to end at their junction. See Thermopile.

Thermopile—A chain of two different metals arranged alternately, which, upon being heated at the alternate joints, produces an electric current. In combination with a delicate galvanometer forms a senstive thermometer.

Thimble—A metal ring, though sometimes heart-shaped, with a groove round its circumference to receive rope spliced round it.

Awards of Portable Radio Prize Contest

(*Continued from page 365*)

the condenser plates. This feature permits the condenser to be variable between any two values of its entire range. For general work, the scale should read maximum when the plates are as close as possible, giving a zero so low that it does not increase appreciably the amount of secondary inductance. This condenser has a somewhat greater capacity than a 17-plate Murdock.

CONNECTIONS

The 'phone tips connect with stiff spring brass strips when pushed into two holes in the front of the case. (See photograph showing front view.) One of these spring clips (the right hand one), is held by the screw which fastens the crystal (a Deforest mounted galena crystal) to the small panel. The other clip is held to the small panel by screws A. The rest of the hook-up is as follows:

From detector post to one condenser pillar; from condenser bushing K to left 'phone clip (held by A) to secondary switch arm; from beginning of secondary winding to one condenser pillar. This system of connections *reduces to a minimum* the amount of connecting wire. A small fixed condenser may be connected across the 'phone clips and placed beneath the variable condenser as suggested at M, altho this will not increase the strength of very weak signals.

PRACTICAL USE

In one of the accompanying photographs the set is being used in connection with a collapsible coil aerial consisting of 50 turns of No. 16 bare copper wire spaced one inch apart. The coil is one foot square, the turns being supported by silk fish line.

When making use of a fifty foot antenna, this set will tune to six hundred meters with the secondary condenser at zero. Cape Race, Brooklyn, Norfolk, Miami and scores of other commercial stations, as well as amateur stations in the first three districts, have already been heard in the short time since the set was completed. using the 50 ft. aerial.

Raided By Radio

(*Continued from page 371*)

receivers which gradually increased until it became a roar. Then abruptly the strange sound ceased and all was quiet. Glancing at the clock he saw that it was just twenty-eight minutes past eleven.

The radiophone station had nothing for San Francisco so Crosby stoppt for the night, promising to call the Pennsylvanian when he had secured a radiogram for Philadelphia or thereabouts.

The following evening found Crosby in an attempt to "raise" the radiophone again, but in this he was not successful. No doubt it was due to the atmospheric conditions that made it impossible.

Not knowing what to do he finally decided to send out a general call to all amateurs inviting some one to play a game of "chess." Even though the contest was ended he felt certain that he would find an eager opponent. In this he was right and was soon engaged in a game with an amateur in Burlingame.

"L—15," sent his opponent, and Crosby accordingly moved the man marked L to space 15.

At the conclusion of the game, Crosby being an easy winner, another unsuccessful attempt was made to get in communication with the station near the Atlantic.

"All in the weather, I suppose," Crosby complained regretfully to himself, "and I have three messages for him too," he added ruefully. "Guess I'll have to let them lay over unless Chicago will take them." However, the operator at that city could not be heard.

Again, as on the previous night, Crosby heard the low rumble which gradually increased in tone until it became a terrific roar in the receivers. It sounded as if it emanated from the very center of the earth, so unusual was it. The hands of the clock again pointed to 11:28! The same time as the evening before!

Was it ordinary atmospheric disturbances? No; Crosby was sure that it was not. Never in all his experience as a radio operator had he heard such a queer sound in his receivers. It reminded him of the rumble of a caged monster. What on earth could it be and why should the same identical sound occur two nights in succession at the same time by the clock?

The thought of interplanetarian radio entered his mind but he quickly discharged this impossibility. Fifty million miles was no joke as several American scientists had found out when they tried to erect huge radio receptors to attempt to receive the signals from the other planets, Mars for instance.

No: the strange rumblings were not caused by the Martians or their neighbors, he was certain of that, but what caused the unearthly signals in his receivers? He did not know but meant to find out.

. . . . .

The next morning's paper had an account of how, for the last two nights two local police stations were wrecked under decidedly queer circumstances, in each case killing several men.

Spectators had said that the buildings had first seemed to totter on their foundations, then with a slight "puff" the walls blew outward as if a terrible explosion had occurred within. Both station houses had been reduced to débris in the same manner and both at the same time, 11:28 p. m.

Allen Crosby gazed up from the paper in his hand with a frightened look upon his face.

"Twenty-eight minutes past eleven," he repeated slowly, "could it be by any chance

that those rumblings in my phones had anything to do with this?"

It was a question open to debate, and the more he thought of it, the more certain he was that the two were connected in some unexplained way. Thinking it would be to his advantage to visit the scene of last night's wreck, he immediately did so in search of information. After spending an hour or more in the vicinity of the devastation he discovered something beneath the ruins which caused him to utter an exclamation.

Quickly hurrying home he at once began on the solving of the mystery, as he was almost certain that he was on the right track.

He first constructed a large frame upon which he wound wire. Although rather crude, it would serve its purpose as a "loop" antenna. Upon the completion of this instrument he suspended it from the ceiling of his radio room and connected it to his set in lieu of his regular aerial. He was greatly pleased to find that with this improvised loop he could locate any transmitting station by simply rotating the coil.

Knowing the location of several amateurs in the vicinity he found that the instrument pointed to their exact locality. With this "Radio Compass" it would be easy to determine the location of the strange signals, and when this was learned the secret of the destruction of the police stations would also be solved.

That evening he did no transmitting but waited patiently for the mysterious signals. Again at 11:28 the strange rumblings occurred and Crosby obtained the location of the sender by moving the coil about.

Upon a map of San Francisco, Crosby drew an arrow in the general direction of the source of the radio signals. Seven blocks due west of his home was a large hill, from the top of which the Pacific Ocean, the Bay, and neighboring territory for miles around could be seen.

The mysterious sender was on this hill as the compass pointed in a dead-line toward the summit!

With this information Crosby left the house, first having learned from the telephone central that another police house was wrecked at 11:28! This was conclusive! The maker of the strange rumblings was the one who had ruined three police stations in San Francisco.

Since the Fire of 1906, the top of this hill had been uninhabited. The only structure remaining being a dilapidated two story house, once used for an observatory but long-since abandoned because of the numerous fogs of San Francisco.

Toward this place Crosby made his way without delay. It was a moonlit night and two white masts could be discerned rising from the roof of both ends of the house. Suspended between them was a wireless aerial! Crosby was not greatly astonished as he was on the look-out for just such a thing.

Crawling close to one of the lower windows Crosby peered into the lighted basement. Five men were inside sitting about a rickety table with an oil lamp illuminating the room. One of the men was speaking and Crosby with his ear close to the window pane distinguished every word.

"Well, that make three of them," the man within said with a chuckle, "and another scheduled for to-morrow night."

At this the rest of the men laughed and one of the others spoke.

"Come on, let's get some work done tonight," said the man, evidently their leader, as he picked up the lamp and advanced to the other end of the basement.

Crosby changing his position saw the man with the lamp raise a trap-door in the floor and the next moment the five men were out of sight and the lower part of the house was in darkness.

At the Post Office Building early the next morning Crosby related his story to the Chief of the Secret Service. He told how he had used the Radio Compass in locating the men and repeated the conversation he had heard the evening before at the window of the deserted house. To the best of his ability he described the men in the house, at which the Secret Service officer broke in with an exclamation.

"Why, that's the most notorious gang of counterfeiters this side of the Rockies!" said the man excitedly. "They're wanted in a dozen cities thruout the United States. There is a reward of $5,000 for their capture! Here," he said as he drew out five small photographs from his desk, "is that them?"

"Yes," replied Crosby, "it's them beyond a doubt. But why should they wreck our police stations? I don't understand that part of it."

"I haven't the slightest idea unless they are afraid of being captured by our local police and are taking precautions by ruining the station houses, with hopes of killing officers."

At eleven o'clock that evening ten operatives of the Secret Service surrounded the house on the hill while five more with Crosby entered the house from the main floor.

"They're all in the basement," whispered one of the detectives and silently the men made their way to the lower regions of the house.

The raiding party paused before the door leading to the room where the counterfeiters were and listened a moment. Voices could be heard on the other side of the door.

"Hands up!" commanded one of the detectives as the door was suddenly flung open and the party filed through into the room. "Hurry up, reach for the ceiling!"

The five law-breakers stared into the muzzles of six wicked-looking automatics and slowly raised their arms. When they were all handcuffed and led to a waiting automobile for transportation to a safe keeping place, the Secret Service men and Crosby searched the building. Under the floor of the basement was a large room with apparatus for making counterfeit money and a stock of counterfeit bank-notes was found near-by.

Crosby was more interested, however, in the method the men used to wreck the police stations. In one corner of the basement a *radio outfit was discovered*. Instead of the ordinary transmitting apparatus, in its place was a large cabinet with many switches, surmounted by a huge pointer.

Later at the city prison where the criminals were placed, the leader of the gang, one Dr. Hemmingway, made a complete explanation of the apparatus found in the corner of the basement.

"Yes, I invented the Ray Projector," he said, "and it served its purpose well. We had already wrecked three police stations, our object in this being to diminish the force as much as we could in order to escape capture. The fourth was to be wrecked to-night, when you came. As long as the game is up I may as well tell you the principle of my invention.

"When I desire to wreck a building I manipulate the pointer until it points in the exact spot of the building to be ruined. Of course the building must have a wireless antenna on it. Then using an enormous current a powerful ray is directed toward this antenna. Previously, however, a box of high explosive is placed in series with the lead-in of the aerial near the apparatus. That being the work of my men who planted the box under the very nose of the police. Some police force, I must say!"

"But what happens when the rays strike the explosive?" queried Crosby.

"A terrific gas is formed which, being so powerful, causes the building to totter, then with a sudden puff the gas expands and pushes the sides out of the building. But how did I become discovered?"

"At eleven twenty-eight for the past three evenings," began Crosby, "I heard strange rumblings in the receivers of my radio set and when I learned that the local police stations were being wrecked at the same time to the minute, I connected the two occurrences. When I searched the ruins of one of the wrecks I came upon an antenna and a small fractured steel box, then by means of a Radio Compass I discovered your location."

Some few nights later Crosby was in communication with the radio telephone in Pennsylvania again.

"Congratulations!" began the voice of the operator in the east. "We have heard all about you back here. The papers say you are the most progressive amateur in America!"

"Thanks, OM." Crosby flashed across the continent, "how about a little game of Radio Chess?"

The Amateur Trans-Atlantic Feat

(*Continued from page 353*)

One of the most important factors which prompted this body of men to this action is due to the fact that the Radio Club of America has for some time past been considering the award of a substantial cash prize to the first experimenter who effectively bridged the Atlantic by means of radio telegraphy or telephony with amateur apparatus and on amateur wavelength and regulations.

It would certainly be more convincing to the radio fraternity at large if in the very near future the feat were again repeated by other actual workings of the apparatus involved. This may prove more difficult than realized owing to the fact that the reported transmission was probably due to a freak condition where atmospheric and other natural elements were exactly suitable for long distance work *at that particular moment.*

Mr. Fansler recently wrote the following letter to Mr. Robinson which would infer that it was Mr. Robinson who was heard in Scotland.

Noroton Heights, Conn.
November 10, 1920.

Dear Mr. Robinson:

I want to congratulate you on what appears to be the first trans-Atlantic amateur transmission. When I saw the article in the New York "Times" I thought that there might be a possibility that he had heard me transmitting to you as the record mentioned is one that I used every evening during the first part of October; also the mention of 400 watts indicated the output of my motor-generator of my set, and I have been mentioning that fact in all broadcasting. However, I phoned Mr. Boucheron yesterday and he said that you were working on the afternoon of the 6th while I was not—that, I remember—which seems to fix the responsibility on you. Of course, it's freak, *but it's great stuff just the same. What are you going to try for next? Moscow? Hope to get my set rigged up again next week with* some *power. I'm going to put in a* 1 *KW.* 2000 *volt generator.*

FANSLER.

Altho a personal trip by the writer to Keyport and an interview with Mr. Robinson failed to disclose much more than is already known concerning this incident, he hopes, nevertheless, to shortly be in a position to present readers more definite facts concerning this marvelous feat which probably means another laurel to amateur radio of America.

Ed. Note.—At moment of going to press we received a copy of the Scotch amateur's answer. This appears on the Radio Digest page 372.

The Eiffel Tower Radio Station

(*Continued from page 352*)

The Eiffel Tower station will not only be a laboratory, but also from the radiotelegraphic point of view a kind of museum. A model of each transmitting system known is actually installed in its underground room. Everyone of these sets is capable of furnishing individual powers ranging from 30 to 50 k.w. in the aerial circuit. All have a range of 1,200 to 1,800 miles, and can insure a regular traffic to all parts of Europe. These stations are the old low tone transmitters used for the scientific time signals, the musical note transmitter, the Poulsen arc, the Bethenod and La Tour high frequency alternator delivering a 20,000 cycle current and running at 6,000 revolutions, and a C.W. set using very powerful vacuum tubes.

The most important scientific rôle of the Eiffel Tower is the sending of the time signals permitting the determination of the longitudes with a great precision in the manner described in this article. The international time conference of 1912 has selected this station to send the time in the manner determined by the International Time Bureau with permanent offices in Paris.

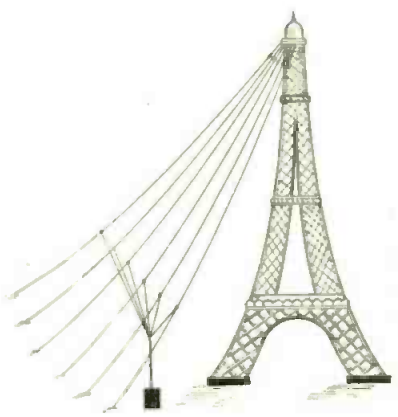

Fig. 1. Schematic Arrangement of the Actual Antenna Supported by the Famous Eiffel Tower.

Such is the future of the Eiffel Tower. After being one of the first powerful stations in the world; after having rendered great services during the war, it will work during peace time towards the improvement of the new technic which is called radiotelegraphy.

Museum and well equipped laboratory, this station which has been and will be useful to the whole world, that is owing to its time signals, has really a great rôle among the powerful stations of the world. It owes it especially to the reason that it is not a commercial enterprise and that the prominent scientists working under General Ferrié's management are not looking for profit but only for progress of the radio art.

A HARD ONE

Radio Shark: "Ask me any question concerning wireless and I will answer it."

Humorous Radio Bug: "How many meters does the gas man work on?"—Clarence I. Mayer.

RADIO COMPASS STATIONS AT SAN FRANCISCO BAY

By Phil Vernon

For some time the United States Navy Department has had in operation, on the Atlantic Coast, radio directional compass stations. The purpose of these stations is to aid navigators to ascertain the bearings of their vessels when entering a port; particularly in foggy weather, when it is impossible to accurately determine true position by observation.

Several months ago, the Naval Communication Service commissioned four radio compass stations at the entrance to San Francisco Bay, California. These stations are located respectively at Point Reyes (NLG), Bird Island (NLD), Point Montara (NLH), and Farallon Islands (NPI).

The aerials at these compass stations are of rectangular loop type, with six insulated wires around a frame about 4 x 3 x 2 feet; and they are movable for direction.

The base of the aerial loop shaft revolves on a table. A pointer on the loop shaft is fixt to register true bearing on a dial that is set to the local meridian. This dial, graduated in degrees from 0 to 360, is fixed on the table. Thus, when these stations hear a ship radio operator calling "Q-T-E" (which means "where am I"), it is an easy matter for them to advise him the bearing. This information is given to him by all of the above stations simultaneously. Then the navigator, on his chart, assumes the position of his vessel to be the center of the small triangle or fix of any three of these directional bearings, allowing for a slight error of one or more of the stations.

The bearings are given on 800 meters wave-length, so that commercial traffic, which is on 600 meters, will not be interfered with; and all vessels that desire to make use of this service have been requested to retune their sets to 800 meters.

Vessels have also been instructed to use maximum power, broad coupling, and low decrement, when ascertaining their bearings by means of these radio compass stations.

There is no charge for this valuable service. All the Naval Communication Service asks is that navigators check back on course line the bearings furnisht by the individual stations when absolute fix is determined by buoys lightships, or lighthouses, and that a short report stating the good or bad results of the radii compass bearings be mailed to the District Communication Superintendent's office at San Francisco as soon as practicable.

This service is especially valuable for vessels approaching San Francisco Harbor, where low, thick fog not infrequently makes the passage dangerous. At the present time no attempt is to be made to guide vessels through the Golden Gate and into the harbor by means of the radio compass bearings. The intention is simply to assist navigators, during thick weather, to locate the lightship, which is anchored seven miles outside. If this experiment proves successful, further improvements, it is hoped, will eventually enable these radio compass stations to actually guide vessels through the narrow, mile-wide Golden Gate and into San Francisco harbor, even when the weather conditions are most adverse.

RAILROAD INSTALLS RADIO

The Nashville, Chattanooga & St Louis Railway has installed a radio station at Tullahoma, Tennessee, for communication between this city and Guntersville, Ala. A mast ninety feet high has been erected in the rear of the Traders Bank and another on top of the building. The operator's office will be located in the railway company's suite of rooms on the second floor of the bank building.

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Before Taking Any Electrical or engineering course, write for details of our special "Earn-Your-Way" proposition. Our wonderful plan of placing students in part-time positions makes it easy for you to become an Electrical Expert or Electrical Engineer. Courses in Electrical Engineering, Practical Electricity, Armature Winding, Starting and Ignition, Radio and Drafting. Learn one of these interesting professions in our big laboratories. Thorough intensive training under a staff of 90 electrical experts. Pleasant surroundings. Fraternity House where you can live at cost, sports, athletics, boating. Write for big free postpaid illustrated book. State age and education and we will tell you the course for which you are best fitted. School of Engineering, Dept. R-61, 373 Broadway, Milwaukee, Wis.

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Millions Spent Annually for ideas. Hundreds now wanted. Patent yours and profit. Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 301 Patent Dept., American Industries, Inc., Washington, D. C.

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Attention Beginners! Here is a real Code Chart that teaches you the wireless code. A wonderful little device that got them all beat. If you want to learn the Continental Code get one of these Charts. Sent postpaid $1.00. A. B. Perry, 23½ West Alabama St., Atlanta Ga.

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Attention—3" enameled dial, raised graduations, 50c.; contact points with screw, 20c. per dozen; postage extra. Wireless instruments, parts, material, educational books, etc. Price list ready. Stratton Electric Co., 215 Federal St., Greenfield, Mass.

Used Apparatus Bargains. Remarkable values List free. Central Radio, Independence, Missouri.

(Wireless—Continued.)

A Real Buy. DeForest Type T200 tuner, $15 Marconi Valve, Class 1, $6, Clapp Eastham Type ZRD audion panel, $11. This apparatus is A1, never used. Wireless, Box 353, Calais, Maine.

For Sale—Loose coupler; Jove detector; DeForest detector, Conn. V. condenser, Murdock Fixed Cond., Murdock phones No. 55, 3000 ohms. Century buzzer, key. Roger Shaw, Concord, Mass.

Tresca Long and Short wave tuners reduced in price from $15 to $10. Type CS Regenerative tuner, effective range, approx. 150 to 500 meters, Type AS, effective range, 600 to 3,000 meters, Type BS, effective range, 3,500 to 20,000 meters, wavelength. Send for circular. Robert Sagebiel, 25 W. Second St., Dayton, Ohio.

Radio Paper. Radio telegram blanks for your station—for delivering messages and for station file. This is the last word of efficiency for supersensitive receiving sets. Blanks well printed on good grade of telegram paper. Hundred sheets per pad. Send your order today for a supply of these forms and install a system that will make operating a pleasure. Enclose M. O. or cash, or send your order and blanks will be shipped collect. Price: One hundred, twenty cents; $2.00 per thousand. Special prices on quantities. Radioform Printers, 207 Baker Bldg., Racine, Wisconsin.

Prepaid to You. One each of the following: DeForest Honeycombs, L-50, $1.30; L-300, $1.35; L-400, $2; L-1000, $2.70; L-1500, $3.20. Western Electric head set, type CW-834, resistance 2200 ohms, $9; Amarad duplex detector, type C, $1.50. Wireless, Box 353, Calais, Maine.

Grid Condenser that will knock 'em cold. Can you beat this? Complete mounted grid condenser for 30c, with our usual guarantee of "Money back if not satisfied." Amateurs try us once and you will try again. Postage 3c. Live wire agents wanted. Radio Testing Station, Binghamton, N. Y.

Radio Phonists Attention. High voltage generators. We supply these motor generator sets in various capacities, especially designed for radio phone work, also low powered rotary converters, dynamotors, fractional H. P. motors and storage batteries. We are in a position to solve your generator problems and supply machines to fill your requirements. We also have the standard RAY-DI-CO phone sets complete, or furnish any part thereof. In fact, if it is radio equipment of any kind, or a set of your own design, write us stating your wants and become acquainted with our service. RAY-DI-CO (not Inc.), 2653 A, N. Clark St., Chicago, Ill.

Slate Panels for That New Set. This slate is free from mineral. Any size or thickness. Write for prices. The Panel Shop, Box 185, Monson Maine.

Good Radio Receiving Sets, $8.50 and Up. Panel transmitting sets, $30.95 and up. Radiophone apparatus, wire supplies of all kinds. Catalog 6R for two-cent stamp. Pocket code card free. Jenkins, 923 Purchase St., New Bedford, Mass.

Dead! Your "A" battery we mean. Always ready if you use our B-B Battery Booster. Charges your battery overnight for 10c. Soon pays for itself. Every amateur needs one. $15.00. It's ready to ship you. Hi Co., Marion, Ill.

Genuine Electrose Insulators. Ball type, 3¼" x 2¼", $.36; 10½" x 1½" type, $.90; 15⅞" x 1⅝", $2.75. All goods prepaid, if order is accompanied by money. St. Croix Radio Laboratory, Box 353, Calais, Maine.

"Type A46 Western Electric variable condenser, constructed of heavy aluminum plates. Has straight line and low zero capacity. A high grade laboratory condenser that meets all requirements for wavemeter and test work. Of .000750 mfd. capacity with bakelite knob and pointed. A $15 condenser at $8 each. Act quick. Supply limited. W. E. Bakelite knobs with pointer, each 15c. W. E. aeroplane phones, 2200 ohms, with head band and ten foot waterproof cord, per pair, $12. W. E. hand transmitter for radiophone, each, $4. High grade radio sending key, heavy silver contacts, mounted on ¾ inch bakelite base, each, $2.50. W. E. Litz wire, made up of 25 strands of No. 32 enameled wire, silk covered. Just the wire for your loop antenna, spider oscillation trans, or other high frequency work. 1c per foot. Bakelite composition, ¼ inch thick. Can be worked with a sharp pen-knife. Just the thing for spider wound coils, per square foot, 50c. Postage extra on all goods. Money refunded if not satisfied. Haupt Elec. Supply Co., 2442 Ogden Ave., Chicago, Ill.

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Amateurs—Why wait for weeks after ordering your apparatus? Send us your name for our weekly stock list of radio supplies. Prompt delivery or money refunded. Isn't that square? Tubes, transformers, CRL Paragon receivers, quenched gaps and other apparatus. Goddard Radio Laboratories. Shawnee, Kansas.

(Wireless—Continued.)

All Amateur Apparatus bought or made in accordance with The Radio Buyers' and Builders' Handbook invariably re-sells very profitably. Study my June and July display advertisements in Q. S. T., see why, and get your copy now. R. Clark, Barnes Rd., Newton, Mass.

Grid Condensers prepaid anywhere, $.50 each. Ingenious invention makes it possible to hermetically seal very small capacitances in very small compartments. Not exposed to changes atmosphere. 100% efficiency performance test. Works with any type tube. Crescent City Radio Company, Department D., P. O. Box 1104, New Orleans, La.

Listen to 'em Buzz In. Use U. A. Phone condensers, 40c; Grid condensers, 40c; Grid-leak condensers, 60c. We carry all standard stock. Vacuum tubes a specialty. French bulbs, $20. The Coast Radio Distributing Co., 301 Second Ave., Asbury Park, N. J.

Our Special for This Month. This month we are making a special offer on Chelsea Apparatus, and for one month we are making an offer of 5% less than list prices and all goods fully guaranteed and will be shipped by insured parcel post paid. We handle all the best grades of radio apparatus and in practically make shipment the same day the order is received. Radio Mail Order Supply Co., 533 West End Ave., New York City, N. Y.

DeForest Radiophone Transmitter and radio apparatus. Rare bargains. Fine phosphor bronze aerial wire cheap. 120 Christie St., Ridgefield Park, N. J.

Sale—Slightly used wireless goods. Stamp for list. G. M. Scheib, 6213 Station St., Pittsburgh, Pa.

Navy Couplers, $11; Variometers, $7; Amplifiers, $35; Regenerative sets, $40; transformers, sockets, tubes, switches, knobs, binding posts and parts. Sets made to order. Jerome Haas, 2011 Atlantic Ave., Atlantic City, N. J.

Bakelite Tubes and Panels, all lengths, diameters 3/16 thick, 2¼c square inch, switch points 8/32 with nut 3c. DeForest self cleaning switches; other radio apparatus. Meade Bakelite Radio Apparatus, 975 Putnam Ave., Brooklyn, N. Y.

Just Off the Press. Design and Construction of Audion Amplifying Transformers (Radio and Audio-Frequency Types). By Edward T. Jones, late Associate Editor Radio Amateur News. The transformers shown in this book have never been described in print before and have usually been considered a manufacturer's secret. The designs are very rugged and simple. A book that every radio "bug" should have. Written so you will understand every word. Price 25c postpaid. Experimenter Publishing Co., Book Dept., 236-A Fulton St., New York City.

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Telegraphy (both Morse and Wireless) and Railway Accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, M. St. Valparaiso, Ind.

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Be Able to Entertain. Our card tricks produce a laugh and a surprise. Sample 10 cents; six—all different, 50 cents. Damon Novelty Co., 6 Church Street, East Weymouth, Mass.

Tricks, Jokes, Magic, Puzzles. Catalog free. G. C. Fenner, 2401 N. Jefferson, Louisville, Ky.

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Keep Your Typewriter clean and repaired with a Typist Self Cleansing Outfit, only $2.50 complete and saves many dollars. Rebuilt Typewriter & Supply Co., 220 East 6th St., Cincinnati, Ohio.

Exchange.

For Sale—Wireless course $10. (Just started.) If interested write J. Collins, 2915 Madison Ave., Indianapolis, Ind.

For Sale—Guaranteed new 1000-meter coupler, $4.75; new 23-plate, .0005 Mfd. variable condenser, $3; 2 1000-ohm receivers with cords, no headband, $2. Trade 10-mile transmitting set for one stage amplifier. Lester F. Wertz, Temple, Penna.

Exchange—Sell ½-K.W. Packard Transformer, $25, or will consider good Regenerative set in trade. Write Webb, 1220 Washington St., Waterloo, Ia.

For Sale Cheap—Close coupled coupler and variable condenser in cabinet, $18. E Whitaker, 159 Cedar St., Lapeer, Mich.

Omnigraph Wanted—Give particulars. Geo. Wagner, 405 D, Lincoln, Nebr.

For Sale—Honeycomb Coils, L-200, L-150, L-100, L-75, L-35, two L-25's, $7.50. Audiotron, $4.50. Sub-panel triple coil mounting, $1.50. 13 plate variable condenser, $1.75. All new. Joseph F. White, 32 Lucy St., San Francisco.

For Sale—Electro 5000-meter loading coil and good Silicon detector, never used, $4.25. Radiotone Buzzer, new, $1.25. Gerald Williams, Presque Isle, Me.

(Exchange—Continued.)

For Sale—Audiotron, $8.00. 1" spark coil, $5.50; 3,000-meter receiving transformer, $3; key, $1; Pancake tuning coil, $2; 2-cell bicycle lamp, $3; 3 lbs. No. 27 magnet wire, $2.50; wire 4x4 loop, $2.50. And others. Ragnar Westman, 102 17th St., Cloquet, Minn.

For Sale—3,000-meter Navy type loose coupler. All bakelite. Nearly new, $20. Washington High School Radio Club, Washington, Penna.

Wanted—Half-kilowatt sending condenser, rifle as part or all cash. Ralph Underwood, Agra, Kansas.

For Sale—Two Western Electric V. T. 2—$12 each. Mili-Ammeter, $9; hot wire ammeter, $5.50; 2 Universal V. T. sockets, $1.50 each; Modulation transformer, $5.50; variable condenser, $3.75; 2 rheostats, $.75 each; mineral detector, $1.50. This goods used one hour for radio telephony. Sidney Sussman, 2917 Jamaica Ave., Richmond Hill, L. I.

12 V. 100 Amp. Willard Battery, $15; voltmeter 0-90, ammeter 25-0-175 with lamp, $13. Edison phonograph (cylinder), $6. Philip Stout, Knoxville, Tenn.

Absolutely New Variometer. RC2 Duplex Variocoupler, RC1 coupler, made by Universal Radio Co. and RCL4S Mignon receiving outfit (special). Spark gap, 1½" spark coil and 2 Murdock fixed condensers. Donald E. Sharp, 128 Pleasant Ave., Hamburg, N. Y.

All for $8: 33 Wireless Age, 20 Wireless World, 8 QST, Year Book, Call Book, Bishop's handbook, Navy Manual, Arlington coupler, $6. John Smith, 3650 Marvine, Philadelphia.

For Sale—P 500 DeForest Audion control panel, $18. 20% off on DeForest honeycomb coils, L-25 to L-400. Howard Strong, Smethport, Pa.

Used Commercial radio equipment wanted. State description, prices, first letter. Address Radio, 103 Bowen, Independence, Missouri.

For Sale—Complete amateur radio station. Get my list. Harold Schulz, Cheboygan, Mich.

Let's Swap! Buy! Sell! What'ye got? Whatd'ye want? Dime quarterly. Swap Bulletin, New York-Detroit.

For Sale—The Radio Apparatus Co. Type 91 long wave receiver, 18,000 meters, complete with wing oscillating inductance and control cabinet, complete with tube, A-1 condition, $50; 1 K.W. Thordarson transformer, $20. Roy E. Sloyer, 308 Monroe St., Kalamazoo, Michigan.

Get a Real Storage Battery—"Iron-Clad Exide" cells, 150 amp. hours, $10 each; Edison cells, 150 amp. hours, $7.50 each. All in excellent condition. New 20-amp. rectifier tube, $15; ¼-H.P. steam engine and boiler, $15; steam turbine, $8. A. R. Spartana, 615 N. Washington St., Baltimore, Md.

Sending and Receiving Station for sale. ¼-K.W. Thordarson type "R" transformer; Thordarson Os. transformer; 6 sections 8 by 10 glass plate condenser. Quick break rotary. Murdock line protector. Clapp-Eastham antenna switch. Duck's Navy coupler. Mignon type RW3 undamped receiver Brandes phones. Every instrument guaranteed. Certified check for $170 takes all. 1 Mignon RW3 guaranteed perfect, $75. Radio 8DB, 727 Arch St., Williamsport, Pa.

Sell—Fine long model B-flat cornet, $16; Omnigraph, $11.50; Crystaloi detector, $3.50; Radiosan detector, never used, $3. Write for particulars. Stanley Reed, Lennon, Mich.

Bargain—Radio apparatus never used and back numbers of the *Electrical Experimenter*. Send stamps for list. John Rakosy, 331 E. 80th St., New York, N. Y.

Bargains—New DeForest honeycomb coils: L-25; two L-50; L-250; two L-500; three L-1500, with three-plug unit panel, $20. Arnold variable .001, rugged construction, fine mahogany case (cost $15), for $8.50. "Superior" Brandes phones, $5.50. Many other instruments. E. G. Baier, 253 Ninth St., Brooklyn, N. Y.

For Sale—1 Pottstown, Navy type, coupler, new, cost $20, for $17. 2-panel type, variable condensers, $3 each; one 75-ohm phone, with headband and cord, $1.50; 65 chemicals, test tubes, graduates and other chemical apparatus, all for $10. Radio keys, $1.25 each. Murdock phones, $4; loading coil, $6. Numerous other radio and electrical apparatus. Send for list. Alfred Mihachik, Freehold, N. J.

Sale—$15 Duck improved receiving transformer, $9; $2.50 detector, $1.50; 17-plate variable, $3.50. Also 700-meter cabinet set, including coupler, detector, fixed condenser, phones and aerial wire, $7. 1½-in spark coil, $1.50; condenser, $.50; spark gap, $.50. Write Edward Sentman, Arcanum, Ohio.

Exchange or Sell—Indian motorcycle, one cylinder, 4 H. P. engine is in excellent condition, for high class receiving outfit with V. T. or sell for $45.00. Ralph Petranek, Muscoda, Wis.

Will Sell—Chemicals and chemical, electrical and wireless apparatus. Send 5 cents for particulars. Karl Peterson, Weldon, Illinois.

(Exchange—Continued.)

Wanted—Two burnt-out VT's must have good plate and grid. Will pay cash for first reasonable offer. Thos. Pillsbury, Enid, Oklahoma.

Set of Hawkins' Electrical Guides, never used, $8 postpaid. Howard Osborn, 340 Peach St., Vineland, N. J.

Will Exchange chemical laboratory for wireless sending apparatus. Lists exchanged. W. D. Myers, Vandergrift, Pa.

Vibroplex Bug—Brand new, never used, in actual work. Sell for $12. Need cash immediately. John Mrowca, Gore Hall, Harvard, Cambridge, Mass.

½-Kilowatt Acme Transformer, $15.00. Jack Moore, 5015 Ross Ave., Dallas, Texas.

Selling Out—DeForest coils LL-1500 at $2.75; LL-100 at $1.35, and condensers CV-1000, $6; CV-1500, $8; Tron panel and bulb, $10; 15 dial (Continental) Omnigraph, $18; 3000-meter coupler, $4. Harold Jones, Ferndale, Wash.

Portable (Cabinet) short wave regenerative set, $35. Miller, 33 Windsor Place, Brooklyn, N. Y.

DeForest Unit Panel Type receiving set, with complete set of coils mostly Litz from L-25 to L-1500; .0015 and .001 Vernier condensers. Galena detector and audion socket with change-over switch, best triple coil mounting, rheostat and potentiometer, primary condenser switch, telephone jack and plug, etc. A $150 set for $75. Address C. F. Allen, Box 1504, Providence, R. I.

For Sale—Knapp Dynamotor, two variable condensers in cabinet, Brandes Trans-Atlantic phones. Enlarging camera, developing film tank, Reinler V. T. socket. For particulars, address R. L. Lenhart, Hamburg, Pa.

Sell—1¼" telescope, magnifies 12 x, $5.80. Albert Kauzmann, 100 Hamilton Ave., New Rochelle, New York.

Bargain—½-K.W. panel transmitter, $35; 2 Murdock sections. Kohnitz, Navy Radio, Duluth.

For Sale—DeForest receiving set and other apparatus. Nearly new. Stamp for list. Will sell separate and cheap. Eldred Hall, Village Hall, Solvay, N. Y.

The Complete Radio Station 9 LA for Sale—Bargain—1-K.W. transmitter, ½-K.W. transformer, Audio-Tron and one-step amplifier; spark and arc up to 20,000 meters. Write at once. L. A. Hendricks and F. S. Fritts, Wakeeney, Kansas.

For Sale—Two-stage amplifiers without cabinet, bakelite mountings, nickel finish, $37. Guaranteed perfect or money refunded. H. Geibel, 1457 N. 28th St., Philadelphia, Pa.

For Sale—4000-meter Clapp-Eastman coupler, $10; .001 mfd. Universal variable coudenser, $2.50; E. I. "Radiocite" detector with mineral, $1. Write G. G. Greeno, 137 Glen St., Glens Falls, N. Y.

Exchange—Mahogany piano player, Aeolian make, with music rolls, cost $200, for complete wireless sending outfit. Faulkner, 349 Summer St., Paterson, N. J.

Swap DeForest P-300 audion ultraudion amplifier, T-200 Multi-wave tuner, twelve honeycomb coils L-25—L-1500, two tubes, Baldwin amplifying phones—plug attached, "Electro" radiotone and complete aerial, four wires, stranded, about 100 x 70, six-foot lead-in, high grade insulators, lead-in insulator, 600-volt lightning switch, cable, etc. New—never been used. Worth $240. First certified $190 gets it, boxed, delivered. F. O B. Home City School, Home City, Alabama. (Long Island P. O.)

For Sale—Murdock loose coupler, $5.00. Carl Staugaard, 4531 N. Rockwell St., Chicago, Ill.

For Sale—From Station 2N.W. (see photo in September Q.S.T.) 1 new Grebe CR7 receiver, $110; 1 Magnavox telemegaphone, new, $45; 1 Rotary converter, excellent condition, 220v d. c. to 150v a. c. at a current value of 10 amps., $115; 1 new remote control automatic starter, Marconi type, $20; 1 Weston A. C. voltmeter, 0-150 volts, 7" face back of board mount, 1 Roller Smith A. C. ammeter, 0-10 amps. 7" face back of board mount, new condition, each $20; both mounted on black oak panel with supports, $40. 1 Type T1 Thordarson transformer (old type) ¼-K.W., $15. All the above absolutely guaranteed. Act quickly, the above are really being sacrificed. I am leaving the States. You to pay all transportation charges. Letters answered. Ralph Brooke Austrian, 694 Broadway, New York City.

Genuine "Junior" Aerial Wire. Seven strands Number 22 solid copper, 100% conductivity, 1½ cents per foot, $12 per thousand. No C. O. D.'s. 15 pounds per thousand. Send postage. Also a limited supply of seven strand No. 22 tinned, suitable for receiving aerials, 1 cent per foot. Lee A. Bates, 8 Moen St., Worcester, Mass.

Want to Buy—Baldwin type "E" or "F" phones and omnigraph. Alex Serna, Lehigh, Okla.

1 Murdock 1500-meter loose coupler, $10.00; 1 Bunnell's mascot 23 plate condenser, $4. Communicate with F. R. Summerville, 28 Orchard Place, Ridgewood, N. J.

Sale Quick—Audiotron bakelite control panel, $5; ¼-K.W. Blitzen transformer, $8. Carmi Miller, Spring Valley, Illinois

(Exchange—Continued.)

Look—Electro Dynamo, Ten Dollars. Twenty thousand meter tuner, Eight Dollars. Two thousand meter coupler, Four Dollars. Omnigraph, No. 2, 30 dials, Fifteen Dollars. D. C. Kerr, Woodstock, Ontario, Canada.

For Sale—German two-step Telefunken submarine type amplifier. Described in December, 1919 RADIO NEWS, page 271. Natalish, 68 West 56th St., New York City. Telephone Circle 658.

Cabinet—Grebe CR-3 in conjunction with new audion detector and two-stage audio frequency amplifying cabinet. First $95 money order takes both, including tubes. G. N. Garrison, East Orange, New Jersey.

For Sale—Regenerative set, audion detector and receivers, $42. Chemical set, $16. Charles Jones, Irvine Ave., Sharon, Pa.

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Moving Picture Machine. "Powers No. 5" without lens, excellent condition, will sell or exchange, $50. An opportunity, address David Forde, Jr., 2523 So. Garnet St., So. Philadelphia, Penna.

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Omnigraph Wanted—Quote lowest price. Bowers, 531 Madison St., Brooklyn, N. Y.

For Sale—Loose coupler, range 400 miles, $12. Francis Bailey, 23 Harvard St., Worcester, Mass.

.22-Calibre Remington Takedown rifle; Duplex Orchestra Snore Drum. Want high grade receiving cabinet. Ahnstrom, 57½ 8th St., Muskegon, Mich.

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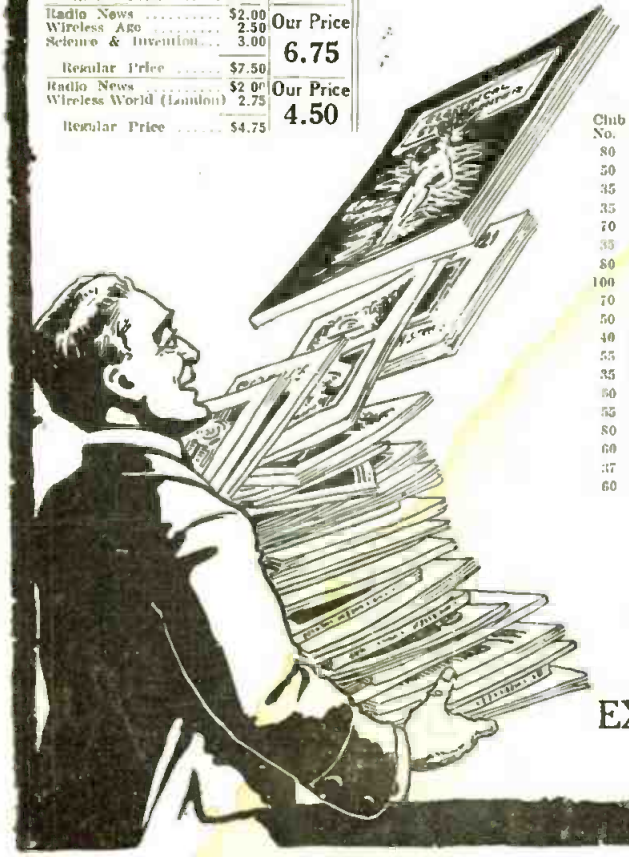

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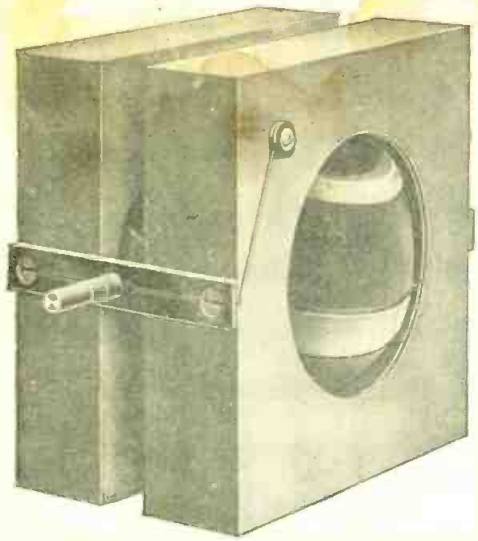

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