FEBRUARY 1923 25 CENTS

RADIO

IN THIS ISSUE:

S. G. McMEEN
V. F. GREAVES
V. G. MATHISON
LAWRENCE MOTT
E. W. STONE
B. F. McNAMEE

Announcing the New Cunningham Amplifier Tube

Type C-301-A **List Price $9.00**

The most efficient vacuum tube ever placed on the market for amateur and experimental use. The engineers of the General Electric research laboratories have at last succeeded in perfecting a tube that every owner of a radio set has been waiting for.

Greater Power Amplification
Only ¼ Amp. Filament Current

THIS new and improved Cunningham C-301-A Amplifier is a high vacuum tube designed for use as an amplifier and detector, containing a new Tungsten Filament, the characteristics of which are long life, low power consumption, low operating temperature and greater power amplification than any previous amplifier tube. The tube has a standard four prong base, and the glass bulb has the same dimensions as the C-300 and the C-301.

The greatly reduced filament current permits the use of four of these tubes without exhausting the A battery any faster than when using one of the previous type of amplifier tubes.

Complete instructions for the care and efficient operation of this new Amplifier Tube are packed with every tube.

Insert a C-301-A in your amplifier set today. Note the improved quality and increased audibility.

The Cunningham Technical Bureau is at your Service. Address your problems to Dept. R

E. T. Cunningham

248 First Street
San Francisco, California

154 W. Lake Street
Chicago, Illinois

RADIO

Established 1917 as Pacific Radio News

Volume V for FEBRUARY, 1923 *Number 2*

CONTENTS *for* FEBRUARY, 1923

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Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast for March Issue

Arthur L. Munzig gives full details for building an efficient broadcast receiver employing a variometer and single tube.

Volney G. Mathison has resumed his Samuel Jones stories and has written one for March RADIO that takes the reader to Mars and back again.

Jerome Snyder interestingly discusses some of the problems introduced by radio broadcasting and suggests some practical remedies for their solution.

D. B. McGown, in the second of his series of articles on the operation and care of motors and generators, will deal with alternating current equipment.

Several articles which were crowded out of this issue so as to make room for matters of immediate news interest will appear in the next issue. Included among these are several helpful construction kinks.

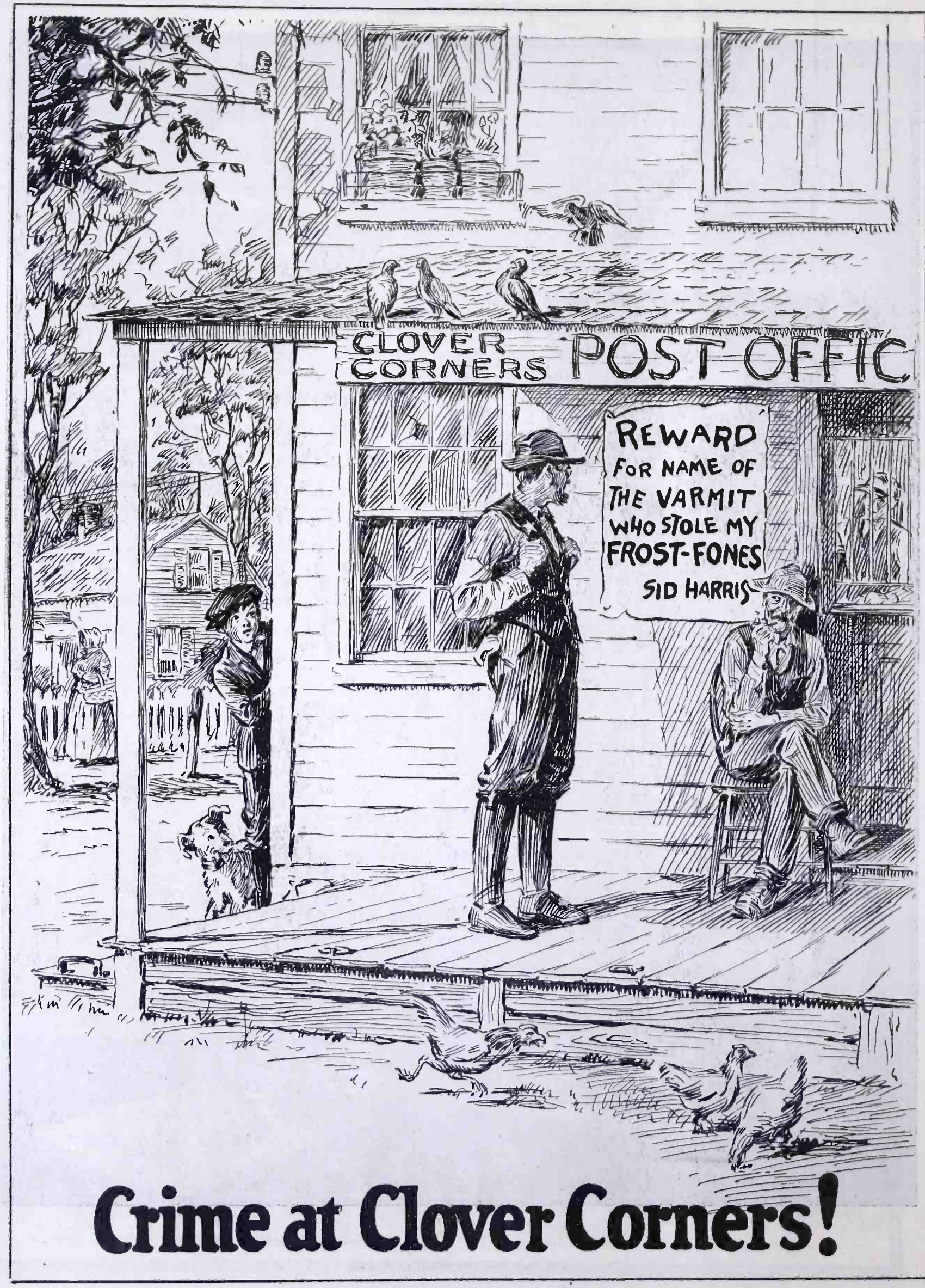
In "Radio Outlets" Stanley E. Hyde gives some practical instructions for making a workmanlike job of a radio installation. This has to do not with the receiving set itself but with the auxiliary wiring.

As G. M. Best's promised description of how to make a small radiophone using ordinary amplifying tubes was not quite ready for the February issue, it has been held up and will be published in the next issue without fail.

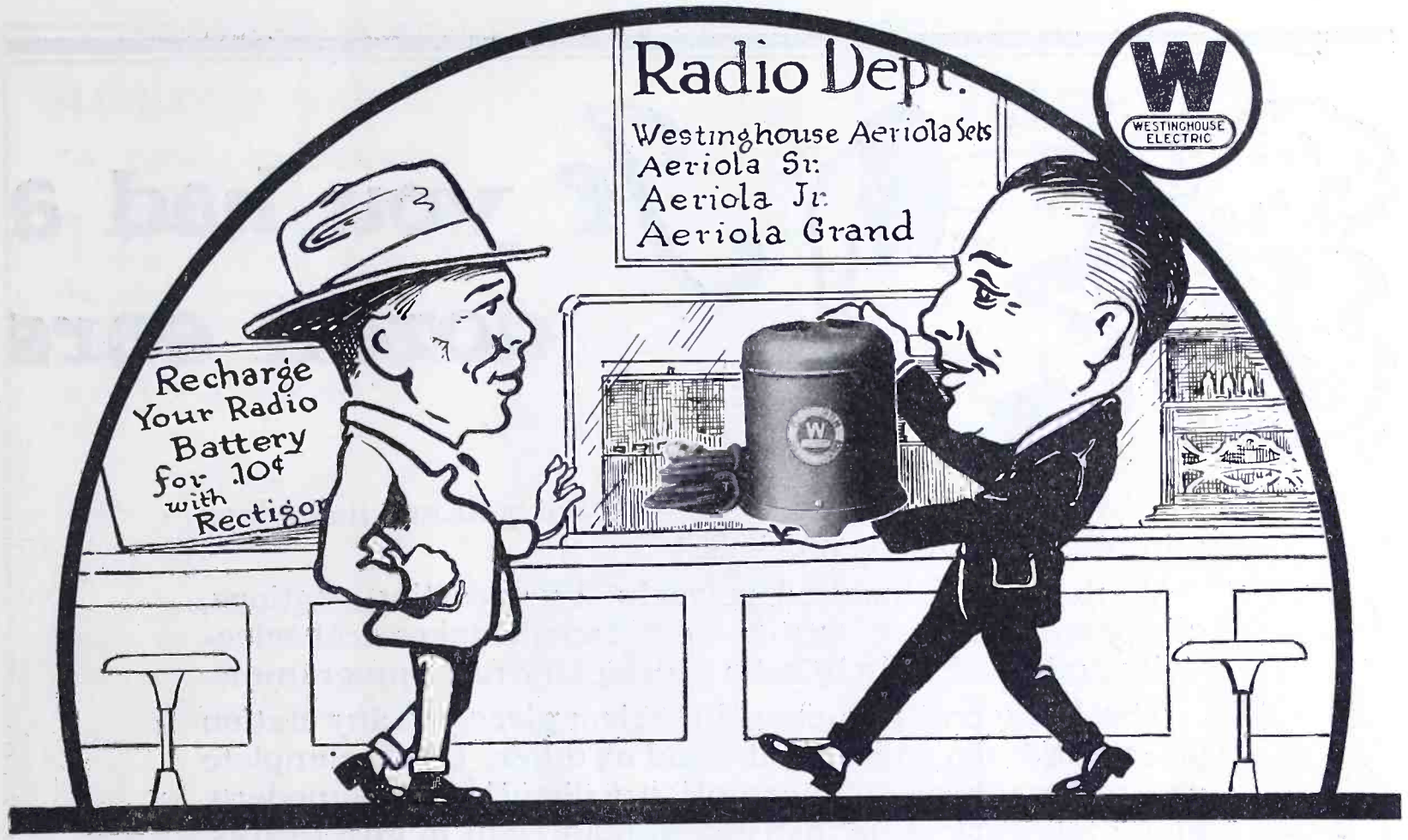
R. M. Barbier has found it possible to use the same tubes on either radio or audio frequency amplification as one or the other may be desired. He gives a diagram of connections which will enable anyone else to do likewise.

Assignments Nos. 11 and 12 in the University of California correspondence course in Elementary Radio by Ellery W. Stone are concerned respectively with "The Armstrong Principle of Regeneration" and "Tube Transmitting Circuits."

Samuel G. McMeen has been doing some research into the more convenient ways of producing radio-frequency amplification as well as making some notes on the not-yet-trite subjects of receiving and transmitting apparatus. The results of this work will appear in early numbers.



Crime at Clover Corners!



Radio Fans Are Buying Again
Sell Them Rectigons!

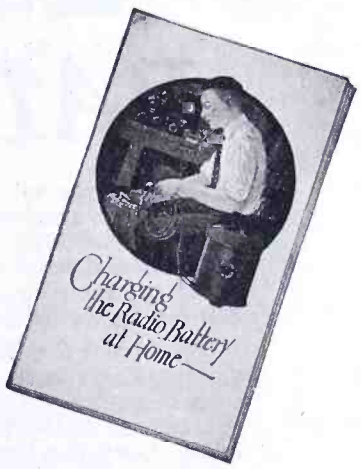
Every vacuum tube wireless receiving set requires a storage battery for efficient operation. And every storage battery requires frequent recharging. Hence, the big market for Rectigons.

Your own radio customers will be interested in Rectigons and the safe, economical and easy means they provide for recharging batteries at home.

The Rectigon has no moving parts to get out of order. Requires no attention and is automatic in operation. It is light in weight and portable. Current consumption is very small.

Rectigons are also suitable for recharging auto batteries, which make the number of prospects still larger.

Stock Rectigons now. Our nearest agent-jobber can supply you.



This new Rectigon Folder is specially designed to help you sell to radio enthusiasts. Get a supply from one of our agent-jobbers to keep on your counter.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse

Tell them that you saw it in RADIO

If you had a dozen ears

You would need them all to hear what you get nowadays with a single-circuit receiver.

With several hundred powerful broadcasting stations, all operating on one narrow wave band, it takes real selectivity and sensitivity to get a satisfactory radio programme.

The Paragon three-circuit receiver gives you any station you want when you want it—and no other. Clear, complete programmes without interruption or disturbance. A modern, high grade, scientific instrument built right to give results.

Ask some experienced amateur what he knows about

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

The amateur will tell you that the Paragon three-circuit receiver, because of its greatly superior selectivity and sensitivity, can pick and choose between broadcasting stations of about the same signal strength with less than one per cent differential.

This means that with a Paragon receiver you get what you want when you want it—complete messages and clear music from the station you tune in on, without interruption and jamming. Until you have listened in with a Paragon three-circuit receiver, you cannot guess the real pleasure and fascination of radio.

Paragon receivers are built by the Adams-Morgan Company, which has been a pioneer throughout the modern development of radio. Paragon was the *first* regenerative receiver manufactured. Paragon effected the *first* transcontinental reception (not prearranged) from New York to California. Paragon effected the *first* transatlantic amateur reception. During the war Paragon receivers proved superior to all others in the interception of enemy signals by the United States army and navy.

Long before broadcasting popularized radio with the general public Paragon equipment was the choice of the experienced amateur. He will tell you today that if you want quality and satisfaction, Paragon Radio Products are the best and safest buy on the market.

An Illustrated Catalog of Paragon Radio Products Is Yours for the Asking

DEALERS—The Adams-Morgan Company has an interesting proposition to make to reputable radio dealers who believe in quality merchandise. Details on request.

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2 Alvin Ave., Upper Montclair, N. J.

Also Manufacturers of PARAGON

Radio Telephone Transmitters	Amplifier Transformers
V. T. Control Units	Control Dials
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Type RD-5 Regenerative Receiver and Detector—$75.00
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"A Public Institution"

THE real progress of radio is shown by the illustrated magazines and newspaper supplements—nobody follows the popular thought closer than the "art editor."

The preponderance of Magnavox equipment in these illustrations of novel and interesting radio uses, indicates how the Magnavox Radio, like the Morse Telegraph or the Bell Telephone, is becoming a "public institution."

R-2 Magnavox Radio with 18-inch horn

This instrument is intended for those who wish the utmost in amplifying power: for clubs, hotels, dance halls, large audiences, etc. It requires only .6 of an ampere for the field.

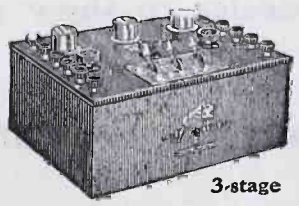
Price **$85.00**

R-3 Magnavox Radio with 14-inch horn

(as illustrated)

The ideal instrument for use in homes, offices, amateur stations, etc. Same in principle and construction as Type R-2.

Price **$45.00**



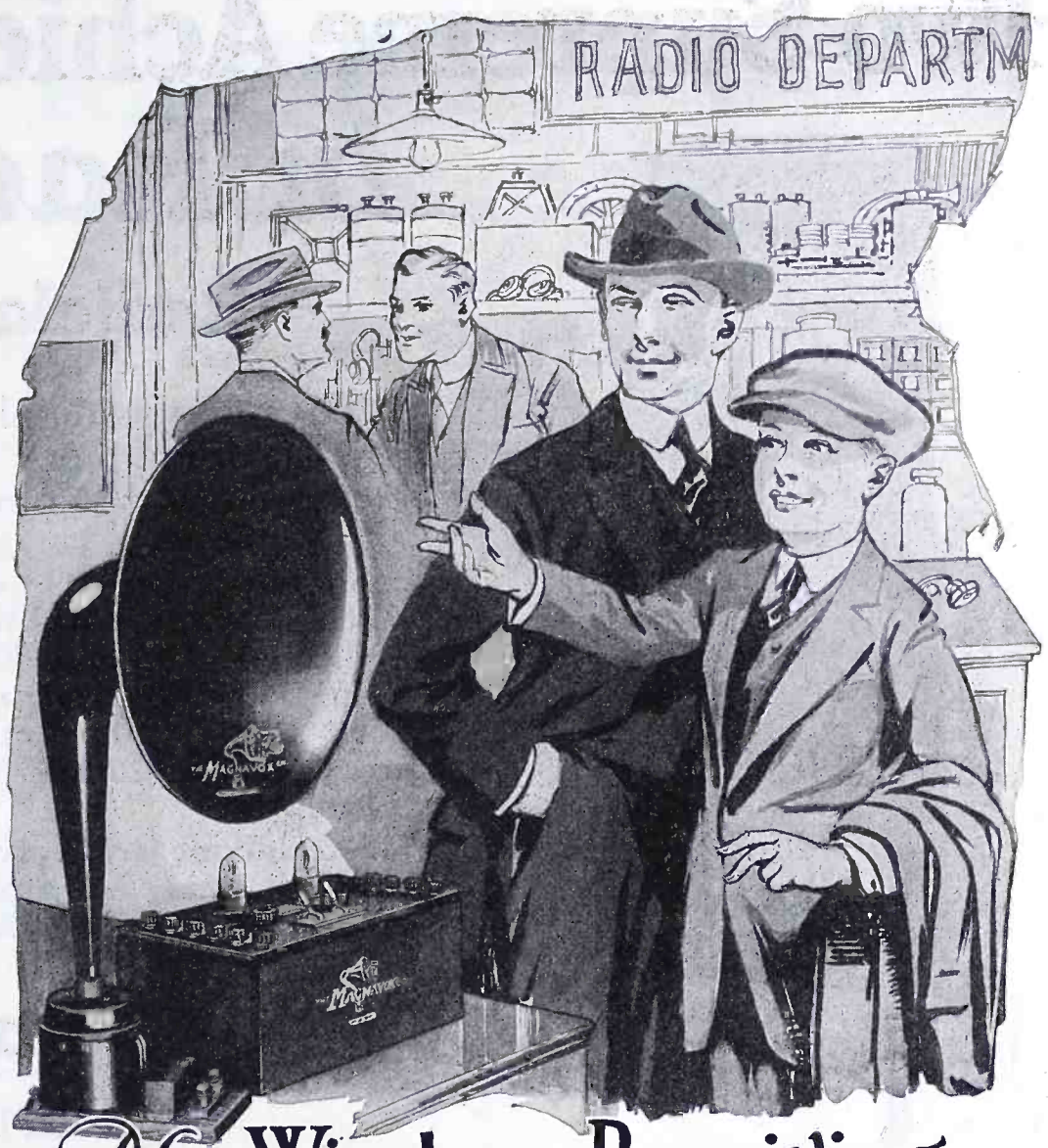
3-stage

Model C Magnavox Power Amplifier

For use with the Magnavox Radio and insures getting the largest possible power input.

2-stage **$ 80.00**

3-stage **110.00**



No Wireless Receiving set is complete without

MAGNAVOX

To enjoy all that radio offers in the way of daily concert, lecture and news, ask your dealer for a receiving set equipped with Magnavox Radio, the Reproducer Supreme.

The Magnavox can be used with any receiving set of good quality—the better the set, the more Magnavox can do for you.

Magnavox products can be had of good dealers everywhere. Write our nearest office for copy of new illustrated folder. Our interesting new booklet (illustrated in three colors) will be sent on request.

The Magnavox Co., Oakland, California

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MAGNAVOX Radio

The Reproducer Supreme

Two Supreme Achievements in Radiolas

RADIOLA GRAND and Mahogany Stand with "B" Batteries, tubes and full instructions, $350.00

Radiola Grand

TRADE MARK REG. U.S. PAT. OFF.

The finest principles of radio detection, amplification and loud speaking are embodied in the new RADIOLA GRAND.

The RADIOLA GRAND has been especially designed to receive broadcasting stations operating on the standard wave lengths of 360 and 400 meters, but an additional range is available up to 550 meters. By means of a new type of Loud Speaker, the entire family may receive broadcasted music and other entertainment and instruction.

A telephone jack is provided in order that head telephones may be employed for the reception of broadcasting over great distances.

RADIOLA IV, complete with 4 tubes (1 spare), all batteries, headset with telephone plug and silk covered leads for antenna and ground, $275.00

Radiola IV

TRADE MARK REG. U.S. PAT. OFF.

RADIOLA IV is a self contained console-type broadcast receiver. The cabinet contains a regenerative receiver, a detector, two stages of audio frequency amplification, a new loud speaker of unsurpassed tone quality and all necessary batteries.

RADIOLA IV is not only a highly efficient receiver, embodying the latest developments in design, but is also a thing of beauty that will grace a drawing room or library.

Both of these Radiolas provide exceptional long distance as well as local reception.

Ask your nearest dealer to show you the Radiola line.

"There's a **Radiola** *for every purse"*

RCA

This symbol of quality is your protection

Radio Corporation of America

WORLD WIDE WIRELESS

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February 1923 **RADIO** Vol. 5, No. 2

Radiotorial Comment

AT once the strangest and yet most natural characteristic of *genus radio bug,* a characteristic that distinguishes novice and amateur alike, is the joy of long distance reception. The greater the distance heard, the greater the pleasure experienced. By affirming "Every day and in every way I am hearing further and further," they are actually accomplishing it. The most popular broadcasting station would be that which would can the canned music, eliminate the personal artists, and steadily repeat "This is Kay Tee Did in the Land of Oz." The proverbial prophet who was without honor in his own country had nothing on the broadcaster in his own city. Though usually a case where distance lends enchantment, the distant station invariably has the best modulation and the "far superior" program.

TO meet the demands of sensationalism, some writers on radio subjects apparently run out of facts and have to draw upon their imaginations to an extent that is injuring the cause of good radio. These ravings are so weird and fantastic that the reader sometimes suspicions that they come from a brain disordered by the drug whose traffic the anti-narcotic forces are trying to stamp out. Future possibilities and impossibilities are played up as present accomplishments, and the reader's expectations are raised so high that the actual wonders of radio lose their charm after the dupe has been disillusioned.

First in this museum of absurdities are the constantly repeated reports of power transmission by radio. Steinmetz, a recognized authority on electrical subjects, has definitely shown its present impracticability. Even when the technical problems are solved, if ever, there will remain the business problem of financing a power project whose supply can be tapped by the unauthorized as readily as does the eavesdropper listen in on the Catalina radio telephone.

Another favorite subject of these romancers, a subject savoring of the water-witch and the divining-rod, is the location of ore bodies by radio. The garbled reports of such feats as come from Germany and Italy have not yet been substantiated by investigators. There are too many unknown variables in the propagation of high frequency electromagnetic waves to allow any safe credence to be placed on the results obtained in underground transmission. The money spent with the hope of gain from such experiments would be far more profitably invested in a diamond drill or even in a pick and shovel.

But the acme of foolishness is the claim that radio has established communication with the spirit world. Fakers of the worst description are preying upon the credulous with a jargon of science and mysticism, fleecing their victims, and then passing on to new fields. We realize that these words of warning are not needed by the readers of RADIO, but should they come across these absurdities, they are urged to brand them as lies and thus help preserve the good name of radio.

AT last comes word that the Kellogg-White federal radio control bill is being given serious consideration by Congress. Based upon the findings of the Radio Conference at Washington last Spring, this bill gives supervision of all radio communication, excepting strictly governmental business, to the Department of Commerce. After the hearing has been concluded by the Merchant Marine Committee, it is hoped that the bill will soon come up for vote.

As to its immediate necessity there is no argument. More than ten years have elapsed since the last legislation on radio. The Radio Act of 1912 is as inadequate to control the stupendous radio traffic of today as would be automobile traffic laws of that ancient vintage. The most serious trouble is in connection with broadcasting. There are today 569 broadcast stations in regular operation, whereas two years ago there were none. These stations interfere not only with each other but also with governmental, commercial, and amateur transmission. On the 2nd of January one Pacific Coast broadcaster completely upset the initial operation of the Navy's Fanning relay circuit for some reason that has not yet been technically explained. A person midway between two powerful broadcast stations is unable to hear either of them satisfactorily. Broadcast interference with amateur communication is fully as serious as amateur interference with broadcasting.

Most of these difficulties will be solved by giving the Department of Commerce the power to assign wavelengths, approve apparatus, and to otherwise supervise the situation. With real power to act, the present feud between broadcasters and amateur operators can be quickly settled. The injustice of a suit brought by a broadcast listener to suppress as a public nuisance an amateur who is operating within the present legal requirements, and who is willing to cooperate, would be avoided. As it is, a Radio Inspector is practically helpless. Radio cannot go ahead without regulation, so the early passage of the new bill is a consummation devoutly to be wished.

Multiplex Arc Radio

By Volney G. Mathison

This is another article published in response to many requests for more information about arc transmitters. It tells of recent developments in commercial transmission practice, including an account of how arc "mush" is being eliminated. This installation is an interesting illustration of successful competition of radio with wire telegraphy.

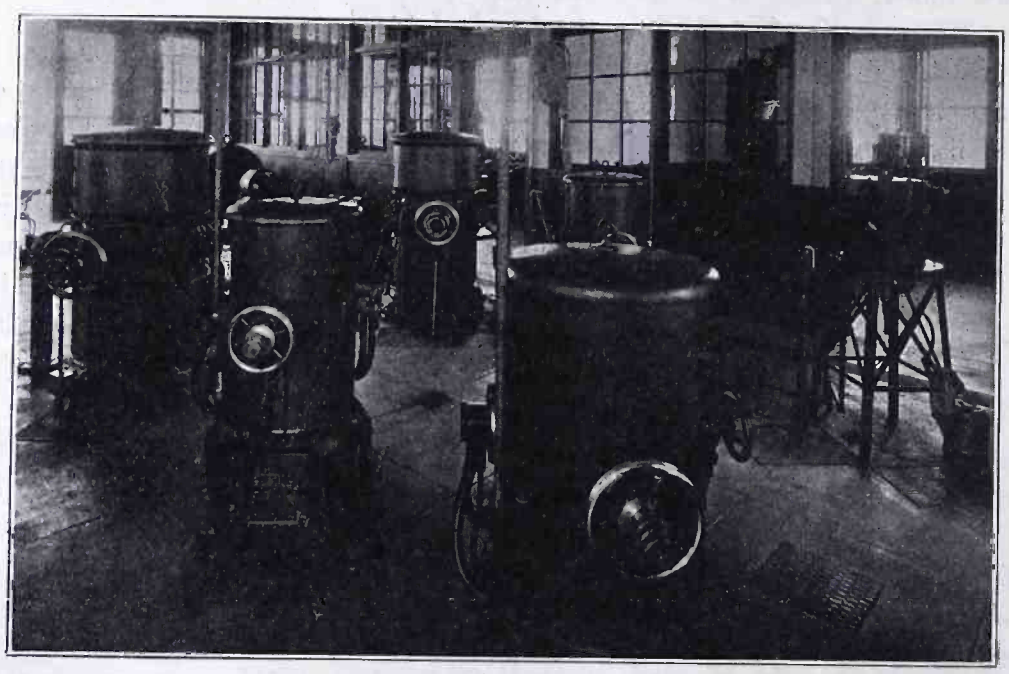
PROBABLY every radio enthusiast in the central and western part of the United States who owns a long-wave receiving set has listened to one or more of the flock of mysterious "no-call-letter" continuous wave transmitters which may be found on the air at any time of the day on various wavelengths between 3,000 and 10,000 meters, rushing through countless scores of "blues," "blacks," and "NLs,"—messages pertaining to wheat and prunes, pork and pig-iron, and a thousand and one other matters.

It is not unlikely that the amateur possessing sufficient receiving skill to read these streams of rapidly sent messages will surmise that he is listening to some sort of overland radio system, and may enviously picture a family of busy brasspounders sitting among facinating mazes of meters and inductances, while powerful motor-generators hum complacently in adjoining power-rooms. But in this fancy he would be entirely wrong—except, indeed, that the operators *are* busy.

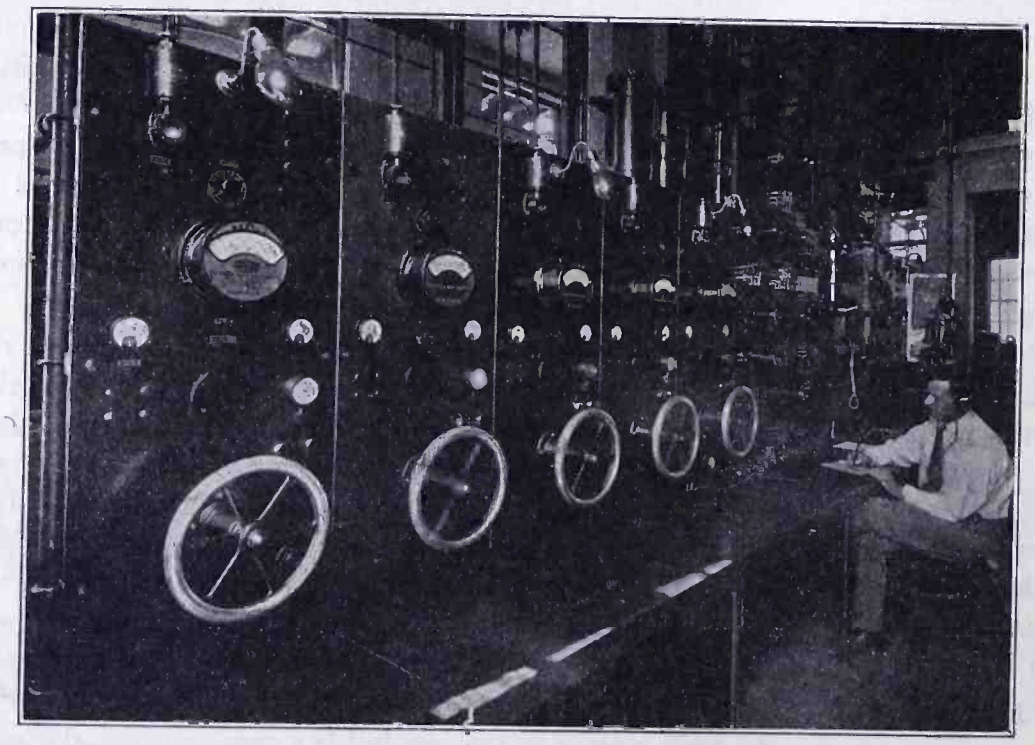
All of these clear, bell-like signals emanate from the arc transmitters of an elaborate commercial radio system which is owned and operated by the Federal Telegraph Company. The system may be said to be centralized at San Francisco, from which point it extends north to Portland and Seattle, and south to Los Angeles and San Diego. Regular domestic telegraph service is rendered between these cities, in direct competition with the Western Union and Postal Telegraph companies.

The San Francisco terminal, to which the equipments in the other cities correspond, consists of six transmitters and six receiving circuits, which are operated simultaneously. The six arc transmitters are placed in one station, as the accompanying photographs show; and their six separate antennas are suspended from a single 626-foot guyed steel mast. This station is situated on a 100-acre tract of marsh land, approximately thirty miles south of San Francisco, but by means of relay keys and distant-control lines, all of the actual sending is done from the company's main offices, which are in the heart of the city.

Out in the transmitting station the mechanical controls of the arcs are concentrated on sectional panels placed side by side, forming a large board, at which an expert arc man is stationed to attend all six transmitters. Radio engineers of the U. S. Navy have expressed much surprise at this demonstration of the practicability of one man attending a large battery of transmitters, and it is probable that the government eventually will install some similar equipment.



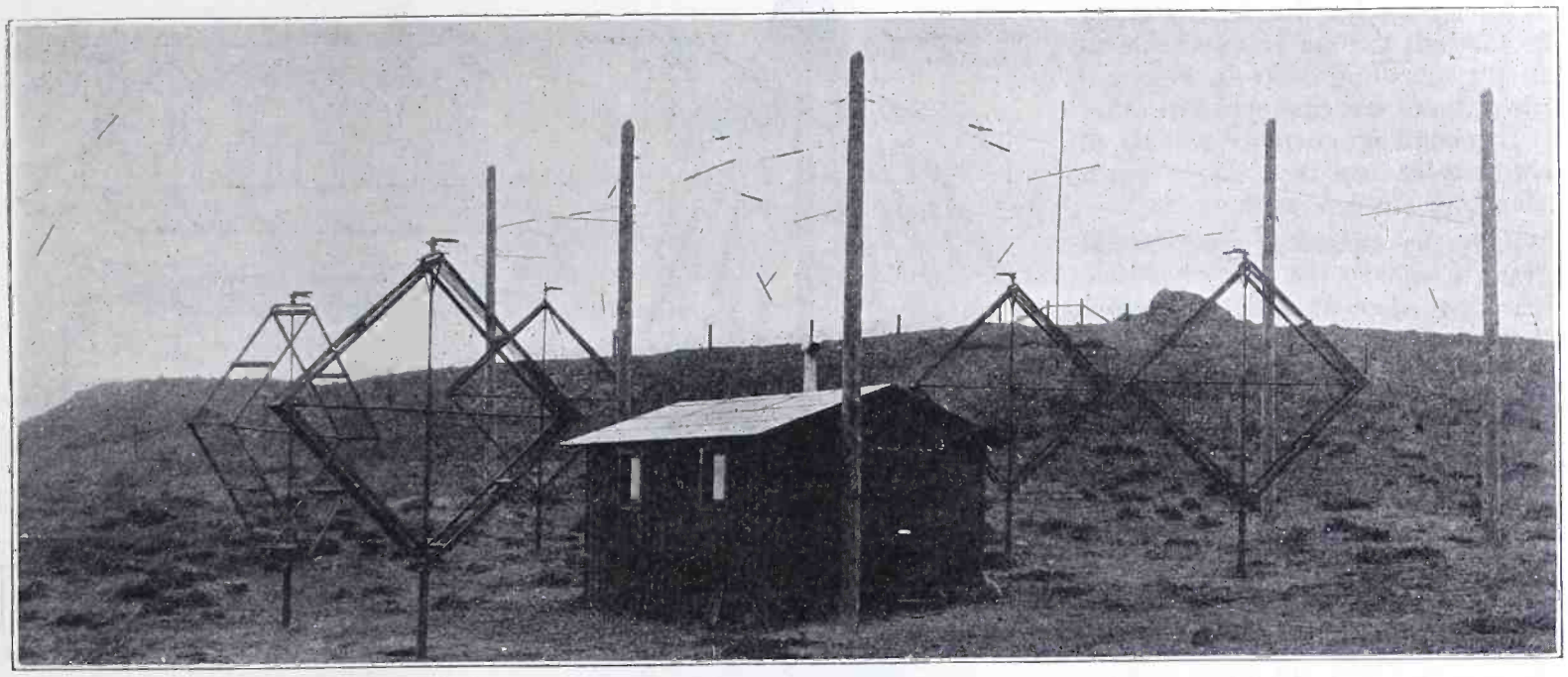
The six arc-convertors of the San Francisco terminal.



Section of control board adjoining arc room, where the station engineer attends the arcs. He is now occupied at a local circuit through which he gets warning when an arc flutters.

Large, light-running hand-wheels on the board are connected through rotating shafts to the carbon-holders of the convertors in the adjoining arc room. Upon the control panels are also mounted voltmeters and ammeters showing the current input to each arc, current input regulators, radiation ammeters, and automatic alcohol feeding devices whereby denatured alcohol is fed through copper tubes to the various arc chambers where it forms the necessary hydrocarbon gas.

At one end of the switchboard is mounted apparatus pertaining to the relay-key systems and to a local calling circuit, by means of which the chief operator in the down-town offices can call the station engineer's attention to any arc that is not functioning properly. It has been found that despite the similarity of the many transmitting circuits, each arc has—like a young lady—its in-



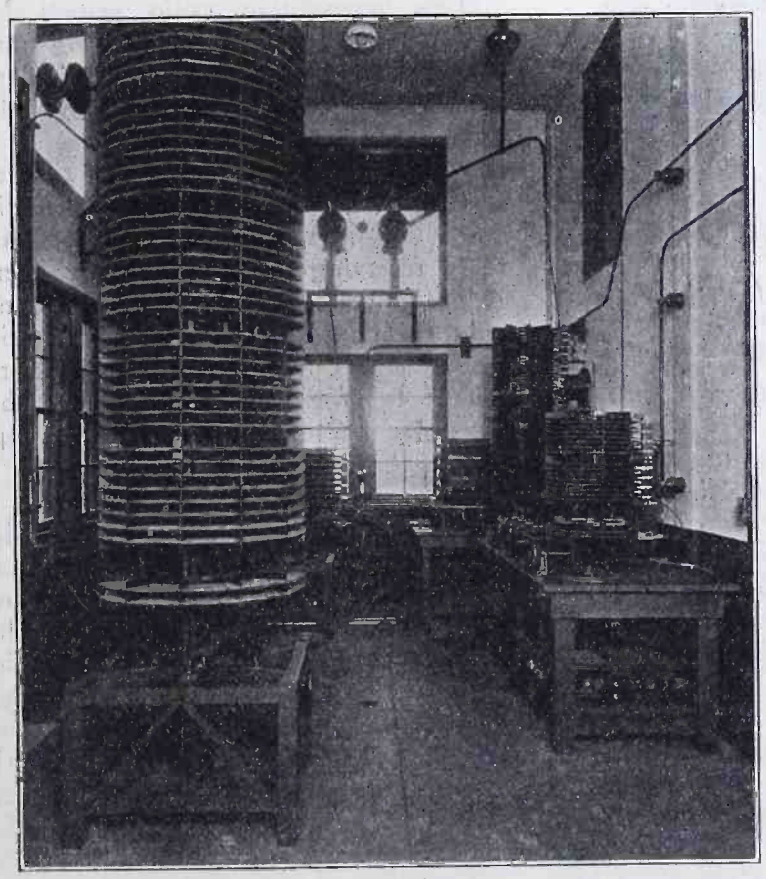
Daly City receiving station. The five loops, and another loop not shown, are connected to six receiving sets inside, from which the head telephone leads are extended through buried conduit to the city offices far below.

dividual little foibles; some of them are inclined to become a trifle flighty at times, while others will burn quietly for hours without a single adjustment of their carbons. This indicates the tremendous improvement of the arc-converter accomplished by the designing engineers since 1909, when Poulsen brought his original twelve-kilowatt model from Denmark to San Francisco —an arc that would hardly burn for thirty seconds without attention.

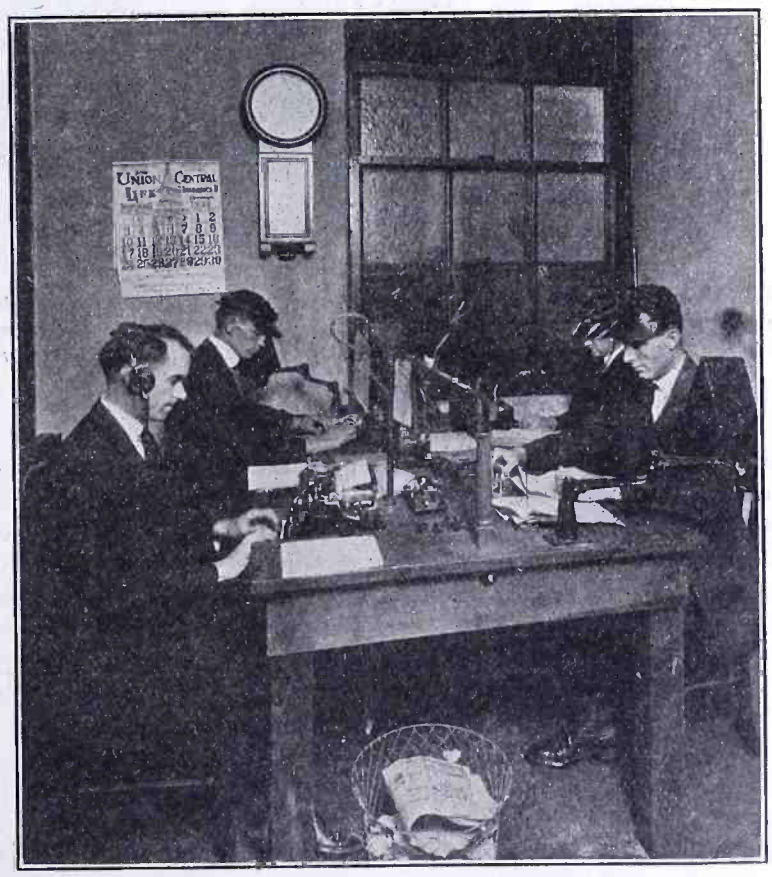
One of the arcs is of only two-kilowatt input; three are of five kilowatt; and two of thirty kilowatt. Another five-kilowatt convertor is being built and soon will be installed. The four smaller arcs work south to Los Angeles, an airline distance of 341 miles, while the two thirties work north to Portland, a distance of about 530 miles. Despite the fact that daylight transmission is maintained and that many mountains intervene between the cities, it has been found unnecessary to operate the arcs, with the exception of the two-kilowatt, at more than a mere fraction of their full power.

Through the highly perfected design of these transmitters the resistance in the oscillating or antenna circuits has been reduced to such a low point that a direct current potential of less than 325 volts suffices at the converter anodes. The construction engineers built a large circular-shaped counterpoise ground for this station, which is supported on wooden poles about twelve feet above the earth. This counterpoise was found efficient when used with two or three transmitters, but when six arcs were brought into operation, it became unsatisfactory. At present a conventional ground system of buried copper plates is employed.

Much credit is due to the builders of this station, not only for their having cut out undesirable radio-frequency reactions of the oscillating circuits upon one another, but especially for having entirely eliminated all "mush" and harmonics. This achievement, which is all the more noteworthy because of the nearness of the transmitters and an-



Tuning inductances, relays, and signal control apparatus of one of the six transmitters.



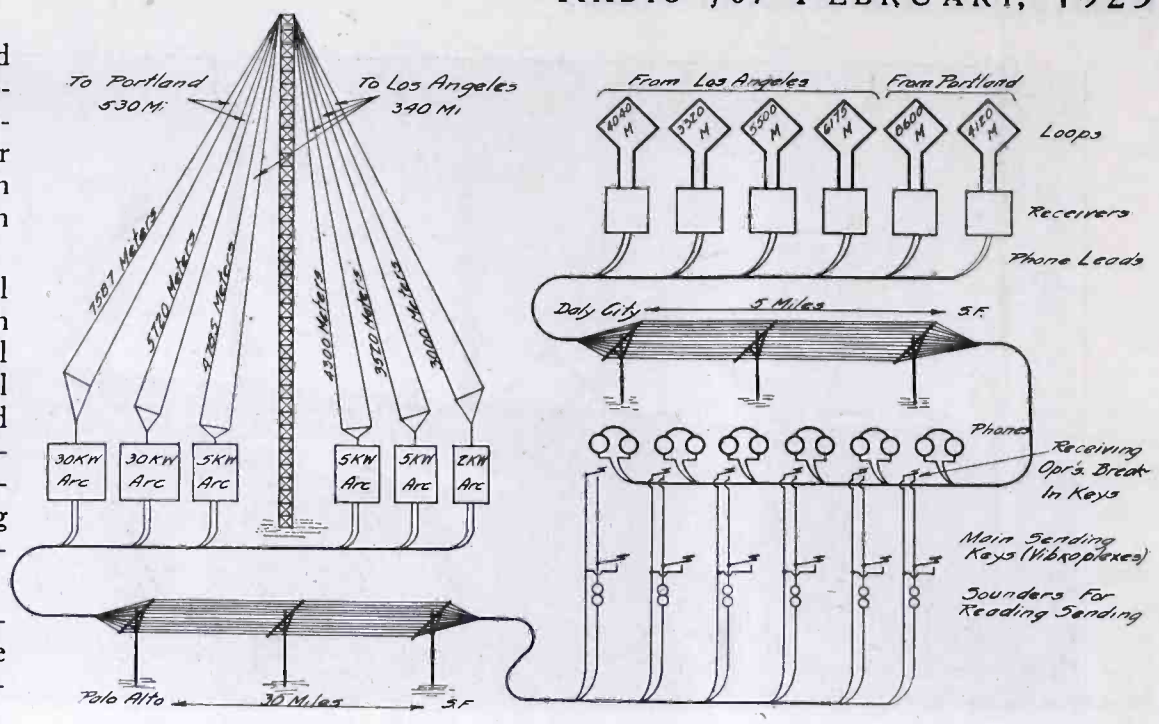
All these boys in the city office have to do is to see how fast they can telegraph. Two are sending and two receiving. There is a table like this for every two arcs.

tennas to one another, has been affected largely through the use of quasi absorption-circuit signalling controls. No compensating waves are employed; in other words there are no currents flowing in the antennas at any time except when the relay keys are depressed.

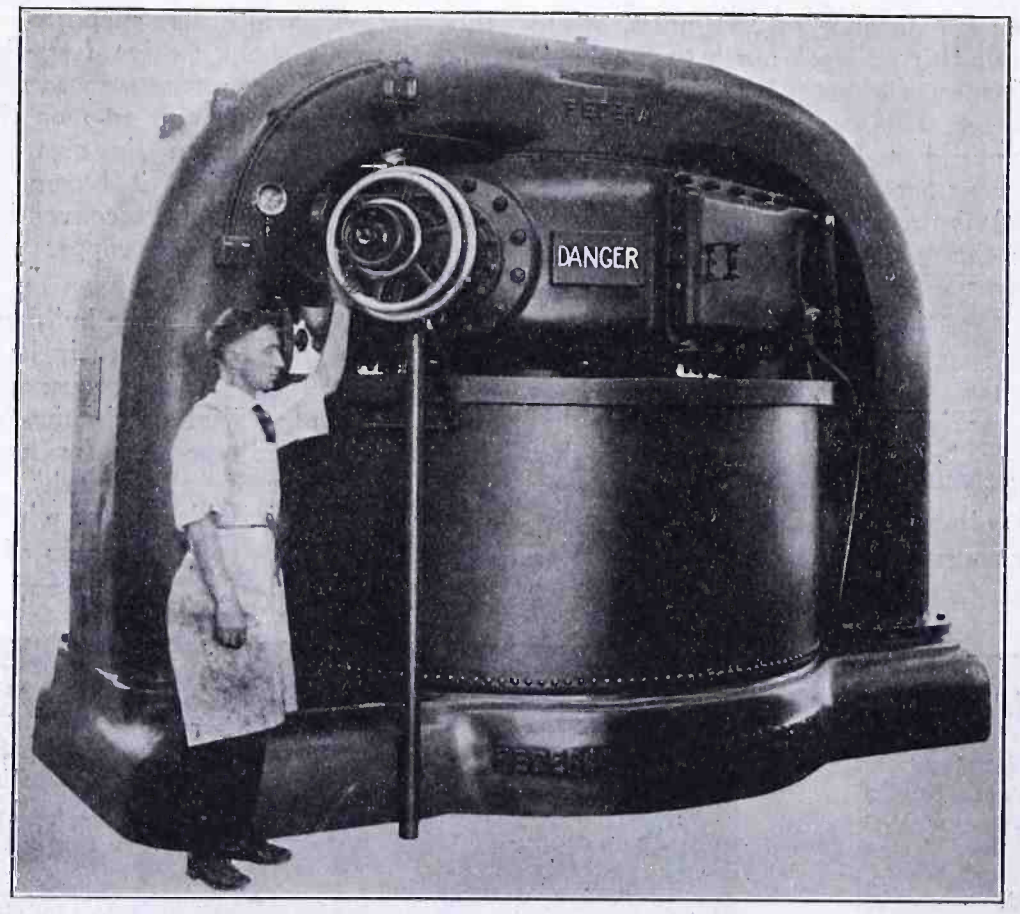
Through the efforts of the Federal Telegraph Company the Navy has been persuaded to adopt this signal control system in their arc stations, which will effectually eliminate all mush and probably some of the harmonics; although a good many of these latter apparently are reradiations from oscillating stays, and would therefore require a different remedy.

Not a little of the success of this interesting multiplex radio system is due undoubtedly to the extraordinary receiving circuits which are being used.

Like the transmitters, the receiving apparatus is all placed outside the city.



Working plan of the San Francisco terminal. The terminals in the other cities correspond to this one. Sending and receiving operators sit side by side, and corrections asked for at the other end are spoken aloud at the tables.



1,000 K.W. arc-convertor. The frame and field poles contain 100 tons of soft steel. A station on the Pacific coast for working the Orient is projected, which would employ one of these units, operated on an antenna 1,000 feet high, and expected radiation of 750 amperes.

At San Francisco, the receiving station is situated up on the crest of a mountain near Daly City. Here in a small wooden house are six separate receiving sets, the head-telephone leads of which are extended over a set of twelve wires to the central offices in the city far below.

It is greatly to be regretted that a description of the actual receiving equipment cannot be given, for some remarkable circuits are employed, but unfortunately, owing to new and important developments, the engineers are unable to permit the publication of any details at the present time.

It may be said, however, that loops are employed for receiving, a separate loop for each receiving set, and no aerials are used except very small ones suspended just above the loops. These aerials comprise part of special unidirectional circuits whereby signals will be received from one direction only. Up in this lonely station on the mountain top, a trained expert attends the many instruments, or amuses himself by listening in on the hard-working boys down-town.

It will be evident from the foregoing that the main thing the telegraphers in the city offices work on is their typewriters. Each operator's equipment consists only of a pair of phones, a key, and a "mill." An ordinary telegraph sounder connected into his key circuit enables him to listen to his own sending. The local circuits also enable him to tell the engineer out at the transmitting station to put out an arc when business on his "wire" gets slack, which is seldom.

So nearly perfect are the receiving circuits that the operator almost never hears a stray signal, a harmonic, a shot of static, or a radiophone concert,—nothing in fact but the signals of the fellow at the other end. Telegraphing is carried on at a usual speed of thirty-five to forty words a minute. These operators, who are regular licensed radio men, receive at present a salary of $160 a month and approximately $1.28 an hour for time over eight hours. They do not work on Sundays.

This remarkable radio system has been evolved from a comparatively small duplex wireless system which the Federal Telegraph Company operated in 1914. Distant control single arc transmitters were then employed; but at that time receiving aerials were strung on the city office buildings and the operators had their receiving apparatus before them. A heavy traffic has been built up, not only through the offering of attractive message rates, fifteen words being transmitted for the usual price of ten, but especially because of the extreme rapidity of the service.

Although sending and receiving at the same time is nothing new in radio, this is the first time that six transmitters have ever been operated simultaneously in one station. Likewise here has been developed one of the first receiving circuits that will respond to a single low-powered distant transmitter without picking up interference from any of the many other arcs belonging to the same system or from any of the countless other stations operating in the vicinity. Here, indeed, is an ultra-modern demonstration of the titanic possibilities of continuous wave radio.

The Versatile Vacuum Tube

By Samuel G. McMeen

This is an authoritative account of some of the many uses to which the triode may be put. These uses include not only the applications to radio but also those to wire telephony and to electric power transmission. The author is a consulting engineer specializing in telephony and telegraphy. He shares with the rest of the world a deep interest in the newest communication art and writes of the device that has turned out to be radio's greatest stimulus.

THOSE who are interested in the art and science of radio communication must have an interest in that marvelous device that is at once the heart, the brain and the nervous system of any radio apparatus except a crystal set. We are wholly in accord with the authority who calls the three-electrode vacuum tube an element "that can be justly be placed in the same category with such fundamental devices as the steam engine, the dynamo and the telephone." This is the highest praise, but it seems to be entirely warranted by the facts, though the vacuum tube in question is not a unitary operating apparatus, but only an essential part of such.

Three steps were required to carry the mind of man from nothing to the therminonic tube as we know it today. Step one was taken when the incandescent lamp was born. Step two when the same genius added the plate to an incandescent lamp. Here the matter rested for years, when De Forest added a grid, and the thing was done.

But did you notice that we have already called the device by several names, and are only well begun talking of it? That happened to be intentional this time, but it will be well, we think, to call the roll at once, and see by what variety of names the thing is really known. Here is a list, though probably some of the names are escaping us: Audion, Vacuum tube, Three-electrode thermionic tube, Thermionic tube, Triode tube, Pliotron, Hot-cathode tube, Detector, Amplifier, Oscillator, Generator, Oscillation generator, Modulator, Demodulator, Repeater, Telephonic relay.

Some of the names in the list are of course functional, describing the uses of which the device is put rather than its form. Descriptively, the names "three-electrode thermionic tube" and "hot-cathode tube" have their points, but both are too long for daily use. "Audion" has a claim on us because the father of the device so named it, and also because it is somewhat descriptive of one of the great powers of the thing itself. But there are so many of those powers that the name fails in the respect that it is limited, though it was fully descriptive of the known powers of the tube when the latter was first created.

The name "vacuum tube" is objectionable because there are many kinds of tubes that have the air pumped out

Samuel G. McMeen

of them. Every incandescent lamp is just as much of a vacuum tube as is an audion.

"Triode tube" is open to nearly the same objection, in that it will apply equally well to any sort of a tube having three electrodes, whether they are arranged for these purposes or not, and whether there is any air inside or not.

"Pliotron" is a coined name, like "audion," has the negative virture of Greek parentage, and does not describe as clearly as the latter what the coiner had in his mind.

"Hot cathode tube" describes any tube with a hot inner terminal that is connected to the negative pole of an external circuit, and while it describes something it describes too much.

The last nine names on the list, beginning with "detector" and ending with "telephonic relay," have their origin in the uses to which the tube is put, and we must in all fairness use them only with relation to those special uses, wherein they will apply very well.

But if you have been checking the list while we have been talking we suppose you noticed that we omitted any comment on the name "thermionic tube." As nearly as possible in short space, it seems to us that this describes the device as a unitary thing, without reference to the uses for which it may be chosen, but with rather strict reference to the way it works. For it is clearly the belief of those who should know that the operation of all thermionic tubes always involves, first, the existence of heat in the filament, and second, the disengagement from that filament of electrons which pass to the positively charged plate because they are themselves negatively charged. The name is faulty in that it suggests ions instead of electrons; it is good in that it suggests heat, and by a familiar syllable.

All this may have seemed like a heap of talk about mere names, but what we have been hoping as we have been telling it is that some one or more of our unseen radio audience may have some obscurity illuminated, or be saved a possible misunderstanding, rather than to have hoped that the matter was highly entertaining.

But the uses of the thermionic tube are of interest to us all, and when we speak of uses we refer to those that are known now, and fearlessly predict that these are not all the possible applications. It is a subject of some amusement to those that have seen the vision of the tube that electrical-power engineers are as yet so callous to the tube's appeal. When they are awake to that appeal we may expect startling revisions in electrical-power practice.

Things Tubes Can Do.

THE late Elbert Hubbard used to say, "There are only two things about a man that matter: 'Who are you?' and 'What do you do?'" We have seen some of the names of the tube; let us recall some of the things it can do, and incidentally how it does them.

The first-discovered power of a thermionic tube was that of detection. This is the power of turning inaudible high frequency radio currents into low frequency currents that will operate a telephone receiver. The currents coming from the antenna or aerial are incapable of giving sounds in a telephone receiver for two reasons. For one thing, they are too weak and for another they alternate too rapidly. The human ear can not apprehend sounds having vibration-frequencies faster than say 30,000 per second, nor can the telephone receiver respond to frequencies anywhere near that high. But the tube has the power of varying direct current in its plate circuit in response to changes in the voltage of its grid. If, therefore, the grid be arranged to feel for the varia-

tions in the stream of radio-energy in the aerial it will interpret those variations into the plate circuit, thence into the telephone receiver and so into sounds.

This transforming power of the tube is present whether the frequency of the received energy is high or low; the same tube will receive waves of lengths varying from ten meters to twenty thousand. No change is required in the tube in this wonderful range from 30,000,000 down to 15,000 cycles per second. No other electrical device has such a breadth of ability.

All of this power is the result of the ability of the grid to control, by its own potential, the stream of electrons passing from the filament to the plate. As long as the filament is hot there is such a flow of electrons to the plate, each with its negative charge, and this flow is controlled in the amount of its volume by the degree of charge on the grid. It is a true case of the mere *condition* of one object controlling the *action* of another, one of the most economical concepts the mind can imagine.

As An Amplifier.

THE same power that enables the tube to detect enables it to amplify what it receives from another tube or from any other source in which there is present the very usual condition of varying potential which the grid can observe and utilize. Likewise, the output from the plate of an amplifier tube can be carried to the grid of a second amplifier, and so on in a series. A dozen or more tubes can thus be connected "in cascade," with the result that the original energy is magnified many thousands of times.

This ability to amplify, like the ability to detect, is independent of the frequency of the received energy. That is, the frequency may be relatively low, on the order of sound waves, say an average of 800 cycles per second, or it may be very high, of radio frequency, say up to 30,000,000 cycles per second. In the first case the amplifiers can be placed after the detector, and in the second before it. In this latter case weak signals or speech can be picked up and amplified, then passed to the detector, then, if desired, amplified at the now existing hearable frequency. It is regular practice today to use both of these methods of amplification in the same set, the high frequency amplifiers preceding and the low frequency amplifiers following the single detector tube. In this way the outfit can make audible speech and signals that would not be audible in the least degree with a detector tube alone, or in many cases with any number of amplifiers following the detector.

It is in the detector that the frequency is brought into the realm of sound. Before detection the frequency of the energy is high and afterward it is low. For this reason the two methods of amplification are known respectively as "radio-frequency" and "audio-frequency" amplification.

As An Oscillation Generator.

THE same tube that can detect and amplify can also transform direct current into alternating current of practically any desired frequency. This happens, from the nature of radiation, to be a gift to the communication art almost as great as that of the detecting powers of the tube. For the purpose of radiation the electric energy that carries the message must alternate many times a second, and the means of getting a smooth stream of such high-frequency were few at the time this property of the tube was discovered to exist. One of the previous ways was the use of the electric arc and the other the use of machines of the dynamo type, with many poles and very high speed of rotation of the moving part. Neither of these ways has the order of simplicity and ease of control of the tube, nor can the methods be made serviceable in small units.

Both are adapted to the longer wavelengths and fail at the shorter ones. They are therefore out of the question for all amateur experimentation and for many commercial purposes such as broadcasting.

When a tube acts as a generator it receives direct current and gives an alternating one, the frequency of the latter being under control within wide limits, even down to a few cycles per second. It is this combination of abilities that makes the oscillator so promising a device for power-transmission work in the future.

Using a single oscillating tube, both speech and signals may be transmitted, by arranging that the telephone transmitter may absorb a portion of the generated current. For telegraphy the absorption apparatus may be omitted.

As a Modulator or Demodulator.

WITHOUT change from the form adapted to detect, amplify and oscillate, a tube may modulate. That is, it may be used to vary the output of an oscillating tube in response to speech. The cycle of happenings then is: Speech into a telephone transmitter produces an alternating current of, say, 800 cycles per second. This current is allowed to change the potential of the grid of a modulator tube, which in turn affects the output of an oscillating tube, the resulting output being carried to the aerial for radiation. To modulate means to change; the office of the modulator is to change the otherwise smooth stream of high-frequency energy from the oscillator into a form similar to that of the speech to be radiated.

As a Demodulator.

WHEN used with the system of wire-directed radio telephony first proposed by General Squier, the tube sometimes is called a demodulator. In this office, it is required that it act to convert the incoming high frequency wire-carried waves into lower frequencies, corresponding to the voice frequencies that originally modulated the oscillator output. It is by that action closely parallelling the action of a detector. The principal difference is that the latter is used on strictly radio work, and the former on wire-directed or "carrier" service.

As a Telephonic Relay.

BY "carrier service" is meant telephony or telegraphy wherein the message is passed over wires, not by direct currents or by alternating currents of voice frequency, but by the much more rapidly alternating currents produced by oscillator tubes. By this means a number of conversations are possible over the same wires at the same time without interference. One pair of wires can transmit half a dozen voice messages and a number of telegraph messages at the same time, the carrier currents all intermingling enroute but being sorted out into their separate terminal destinations without any loss of secrecy. And at intermediate points on the line these carrier currents are amplified while still intermingled. This process is one of the larger marvels of the tube's repertoire.

From the earliest days of the telephone engineers sought for a method of reinforcing the small currents of speech so as to enable long distance service to be as satisfactory as local service. The voice currents issuing from the speaking station attenuate rapidly in their passage over a long line, and in even the best lines of two plain copper wires they reach about the limit of commercial volume in say seven hundred miles. This, in a country like ours, is much too short a distance. In telegraphy, groups of relays are inserted in the long lines at intermediate points, and these receive the weakened signals and send out stronger ones exactly like them, enabling the longer distances to be worked successfully. This is just what the telephone engineers wanted to accomplish in their own art, but many obstacles intervened. Finally Shreeve produced an electro-mechanical relay and a set of associated circuits that did the thing, and soon thereafter it was found that the vacuum tube could be used for the same purpose as the electro-mechanical relay. While the Shreeve relay does its work excellently, the tube relay is ideal for the reason that there are no moving parts larger than parts of atoms, no requirements of adjustment, and no de-

Continued on page 50

The Armstrong "Radio Flivver"

By V. Ford Greaves, Engineer Federal Telegraph Company

Here is a one-tube super-regenerative hook-up that actually works on wavelengths of from 190 to 400 meters. It represents a great simplification over the original Armstrong circuit and is comparatively easy to operate. Complete directions are given for construction and operation. Included also is an account of a novel "bank-wound" loop.

THE author claims the distinction of being one of the first (if not the first) amateurs in the country. My first antenna was constructed on the chimney of my father's home in the middle west during 1898. The fan-shaped antenna was connected in series with a ball-bearing coherer and an ordinary telegraph sounder to ground, by which arrangement I expected to get signals from England where Marconi was then conducting his early tests. I was not discouraged by the fact that my apparatus did not work, but have continued my efforts at intervals over a period of nearly twenty-five years, and while my radio activities have been confined mostly to government and commercial operation and engineering, my interest in the amateur and broadcasting fields is intense.

The new Armstrong super-regenerative circuits, as published several months ago, excited my amateur instinct, as they did that of thousands of others, and I decided to try them. As I understand Major Armstrong's paper published in the *Proceedings* of the Institute of Radio Engineers, super-regeneration is a combination of radio frequency amplification, detection and oscillation with three or less tubes, producing a volume of amplification far in excess of that possible with detector, regeneration and two-step audio frequency amplifier, especially in the range of short wavelengths.

There is one three-tube circuit in which each tube performs one of the three functions; two two-tube circuits in which one of the tubes is forced to perform a double function; and the one-tube circuit in which one tube performs all three functions. Editors of radio magazines and others have published many variations of these circuits, some including complicated filters and audio frequency amplification.

Recently the amateur interest in super-regeneration seems to have subsided considerably and the general opinion appears to be that the circuits are remarkable but too critical of adjustment even for the more experienced. In fact, there are many who have never succeeded in getting results even with detailed diagrams and constants.

In his talk before the Radio Club of New York, Major Armstrong is quoted as having said that the superheterodyne was the Rolls-Royce of radio reception and that the one-tube super-regenerative receiver was the "Radio Flivver." During the early part of my experience with super-regeneration I often wondered if Armstrong got his idea because the one-tube outfit was inexpensive or because it was so noisy.

My comparatively easy conquest of the three and two-tube super-regenerative circuits soon convinced me that my only interest lay in the one-tube circuit, or the "Radio Flivver."

In its most complex form, the one-tube circuit is indeed critical to adjust; that is to say, not exactly critical as we understand the word in connection with adjusting a standard regenerative receiver, but critical as the word might be used in connection with trying to hit upon the combination to a safe by trial. One evening in the course of my experiments, I laid the telephones on the table and walked about the room. In the course of a minute or two I was startled by loud music suddenly coming in, in the middle of a record. Returning to the apparatus I found that it had apparently adjusted itself and was operating in every way as it should. I then found that adjustments of the variable units could be changed slightly without losing the combination, but if any one variable was changed enough to cut out the music, then it again became necessary to try various new combinations, and it seemed to be largely a mat-

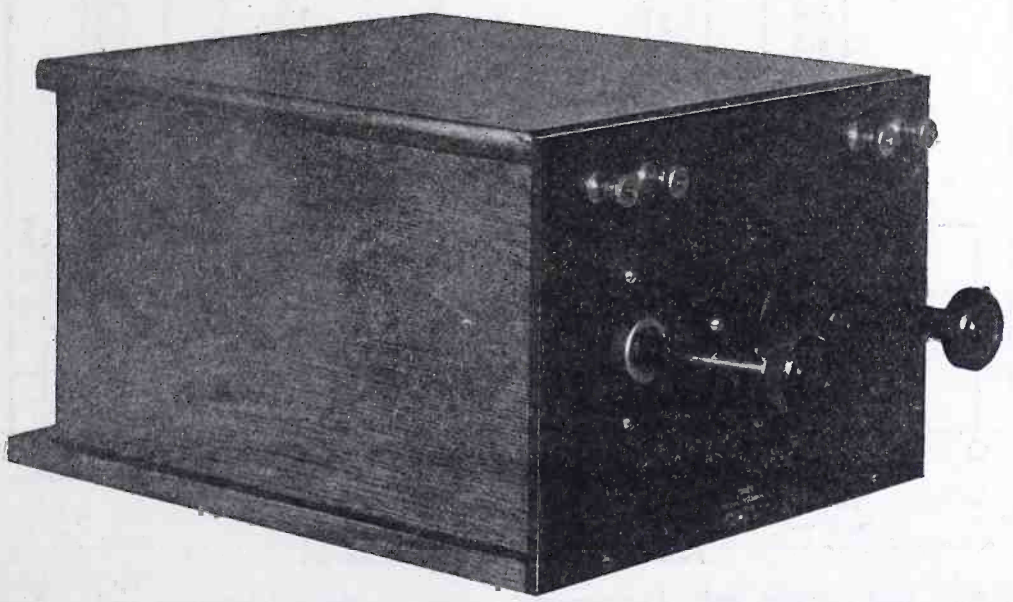


Fig. 1. One-Tube Super-Regenerative Receiver

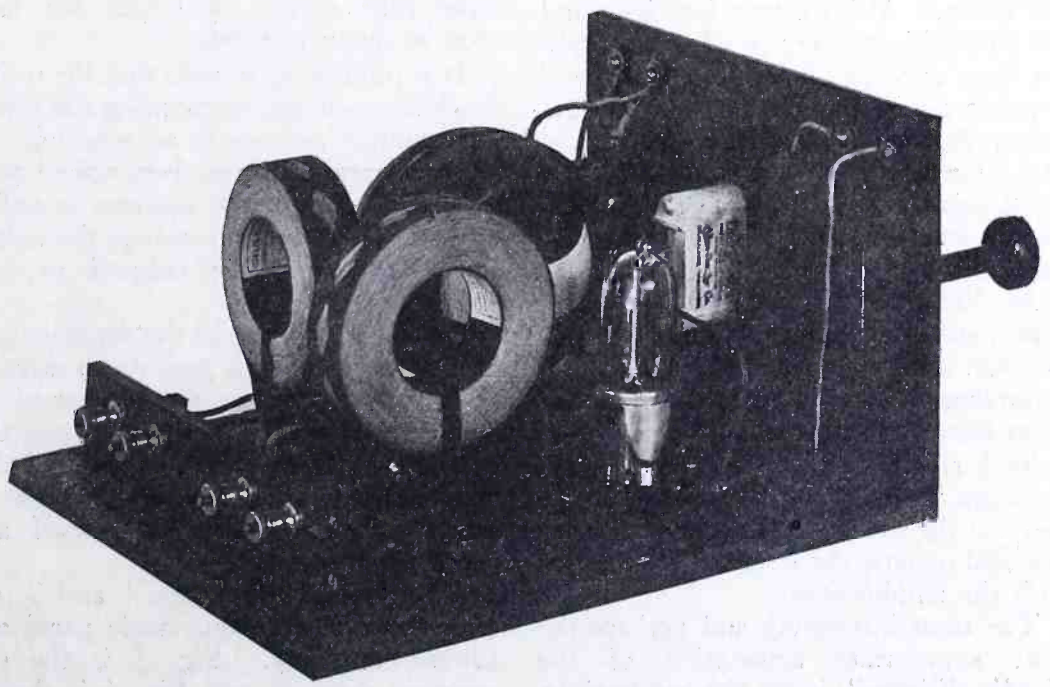


Fig. 2. The "Insides" of the Armstrong "Radio Flivver"

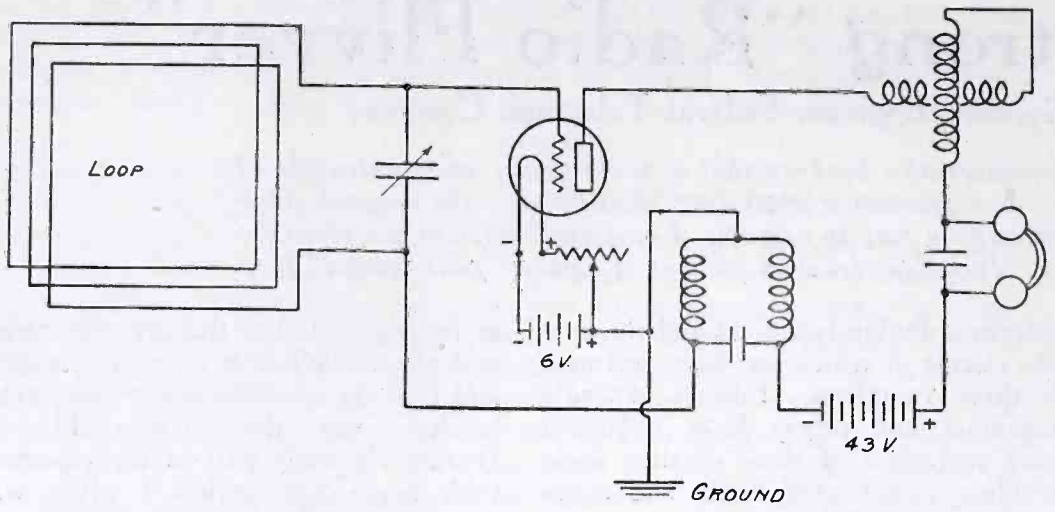


Fig. 3. Elementary Circuit Diagram

ter of luck when a new combination was found. Without serious study, this condition seems to indicate the possibility of a proper phase relation between two or more of the various cycles, or harmonics of cycles, taking place within the circuits, which, when established, may be somewhat self-maintained as in the case of a synchronous motor.

It is claimed for super-regeneration that the amplification increases inversely as the square of the wavelength. That is to say, super-regeneration works better on short waves than on long ones. For an excellent discussion on this subject, the reader is referred to an article in the December 1922 issue of RADIO by Walter Emmet, entitled "Are Shorter Wavelengths Worth While?"

There is considerable latitude in the arrangement of the super-regenerative circuits and choice of constants, depending upon the results desired and the kind of service to be received; whether C. W., telephone broadcasting, or spark.

It is believed that the design and constants of such a receiver, constructed by the author and demonstrated under various conditions, will be of interest to many. This particular circuit was designed for broadcast reception only on 360 meters, but has a range from 190 to 400 meters. With a two foot loop and one tube, this receiver is a better amplifier than average antenna, detector and two-step audio, and almost equal to antenna, detector, regeneration and two-step. Compared on the same loop, it is about equal to two stages of radio frequency amplification, detector and two-step audio.

At 360 meters, the "Radio Flivver" is not, strictly speaking, a long distance receiver, although under favorable circumstances distances from 400 to 800 miles have been covered. It is more of a loud speaker or power amplifier at distances up to 25 or 50 miles. However, on the shorter wavelengths, say below 200 meters, the distance is increased with the amplification.

The most interesting and perhaps the most appropriate application of the "Radio Flivver" is in the automobile, where a one-tube outfit with a one or

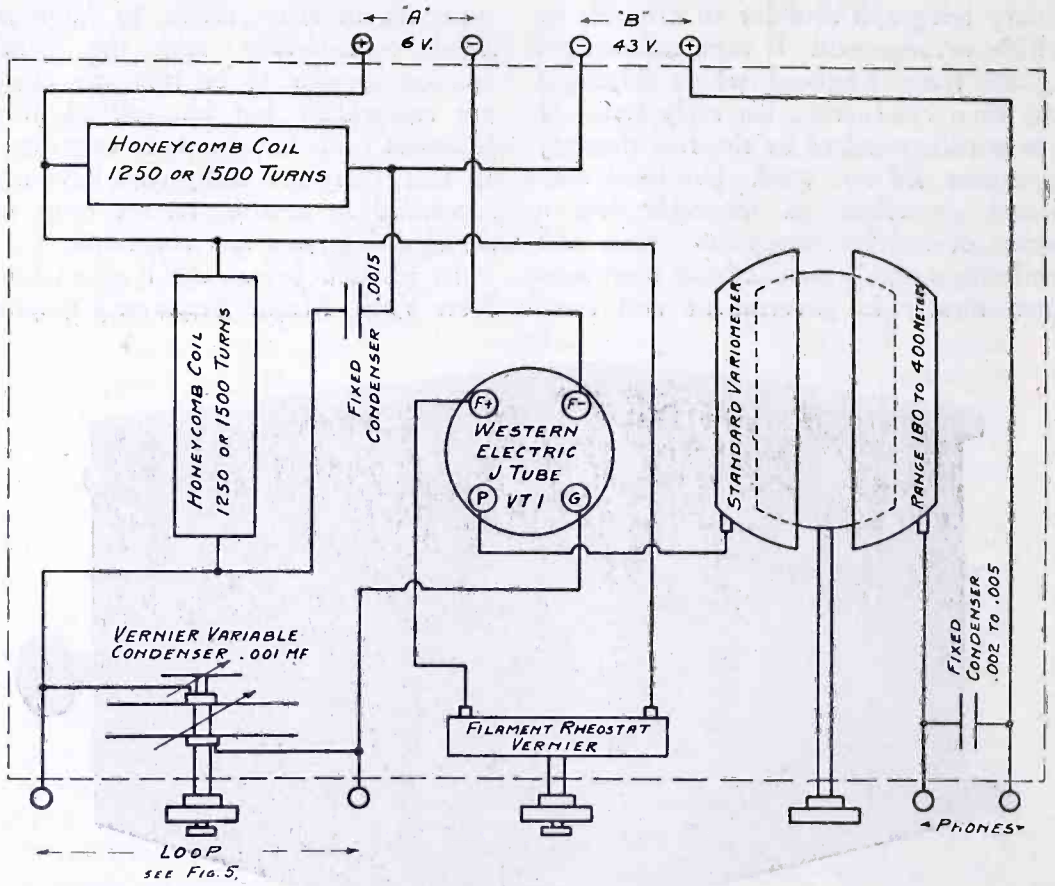


Fig. 4. Detailed Wiring Diagram

two foot loop is not only inexpensive but compact and inconspicuous compared to the elaborate rigging and multiple tube outfits of which we have seen so many pictures.

It is interesting to note that the writer has had no success in coupling the super-regenerative receiver to an antenna. At least the results are no better than with a small loop. If the antenna is sufficiently loose-coupled to reduce the noises, then the signals are reduced to loop strength.

By slight sacrifice in the total volume of amplification, it is possible to simplify the circuit and reduce the number of adjustments to a degree which practically eliminates the so-called critical or difficult manipulation and yet have a receiver which is indeed a marvel and opens up a new radio field.

The photographs, Figs. 1 and 2, are two views of the home-made panel and cabinet assembly. Fig. 3 is the elementary diagram and Fig. 4 is the assembly or wiring diagram.

The parallel loop coil and the feed back coil shown in Armstrong's published circuits have been omitted in favor of the tuned plate circuit by means of a standard variometer. The variable condensers across each of the large "honey-comb" coils have been substituted by a fixed condenser across both coils. Thus the adjustable elements have been reduced from six to three; i.e., the loop tuning condenser, the plate variometer and the filament rheostat. The diagrams are self-explanatory and show the constants.

The arrangement of the various parts in the assembly is somewhat essential. The honey-comb coils should not be too close to the variometer and are set at right angles to each other, forming a "T;" a position of minimum coupling. There is no necessity for or advantage in varying the coupling between these coils. The loop tuning condenser and filament rheostat must both have vernier or fine adjustments. An important element is the tube. I have been unable to get results with any but a Western Electric oxide-coated filament tube, and it must be burned considerably brighter than normal. It also appears that grounding the filament or "A" battery to a water pipe, or to the frame of the car in the case of an auto installation, makes the adjustments even less critical and sometimes increases the signal strength.

In making adjustments and tuning for a station the following should be noted. When the filament is lighted, a very shrill continuous whistle should be heard which will almost disappear when the proper adjustment is found.

Continued on page 52

The Vacuum Tube as a Detector and Amplifier

By Ellery W. Stone

This constitutes the ninth and tenth assignments in the correspondence course in Elementary Radio being conducted by the Extension Division of the University of California. Herein is simply told the elements of vacuum tube theory.

IN the first assignment, we observed that a metal, differentiated from such insulators as wood and glass, is a conductor of electricity, because the atoms of metals are not closely knit structures of positive and negative electrons. The atom of a metal appears to be of such assembly that at least one negative electron is able to leave the ring (or rings) of negative electrons surrounding the positive nucleus and is thus free to move about within the metal. This makes possible a concerted movement or drift of negative electrons within a metal which may actually constitute the passage of an electric current.

Ordinarily, both the atoms and the free electrons of a metal are in quite rapid vibration. In fact, the velocity of their somewhat aimless to and fro movement is several hundred feet per second. We learned in the second assignment that as we apply heat to any substance, we increase this atomic vibration. With a metal, the application of sufficient heat will so increase the velocity of the free electrons and the atoms that the electrons, and even some of the atoms, are driven clear of the metal into the surrounding space. This atomic and electronic "evaporation" is enhanced if we diminish the pressue of the gas surrounding the metal and hence it is quite pronounced in a vacuum.

The radiation of electrons from a heated metallic substance constitutes the fundamental basis on which the modern vacuum tube was developed. It is sometimes spoken of as the "Edison Effect" since it was first observed by Edison about 1890 in the manufacture of electric lamps. Edison, however, did not then realize its significance and did not thoroughly understand it. He discovered that if an electrode were sealed into an electric lamp and insulated from the filament, it became negatively charged when the filament was lighted. This phenomenon was assumed to be due to the radiation of negative electrons.

As was stated in the last paragraph, if the filament is heated sufficiently, actual metallic atoms will be radiated from it in addition to the negative electrons. It is the radiation of these atoms, not of the electrons, which blackens the inner wall of an ordinary lamp after long use.

Fig. 59 represents a small electric lamp in which an additional electrode (a small plate of metal) has been sealed. When the filament is lighted there will be an emission of free electrons from the filament surface. Now, if we connect a battery, called a "B" battery, in the plate circuit so that the plate will have a positive potential, and attach the other end of this circuit to the filament, a current of electricity will flow. This is caused by the attraction of the electrons, which are negative electrical charges, toward the positively charged plate.

It has been previously shown, however, that current will flow only from a zone of high potential to one of low potential. Hence the current will flow from the plate to the filament against the electron flow, since the plate is maintained at a higher potential than the filament. The fact that the current flows in the opposite direction from the stream of electrons is a little hard to understand, but the explanation above gives the reason. Another method of reasoning might be followed if you consider that the flow of negative electrons from filament to plate is the same as the flow of an equivalent number of positive charges from plate to filament. It was this current flow which first brought Edison's attention to what is now known as the Edison Effect. If the "B" battery is reversed so that the plate will be negatively charged, then no current will flow in the circuit between plate and filament, since the negative free electrons are repelled by the negative plate potential.

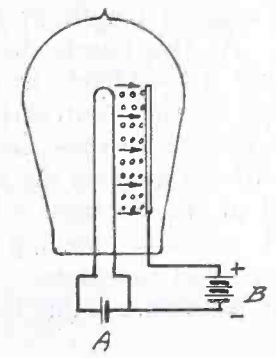


FIG. 59

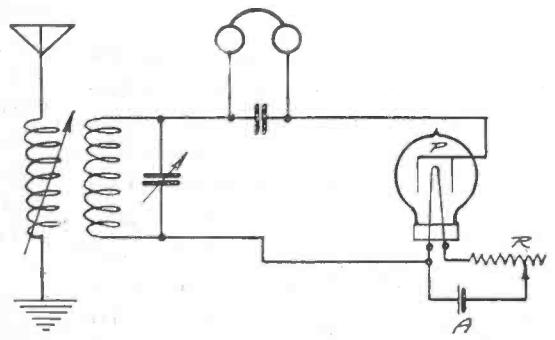


FIG. 60

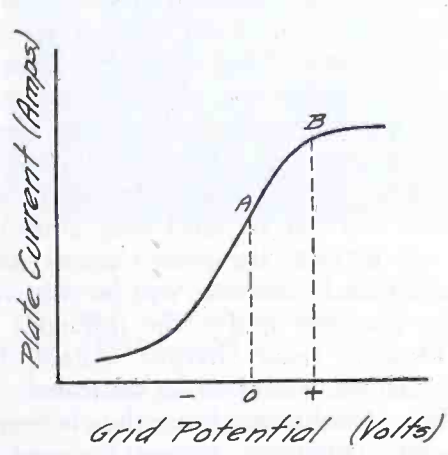


FIG 61

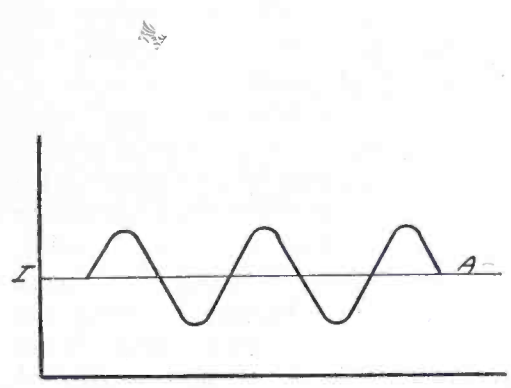


FIG 62

Fig. 59. Two-Electrode Vacuum Tube
Fig. 61. Relation between Grid Potential and Plate Current

Fig. 60. Fleming Valve as a Rectifier
Fig. 62. Graph of Plate Current with Alternating Potential

The device shown in Fig. 59 is termed a *Fleming valve,* named after its inventor, J. A. Fleming of London, who brought out his invention in 1904 as a natural result of his investigations of the Edison Effect. He realized that such a device, based on the Edison Effect, would have the properties of a rectifier since it would pass current between the plate and the filament in but one direction.

In the seventh assignment, we learned that crystal detectors function as detectors of radio waves due to their property of unilateral conductivity or rectification. The Fleming valve, therefore, as shown in Fig. 60, may be substituted for the crystal detector in any standard receiving circuit.

The filament of the valve is usually made of tungsten and is lighted from a storage battery, *A,* connected in series with a variable resistance or *rheostat, R,* which serves to vary the current through the filament. The battery used to light the filament may be a storage battery or dry cells in sufficient quantity to give the proper voltage and is commonly called the "A" battery.

The operations of tuning the loose coupler and the secondary variable con-

densers are exactly as have been previously described. The radio frequency potential is tuned to a maximum across the terminals of the variable condenser and impressed across the plate and filament of the valve or vacuum tube. Due to its property of rectification, the valve permits a series of direct current impulses to charge the small, fixed condenser connected across the telephone receivers. (At this point, you should review that part of the seventh assignment which treats of the action of the crystal detector.)

The Fleming valve proved to be considerably more sensitive than the crystal detector and had the advantage of being easily operated, the only adjustment being that of the battery rheostat. However, it was soon superseded by the *audion*, or vacuum tube as it is more commonly termed.

The modern vacuum tube was invented by Dr. Lee de Forest, an American radio engineer, in 1906. It differs from the Fleming valve only in the addition of a third member, the *grid*. The grid is placed between the filament and the plate and is so constructed that the electrons radiated from the filament may pass through it to the plate. In order that the grid shall not obstruct the electronic flow, it is usually made of fine wire either in the form of a spiral or lattice completely surrounding the filament, or in a flat zig-zag grid placed on either side of the filament.

When the filament is heated to a temperature sufficient to cause a prolific emission of negative electrons, the space around the filament becomes negatively charged just as though it were a solid, metallic substance. This negative charge surrounding the filament is called the *space charge*. This space charge, being of the same polarity or sign as that of the electrons, tends to repel more negative electrons which might be driven off from the filament. Or we may say that the radiation of negative electrons from the filament tends to leave it positively charged, with the result that this unlike charge on the filament tends to attract some of the free electrons back to it. There is, therefore, a limit to the number of electrons which can be radiated from the filament to the plate of the Fleming valve due to this negative space charge.

If we apply a positive potential to the plate, as shown in Fig. 59, this unlike charge will tend to attract the electrons to it so that the majority of them will not return to the filament. As we increase the "B" battery potential on the plate, more and more electrons are attracted to it from the filament. As we have previously seen, the stream of negative electrons from the filament to the plate is equivalent to a flow of positive electrons from the plate to the filament. This flow of current from the plate to the filament, under the influence of the positive potential on the plate is termed the *plate current*. Consequently, with increased plate potential, there is an increase of plate current.

This phenomenon might be considered to be in accordance with Ohm's Law, since with an increase in E there is an increase in I. However, the plate current in a vacuum tube does not follow Ohm's Law, as can be seen from a consideration of the following.

At moderate potentials of the "B" battery, only a few of the electrons are attracted to the plate. The rest, under the influence of the negative space charge, are returned to the filament. For a fixed value of filament current, and hence electronic radiation, more and more electrons are attracted to the plate as the plate potential is increased until finally all of the electrons which are radiated in a given length of time reach the plate. At this point, the negative space charge is completely neutralized or annulled by the positive plate potential. Any further increase in the plate potential will not increase the plate current, since all of the electrons which can be radiated are now flowing between the filament and the plate. The plate current is therefore said to be *saturated*.

Now if we should set the plate potential at a fixed amount, and commence to increase the filament current from a zero value by varying the series rheostat, we shall increase the plate current gradually to the point where the space charge is neutralized by the "B" battery potential. Any further increase in the filament current or electronic emission, will not increase the plate current since the additional electrons will be returned to the filament under the influence of the negative space charge. Again, the plate current is said to be saturated.

Thus, whether we leave the electronic emission (filament current) constant and vary the plate potential, or whether we leave the plate potential constant and vary the electronic radiation, the plate current will be increased only up to that point where the space charge is neutralized by the plate potential.

By interposing the grid between the filament and the plate, De Forest provided a means for controlling the space charge and hence the plate current. When the grid is positively charged, it tends to reduce the space charge and hence to increase the plate current. When it is negative, the space charge is assisted, since a greater number of electrons are returned to the filament and the plate current is reduced.

Fig. 61 shows the curve which represents the relation between grid potential and plate current.

Such a curve is obtained by recording the various values of plate current for different potentials impressed on the grid, and plotting these results on graph or cross-sectioned paper. Grid potentials are laid out horizontally and plate current vertically. From the curve, it will be seen that when the potential on the grid is zero, the plate current has approximately one-half of the maximum value which it can attain. When sufficient positive potential value is applied to the grid, the plate current will become saturated, as indicated by the upper flat portion of the curve, B. Conversely, a negative charge on the grid will reinforce the negative space charge and the plate current will be reduced below the half-way point, A.

In Fig. 62, the horizontal line IA represents the constant plate current which will flow when the grid is at zero potential. This current has a value indicated at the point A of Fig. 61. If we apply a slight, alternating potential to the grid, the plate current will assume the alternating form shown by the heavy line in Fig. 62.

The vacuum tube will thus be seen to resemble in principle an ordinary telegraph relay in that feeble impulses in the grid or imput circuit of the tube will be faithfully reproduced in the plate or "local" circuit. Due to the steepness of the curve in Fig. 61, however, only a very slight change in the grid potential is required to produce a very large fluctuation of the plate current. It is this property of a tube which makes it an amplifier. The very small amount of energy contained in the received radio wave when impressed on the grid releases a relatively large amount of energy in the plate or "B" battery circuit.

We may compare this principle of tube action to a pistol, in which the light pressure of the finger on the trigger releases a large amount of stored up energy in the cartridge. The trigger is the grid, the finger pressure is the potential of the incoming wave, the stored energy of the powder is the "B" battery, and the propelled bullet represents the plate or "B" battery current.

Fig. 63 shows the "hook-up" commonly employed when using the vacuum tube as a detector. P and S represent the primary and secondary of a loose coupler; VC the secondary tuning condenser; SC a small stopping condenser, employed for the same purpose as in crystal detector receivers; F, G and P the filament, grid and plate, respectively, of the vacuum tube; A the *"A"* or storage battery, usually 6 volts; R the variable resistance or rheostat for controlling the filament current; and B the *"B"* or plate battery, usually about 23 volts.

As a detector, the vacuum tube makes use of both its rectifying and amplifying properties. The filament is heated to the proper temperature by the "A" battery and the required positive charge is impressed on the plate by the "B" battery. The received radio current, when

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The Operator's Audion

By Volney G. Mathison

Herein is discussed a moot question in a sane and reasonable manner, the conclusion being that good service requires that the operator possess an audion. This is the concluding installment of the author's series on "The Professional Radio Operator."

THERE has been a great deal of contention over the question of whether the commercial radio operator should make a practice of using privately-owned audion receiving apparatus when he finds himself assigned to a ship where nothing better than crystal-detector equipment is provided by the owning or leasing company. Since many operators are doing so, numerous opinions on the matter have been aired in the different radio publications, and arguments on both sides set forth;—arguments correct in some points, but conspicuously defective in others, and showing a lack of clear thinking and broad treatment.

The spirit in which most of the criticism of the use of privately-owned audion apparatus is made is remarkably typified in a letter that was published some time ago in a wireless magazine—a letter so long that space will not permit its being reproduced in full here; but a few extracts illustrative of its nature and of the nature of almost all arguments against the use of private equipment are well worth giving.

After asserting that the use of privately-owned apparatus is against the rules of the wireless companies (which is absolutely untrue, nearly all companies nowadays approving its use), the writer goes on to ask:

"Is it not a fact that years and years before there was such a thing as audions, that the radio business was conducted just as satisfactorily as it is today? I am ready to state that it was conducted more satisfactorily. So the service company has full right to expect the operators of 1921 to be as capable as they were in 1910 or 1912. It takes no ability to receive with an audion, but it is an *art* to get business through with a crystal detector.

". . . It is unlawful—or so they say—to use the amateur audion for commercial work. If it is unlawful for the service or steamship company to make use of the audion, I gather that it is equally unlawful for the operator to use it. Some operators are so very accomodating that in order to get time signals and a few items of press, they violate the injunctions and counter-injunctions of the courts. After all, you must be looked upon by different interested parties as a perfect fool!"

After delivering this pop-gun barrage, the writer pants through another paragraph trying to discuss some things which he does not understand; and then he loads up for another sarcastic broadside with the assertion that the radio operator has no more right to bring aboard ship any private apparatus "than the master has to throw the life-boats overboard and replace them with something else of his own fancy."

". . . This practice of every operator making up some sort of a 'rig' any old way must be stopped. . . . It is a perfect disgrace to behold what one sees on some ships. Loose wires all over, bare joints and switches, hundreds of holes drilled in tables, bulkheads, and ceiling, the whole affair looking like it had just emerged from a typhoon.

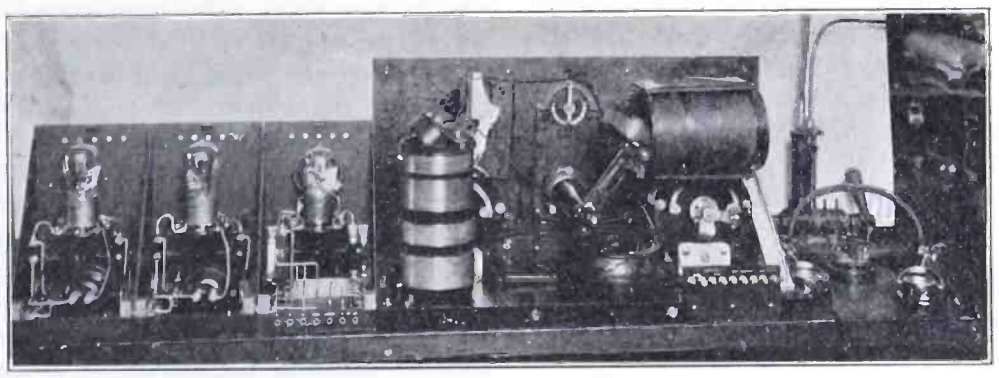
". . . Is it such a great stunt in these days to hear Germany in the Pacific that it is worth $300 to $400 of your money in order to do so? Did you ever see a chief engineer bring a feed pump of his own aboard because the ship's pumps were not satisfactory? Did you ever see the captain purchase a whistle and install it because the ship's whistle was not loud enough? This apparatus cost no more than a good receiving set. Why should you be the only 'mutt' on the vessel? If you are an experimenter, stay at home and experiment. Bring out something worth while, and don't go around and make a mess of every ship station you come to, and, incidentally, make a fool of yourself and the rest of us."

This is enough to give the reader an idea of the sort of arguments that are usually adduced against the use of privately-owned apparatus on shipboard. In this letter, it is seen that the writer (an operator himself) spends much of his strength in stigmatizing operators who use private equipment as meddling experimenters, and fools. In making this assertion the writer was perhaps referring especially to himself, since he had been boasting but a short time before, in the pages of the same wireless magazine in which this letter appeared, of long-distance records that he established aboard ship with his own private receiving equipment.

It is a part of the art of the sophist, even though he be only a crude sophist, to drag into an argument various considerations that are not vitally related to the question at issue; and this is what is done by those who pretend to oppose the use of a privately-owned audion on shipboard when they assert that such use of it is "unlawful,"—meaning that certain vacuum-tube patents are thereby infringed.

The question really is this: Should audion receiving apparatus be furnished by the radio operator or by the ship-owner? What have patent questions to do with it? The illegality, if any, of the use of the vacuum-tube on shipboard is similar to that illegality which would be involved if a woman, having bought some new ultra-efficient washing-machine, patented, and licensed to be used only for washing chemises, should use the machine for washing a pair of her husband's pink-striped pajamas. Strictly speaking, she would be a law-breaker—but whose conscience would be troubled?

It would seem that the statement of the question, should audion receiving apparatus be furnished by the radio operator or by the ship-owner, is in conflict with the assertion quoted above to the effect that receiving on an audion requires no ability, whereas getting results with a crystal detector is an "art." The inference of this assertion is that the use of an audion is unnecessary—that it is a confession of incompetency; and that the operator—if only he is expert enough—can do just as well with a piece of piano-wire and a chunk of lead-ore as he can with a modern vacuum tube.



The crystal detector goes into the ash-can! Here is a standard Radio Corporation shipboard receiving set, consisting of a remodelled 106 tuner with regenerative circuit, a detector-tube unit, and two-step amplifier. These instruments replace all cerusite, galena, and carborundum detector apparatus formerly used.

The author of such a statement will probably also insist that a man can shoot as far with a blunderbuss of the Middle Ages as he can with a latest model high-powered hunting-rifle—if only he is an artist at shooting;—or that a dextrous old maid with a spinning-wheel of the days of the Revolutionary War can hold her own with a twentieth-century Jacquard loom. Such a one presumably will also maintain that a barn lantern can be made to cast as powerful a beam as a battle-ship's search-light—that is, provided you know how to trim the wick. All this, of course, is to be smiled at; so, likewise, no one need dispute the fact that the veriest beginner can do more with an audion detector than the super-operator might accomplish with a warehouse full of cerusite and galena.

But, at the same time, the universally recognized fact that the vacuum tube is a necessary device for efficient radio communication by no means promises the conclusion, as some appear to believe, that the radio operator should furnish himself with an audion;—it points to exactly the opposite. By so much as the vacuum tube detector is a needful, indeed an indispensable part of the modern shipboard radio station, by just that much does it devolve upon the owner of that shipboard radio station to supply it. If the ship-owner wishes to enjoy the incomparable advantages of modern radio equipment over obsolete junk, is it not clearly up to him to furnish that modern equipment, or—and this is the same thing—request his wireless leasing company to do so?

This, of course, is too evident to need argument; and yet, paradoxically enough, the lack of vacuum tube receiving equipment on shipboard is *not* the fault of the ship-owner,—as I shall try to show in a moment.

It has been asserted that the radio operator is justified in bringing aboard ship private apparatus for his personal convenience, so that he does not substitute any integral part of the equipment, as for instance the motor-generator or the sending-transformer. In so far as this statement refers to vibroplex-keys or expensive telephone receivers, it is correct; but who will dispute that the audion detector is not as truly an integral, an essential, part of the modern radio receiver as are the motor-generator and the sending-transformer of the transmitter?

It has also been pointed out that navigating officers provide their own expensive sextants; but this is an erroneous comparison. Sextants are very delicate and finely-adjusted instruments, not adapted to promiscuous handling. Ship-owners would furnish sextants as well as they supply the rest of the ship's navigating equipment—in some cases they have furnished them—but, for the reason just given, mates and masters do not care about them. Even were this not true, two wrongs do not make a right.

The writer of the blatant letter partly quoted above, on the other hand, remarks caustically that chief-engineers and captains do not bring aboard their own private feed-pumps, whistles, and life-boats; but he forgot to mention, or perhaps does not know, that government steamboat inspectors pass upon life-boats, whistles, and feed-pumps; and if anything is found wanting in them, the vessel can not sail.

It may be returned that likewise the government radio inspectors pass upon the ship's wireless equipment; and that they do not require the installation of audions. While this is true, it must be remembered that the authority of the radio inspector, in the matter of apparatus, is extremely circumscribed,—especially in the cases of cargo steamers or any other vessels that are voluntarily equipped. On these ships, he has no authority to require *anything*. Radio is ten years ahead of our radio laws. We have had no important radio legislation since 1912; whereas the radio art itself has in this short time been completely revolutionized.

And here we come again to the assertion that the absence of audion equipment on shipboard is no fault of the ship-owner. Marine radio has always been so largely in the hands of the wireless leasing companies that the executives of the steamship concerns know virtually nothing about the technical side of it. If they had any conception of the inestimable value to themselves of a device that they can buy for less than one hundred dollars, they would immediately see to it that they had it. Generally speaking, the ship-owners are in ignorance of the necessity of vacuum tube detecting and amplifying apparatus for reliable and efficient radio service.

The U. S. Navy and the Shipping Board have provided audion detector apparatus upon almost all their vessels, and in many cases amplifiers. At least one manufacturer of privately-owned shipboard wireless outfits is doing likewise, while the Radio Corporation of America has installed first-class up-to-date audion detectors, one or two step amplifiers, and regenerative circuits upon every ship that carries the Corporation's leased radio equipment.

From the foregoing it seems to be clear that the thing the radio operator must do is to strive by every means at his command to convince the ship-owner that audion equipment on his vessels is of value to him almost beyond any price. A great many operators never think of trying to get the steamship companies to buy anything for them. I have in mind an occasion when just one brief request by a radio operator to the owners brought to his ship a complete audion-detector and one-step amplifier, a filament-lighting battery, and the necessary battery-charging apparatus.

When the operator is on a ship where no audion equipment has been provided, perhaps the best thing for him to do is to furnish his own, installing it as neatly as he is able, so as to avoid the "hundreds of holes" of our frenzied friend; and then try to impress upon the captain its incomparable superiority. Get out press five thousand miles at sea; put through ship's business fourteen days from port; get time signals round the world;—then call the master's attention to the fact that this could never be accomplished without the audion. When the "B" battery becomes exhausted, or when the tube has delivered its alloted hours, ask him to order renewals for you on the ship's requisition, first advising him of the slight cost of the required articles.

Or, better still, make out a requisition of the apparatus needed for an audion detector and amplifier set, asking only for what you feel is absolutely necessary, and then write the best letter you know how explaining the essential nature of the equipment; point out that its first cost need not be more than eighty or ninety dollars; that the cost of renewal tubes and "B" batteries will not amount to over thirty dollars a year; and then try to get the captain to endorse the letter and send or take it up to the office of the steamship company.

In putting through requisitions for audion equipment or for renewals, it is usually important to follow them up in order to get action. Try to have a short talk with the company's purchasing agent, or whoever has charge of the ship's buying, giving him the address of the place where you think the apparatus may best be purchased; and always name a wireless store or company in the city where the steamship company offices are situated,—not some distant one necessitating mail orders. It must always be kept in mind that individual units of radio equipment are things which the steamship company executives have never before bought, and probably do not know very much about.

When the active co-operation of the captain can be obtained, the operator usually will be able to get an order from the steamship company on some specified wireless supply-house, thereby enabling him to do the actual buying of the apparatus himself. When possible, this is of course the best way.

If the ship has a leased set, the owner may object to buying any apparatus on the ground that the wireless company ought to furnish it—which is perhaps true;—but then the operator can only point out that the wireless company has not furnished it, and urge the owner that it is to his own best interests to buy it anyway.

If the operator fails in gaining the ear of the captain, there should be no

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Wallowing easily along, the "Perseus," cargo carrier, pushed her fat forefoot through the moonlight at her unvarying 9 knots—the smoke rolled blackly away from her stack.

Worth, a Tale of Loyalty

By Major Lawrence Mott

Only one who knows men—and radio—can write such a story as this. It has a heart interest that grips and holds the reader to the end. Its flavor is one that will appeal to the practical operator as well as to the amateur. It seems destined to live as the classic of radio fiction.

HE was a little boy—such a *little* boy—for 14 years of age. Fourteen pinched years had he existed—not years of actual, physical want, but years of soul and heart starvation for just a penn'orth—even—of that which Humanity—by-and-large—knows as "love," "sympathy," "encouragement."

Mathias Z. (standing for Zebediah) Ellison, owner of a very good farm, as farms go, in Vermont—and the boy's father—did not mean to be hard; did not mean to be unkind, to the lad. Indeed he would have resented the imputation vigorously. But with the mother's passing to Easier Places, some five years previously, there had also passed "sentiment" from the farmer's existence.

Thenceforward it had been one long drive for the eternal dollar—with a parsimony, a thrift, that became—in Mathias—an obsession. The cheapest, most simple of foods, and rough-made, sweat-shop clothing, pleased him vastly, and had to suffice for the boy—Walter—and for an unfortunate, soul-shutter'd girl of seventeen—a niece of Ellison's—who was at once cook and general utility "man" around the farm buildings.

"HEY! Come down out o' that! What in time'r you a doin' of—in that loft? Dreamin' 'bout that fool wireless stuff, I s'pose! 'Member what happened to you, when I ketched you with the last book! Go down in the lower pasture and fetch up the cow!"

Well did the boy remember—when his father had found him, eagerly poring over a radio manufacturer's catalog, that he had picked from the post office waste paper basket. Though time is merciful—in the matter of the keener edges of memory—long, still dark welts on his back, that hurt did he lie on them, prevented his forgetting too easily.

He slunk quickly past the towering farmer, dodged the cuff that was aimed at him, and wearily set out after the brindle cow, picking his barefoot way carefully—for Mathias Ellison held with "no sich foolishness" as shoes and stockings, till "snow flew," and it was bitterly cold this late afternoon in October.

The last rays of the sun kissed the sveltly-rising hillsides, and by the warmth of its caress, brought out their multitude of autumnal hues — bronze and gold, crimson and rich yellow—amber and sienna—the colors blended in one gorgeous mass—rising up against the blue and green-grey of the cloudless skies. The air was still, save for the *tinkle-ting* of the bells of the herd in the pasture below.

THE evening meal—meagre as always—was eaten in silence. Boy and girl ate timidly—shivering, did they but clink spoon 'gainst the coarse chinaware.

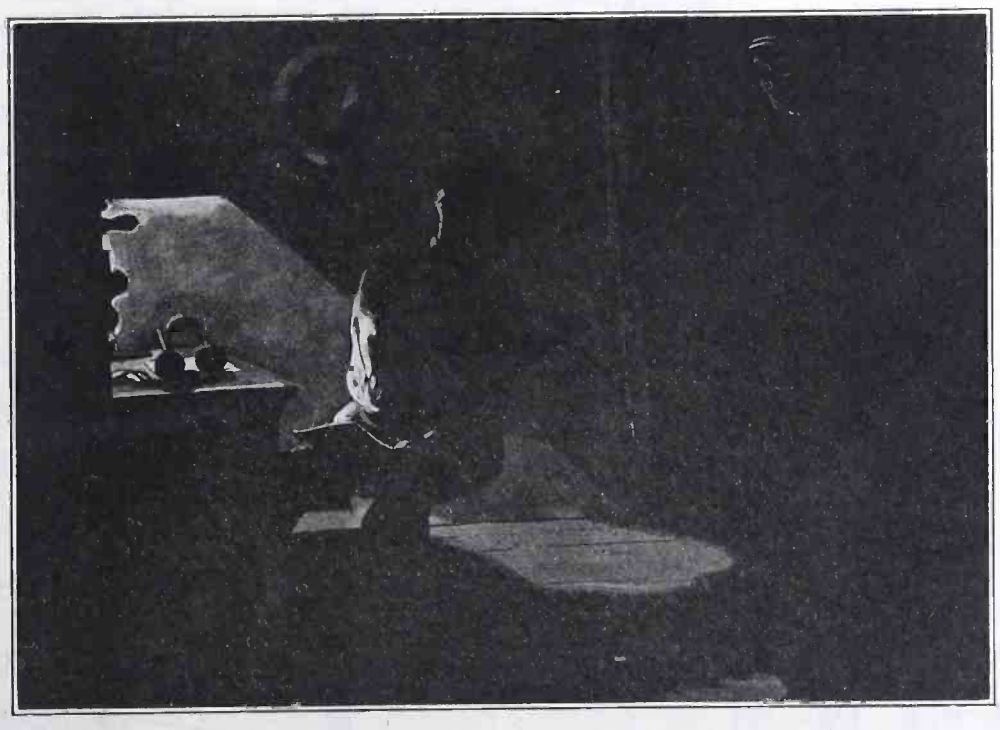
Ellison filled his pipe—"heave some wood on!" he said gruffly—and the lad put two logs on the smouldering embers in the gaunt, stark fireplace.

"Not two at once, *fool!* More'n half the heat goes up the chimbley, anyway!"

And Walter burned his fingers in his haste to take one log off.

Flora—the girl—sewed furiously at some much-patched clothes, what tho' the single lamp gave but a sickly light, and there was no sound save for a little, cold wind, that mournfully whimpered and sighed about the house, and gently shook the aspen leaves.

"Drat such fool notions!" the farmer threw the local weekly across the room—"Allus talking about schoolin' an' larnin'—and sayn' as how children over 8 *must* go to school! *Ha!*" — he snorted—"look at *me!* I never went to no 'school'! Teacher come to see my paw, one day—said's how I'd orter — and paw, he licked him proper! 'Lowed he knowed whut was best for his



It was but the continuation of one motion for Ellison to pull open a drawer, take out an automatic—"I wouldn't—if I were you!"

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One Tube Receiving

By Carlos S. Mundt

Here is another good answer to the question of simplicity versus complexity in receiving circuits, and for the one-way purse it beats the cat's whisker. The author is the instructor in physics at the high school at Piedmont, Calif. The beauty of this hook-up is that it works equally well on spark, C. W., and phone.

NOWADAYS, with the multitude of many-stage amplifiers, super-regenerators and super-receivers, the ardent radio phan doesn't know just what to think. He would very much like to dabble in radio frequency amplification, but suffers a dizzy spell when cataloging r.f. transformers and tubes. He yearns for a couple of extra stages of audio frequency, so as to show just how much the radio art will produce, but again dizziness overtakes him when he lists the a.f. material. And last, but not least, a SUPER—but diagrams, lengthy articles, complex circuits, money as an outgoing tax—all cause him to pause and breathe Mr. Armstrong's name with reverence.

"So," says he, "Waddya gonna do about it?"

Answer: Take that good old detector tube and make it work overtime!

How? Follow instructions "as is," or, as Mr. Gibbons states, "proceed thusly:"

Obtain, by hook or crook (the latter is easiest), the following apparatus:

One variocoupler (Remler is good).
One .001 variable condenser.
One .0005 ditto.
One switch and five contact points.
One battery clip (copper).
Necessary phones, antenna, tube, etc.

Connect as per diagram often given for the so-called "single coil regenerative" *with the following exceptions*:

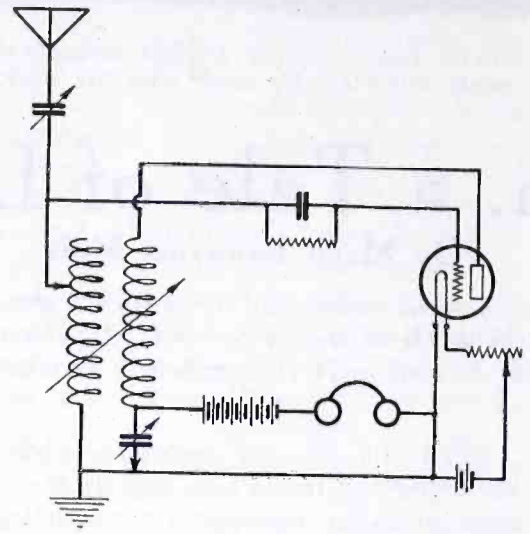
1. The .0005 v.c. is the by-pass condenser, bridging phones and "B" battery.

2. On that side of this v.c. *away* from the tickler (secondary) of variocoupler attach the copper battery clip.

On the lower waves you will find the set to operate remarkably well, and with the .0005 at about mid value and tube pushed a bit the C. W. sigs just roll in as fast as you can log them. Further, the .0005 will adjust the C. W. note to any you wish.

The radio phone sigs on 360 to 425 are all anyone can desire. Ever hear of phone sigs so loud you can hear them all over the room on one tube and loud speaker? Try 'em once.

Now for the next little trick. Disconnect the copper battery clip of the .0005 and attach it on the opposite side



Modified Single Coil Regenerative Hook-Up

of the tickler from which the v.c. is connected.

All of us like to listen-in on 600 meters so as to hear how it is done in commercial work. Well, KPH and KFS will tear your ears off with this *tuned tickler,* and as for other distance VAE and KOK come in enough to cause QRM at times. For the ships, just look below at the result sheet.

The big advantage of this set is its universality—spark, C. W. and phone all being received with equal facility. Many people claim this circuit to be "broad," but the writer claims that skill in operation will offset much of that. One one-hundredth of a dial scale will tune out a nearby phone and bring in the L. A. phone.

So far I have passed this along to several fellows and when I see them the next time they say "I'll say she do—and I'm going to put it in permanently." So here I am, passing it on to you.

Results at 6AJ using above set—two-wire antenna, 85 feet long, 30 feet high, water pipe ground—September-November, all before 9 P.M., P.S.T.—

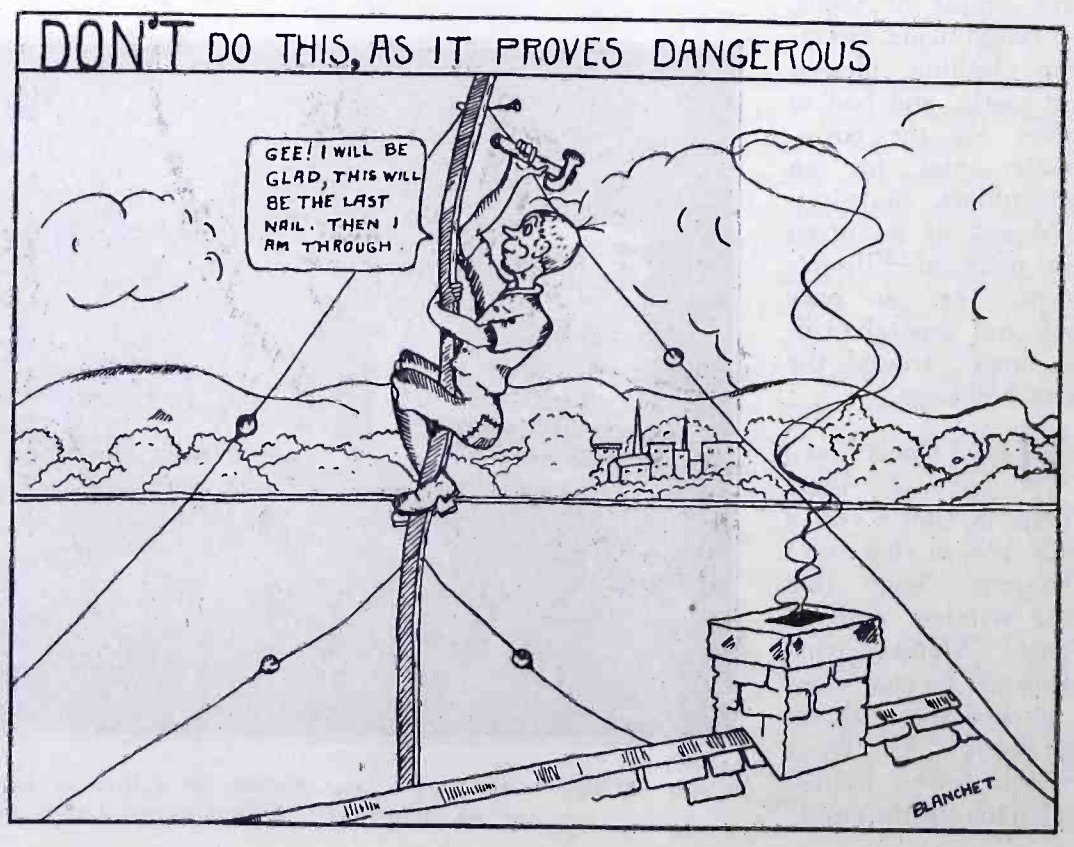
Amateurs (distant only): 6GD, 6ZH, 6ZR, 6RM, 7NY, 7HJ, 7XC, 7AF, 7TQ, 7BJ, 7ZK, 7MF, 7ZO, 7FH, 7OT, 9ZAF, 9AMB, 9BJI, 9APS, 9AVZ, 9BXQ, 9BZI, 5KC, 5ZA, 9CNS, 9BEY.

Phones (distant only): KGG, KZN, KFI, KWH, KFAF, KGW, KDPT, KOG, KFAD, KUY.

Ships (distant only) only such listed as position reports were actually copied: Sept. 20—KDPR 491 mi. south of San Pedro; KDBZ 1165 mi. from San Pedro. Sept.—NISX 12 mi. from NPL. Oct. 30—KEPG 102 mi. south of San Pedro.

When using this set at my former location, Concord, Calif., I was able to log, among many others, 8ZP and 8AGZ, the former on spk., latter C. W. Written confirmation received from both.

Tuning is nearly entirely by the .001, the by-pass controlling regeneration. A vernier on the former helps a great deal.



"Some Facts About Antennas"

By Francis J. Andrews, Radio Engineer

The most important, and the most neglected, factor in good radio transmission and reception is the antenna. Here are some practical suggestions that make for greater efficiency.

A CERTAIN big city newspaper set out to broadcast radio concerts throughout its district. It erected two lofty poles and strung antenna wires between. It installed expensive transmitting equipment. It hired a splendid jazz orchestra. But when it started to send out its programs, something funny happened. Pete Everett, on East 73rd street, tuned in right away and enjoyed that jazz music to the last lilting note. But Walt Clark, on West 69th street—though he adjusted, and tinkered and tuned to the limit of his patience—couldn't hear a solitary note. Nor for that matter could anybody else in Walt Clark's neighborhood.

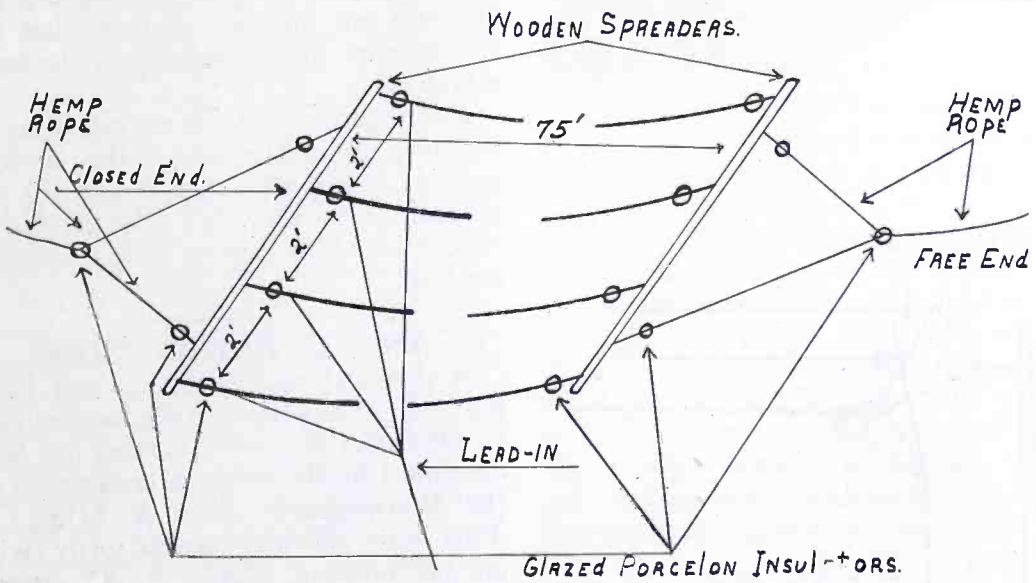


Fig. 1. Inverted "L" Aerial

Experts investigated and laid the blame at the door of an adjacent office building. East of the aerial, it seemed, were no obstructions. The radio waves went pulsating through the ether without interference. Fine for Pete Everett. But on the west towered that giant office building. It was innocent looking enough, as office buildings go, but every time the orchestra played it absorbed or broke up the radio waves to such an extent that the whole west side went concertless. . . . . The newspaper moved the station uptown, out of the way of office buildings and now Walt Clark enjoys jazz music too.

Moral—the fellow who puts up his antenna near a big tree, or a tall smokestack, or any other formidable obstruction, is in for a lot of trouble. Antennas are like army mules—you've got to handle them carefully.

In this article I am going to tell you some things about antennas and how to get the best results with them.

Antenna systems may be divided roughly into two general classes—receiving antenna systems and transmitting systems. (Some antennas, of course, are used for both receiving and transmitting). The two general classes may be subdivided again into three groups—inside, outside, and coil or loop antennas.

While the last year has seen many styles of receiving antennas grow in favor, the old-style outside antenna still holds its own. The inverted L, the T, and the single wire straight aerials are the commonest forms of outside aerials.

The inverted L aerial, or antenna, gets its name from its shape. (See Fig. 1). It is widely used and with good results, though it has one defect—its directional property. This defect sometimes is turned to advantage. It receives loudest only when its closed end, the end with which the lead-in is connected, is pointing towards the transmitting station.

Most satisfactory aerials of the inverted L type employ four or more wires, at least 2 ft. apart and about 75 ft. long. The aerial is 30 ft. above the ground or higher. The lead-in is taken from the end nearest the receiving equipment.

The T aerial, as its name implies, is T-shaped. (See Fig. 2.) It is free from the directional properties of the inverted L type—it receives messages from any direction with equal ease. Four or more wires, at least 30 in. apart, make up the typical T aerial. The flat top portion is about 100 feet long, and the lead-in drops from the exact center of the wires. The aerial should be at least 30 ft. above the ground.

The inverted L and T aerials are excellent for stations that both receive and transmit on the same aerial. The T type, on the whole, is best for amateurs. The "ham" who doesn't want to transmit, however, will find a single wire aerial most satisfactory. This aerial should be about 100 ft. long and not less than 50 ft. high. Take off the lead-in from the end nearest the apparatus. It is a good stunt to have the aerial wire and lead-in all one piece, thus eliminating the necessity of joining two separate pieces together. (See Fig. 3.)

No matter what the type of antenna is, certain precautions must be taken. If you don't insulate properly you are bound to fail. Figs. 1 and 2 illustrate the proper method of insulating an antenna. There are a number of good insulators on the market. Personally I prefer the glazed porcelain type, as they do not absorb moisture. Always install *oversize* insulators, (insulators able to withstand more than a normal current) if you are contemplating or are transmitting. Then you will be ready for any emergency.

Stranded phosphor bronze wire is the best for the antenna. This wire has great tensile strength. Furthermore,

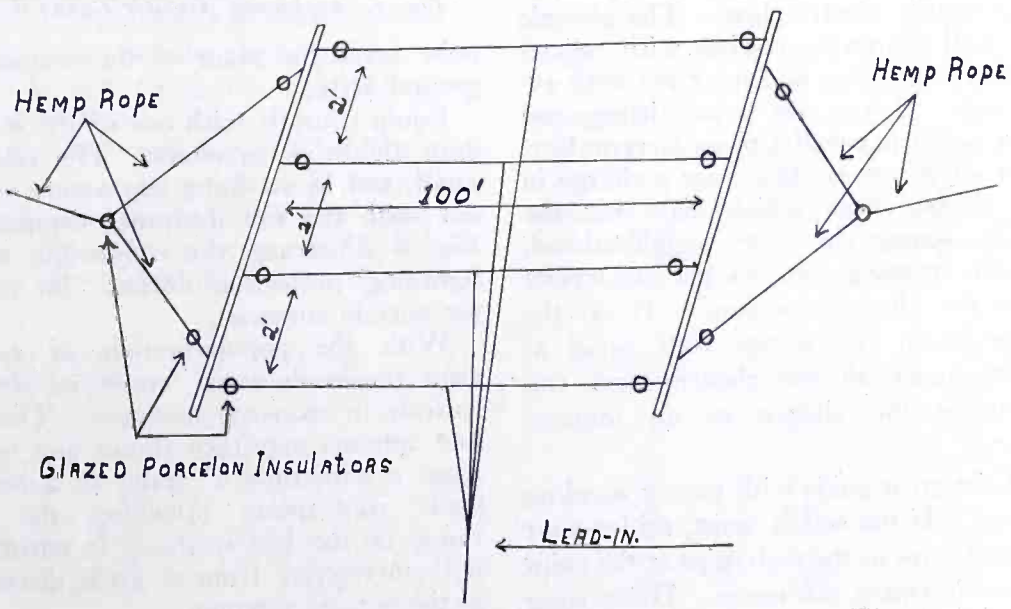


Fig. 2. "T" Aerial

being stranded, it has a larger surface than solid wire. This is of particular advantage in transmitting. Stranded wire is also more flexible than ordinary wire. I recommend 7 strand, No. 18, B & S.

The spreaders, or wooden bars to which the antenna wires are attached, ought to be made of spruce or ash. Whatever spreader you select, be sure that it is strong enough to stand the strain.

Select your halyards, or the rope strung from the two poles that support the antenna, with extreme care. Get the best grade of weatherproofed hemp. The cheap kinds shrink in wet weather,

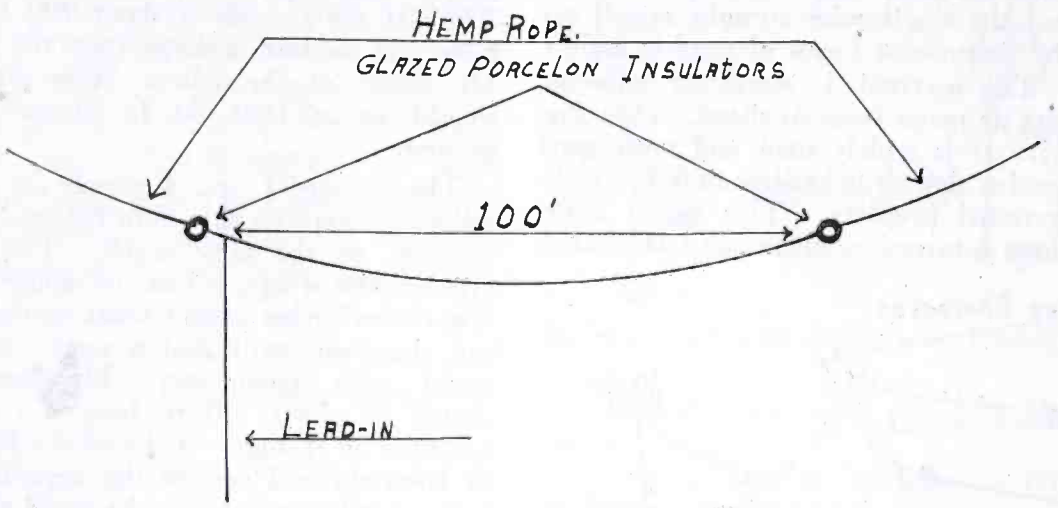


Fig. 3. Single Wire "T" Aerial

and often, because of the strain, snap in two. Never draw your antenna wires taut. Allow some slack for wind and snow.

Profiting from the experience of the big-city newspaper, be careful where you erect your poles. Don't put your antenna near a tall tree. Every leaf of that tree is a miniature antenna, absorbing radio waves for all it is worth. Shun also, smokestacks, windmills, tall buildings—all greedy absorbers of radio waves.

Never stretch your aerial over or under an electric line. The instant one of your wires comes in contact with a wire from the electric line—because of a high wind or some other not unusual cause, anyone operating the apparatus will get a terrific, perhaps fatal, shock. For that matter never stretch an aerial parallel to a nearby electric line. The electric line will charge your wires with electricity by induction, and interfere with receiving. If you are transmitting and your aerial is parallel to an electric line, your wires are apt to induce a charge in the electric lines which may ruin the entire system in your neighborhood, thereby causing you to get in wrong with the electric company. If on the other hand, you situate your aerial at right angles to the electric line, you minimize the chance of an induced charge.

Take great pains with your grounding system. If the soil is moist, solder your ground wire to the waterpipe at the point where it enters the house. Drive some six-foot lengths of pipe into the ground, connect them with wire, and join the waterpipe by wire to the pipe lengths, thus forming one grounding system. If you find it impossible to ground to a waterpipe, bury several square yards of copper sheeting 6 ft. under ground.

For radio telephone transmission, a counterpoise is employed, with great success, in place of a ground. The theory of the counterpoise is too lengthy for discussion in this article. The counterpoise itself is a second antenna, somewhat larger than the main antenna, stretching about three feet above the ground, from which it is thoroughly insulated. The lead-in from the counter-

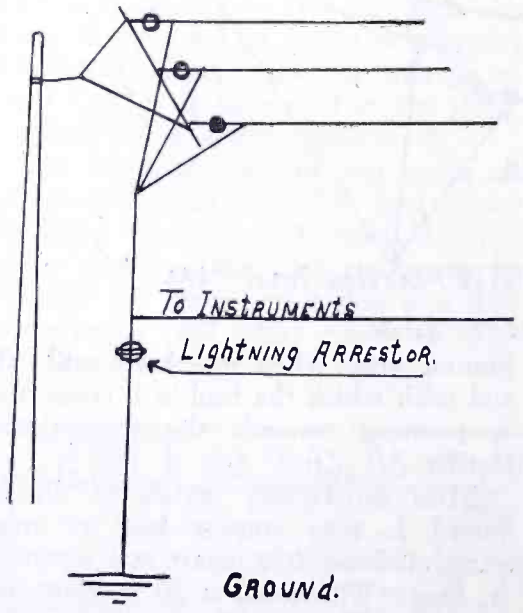


Fig. 4. Lightning Arrester Connection

poise takes the place of the customary ground wire.

Equip yourself with one of the standard lightning arresters. The cost is small, and by so doing you square yourself with the fire insurance companies. Fig. 4 illustrates the connecting of a lightning protection device. So much for outside antennas.

With the popularization of radio, came the inside aerial, employed almost entirely in receiving messages. The inside antenna may take almost any form, from a miniature T aerial to a home-made contraption involving the gas range or the bed spring. It naturally will not receive from as great distances as the outside antenna.

Coil or loop aerials, because of their compactness, are popular. A loop aerial for receiving, if coupled with a good receiver, need not be over 4 ft. square, and may take a highly artistic and tasteful form, a form that will harmonize with the artistic furnishings of a living room or parlor.

For example, I have seen an ordinary phonograph that receives concerts and amplifies them through the horn, just as it also plays a record. It does this by virtue of two loops, batteries, and other receiving equipment all fitting snugly in the inside of the cabinet. No outside connecting wires are necessary. Such is one advantage of the small loop or coil antenna. The directional properties of the loop antenna are in its favor, for by shifting it to a position parallel to the transmitting stations, i.e., broadside to the approaching waves, the message or speech will be more audible. Thus, by trying the coil in various positions, the direction of a given transmitting station can be found. Again, by shifting the coil one can tune out stations that are transmitting simultaneously on the same wavelength.

But regardless of the development of the loop or coil antenna, the outdoor antenna is still the "ham's" favorite for all-around service. It's a lot more fun to erect and it receives over a greater distance.

AN A.C. RADIO TUBE

A practical alternating current radio receiving or amplifying tube, as described in December *Electric Journal,* has been developed by the research department of the Westinghouse Elec. & Mfg. Co. This tube operates satisfactorily with an a.c. filament supply of .85 ampere at about 5.5 volts and an ordinary *B* battery for plate supply. The heating element is a V-shaped tungsten filament encased in an insulating tube of refractory material which in turn is placed in a nickel sleeve coated on the outside with a mixture of barium and strontium oxides. The alternating current heats the filament and the heat is conducted to the oxide-coated surface so as to cause the continuous emission of electrons without the usual a.c. hum due to changes in voltage, magnetic field and temperature. The grid is a helix and the plate a cylinder of nickel. For a given voltage amplification the new tube has an impedance of about half that of the ordinary direct current tube, thus giving better results for detection and audio and radio frequency amplification. With these tubes it is possible to also use the electric light wires as an antenna. Thus a set used in this way need have no outside connections except the cord running to the lamp socket. For a permanent installation these tubes are more efficient, convenient and economical than those requiring a storage battery or dry cells for filament current supply.

Making a Tube Rectifier

By Stuart A. Hendrick 2, BJG

Simple instructions are here given for the construction of a two-ampere hour and a six-ampere hour tube rectifier for charging storage batteries. These directions include full details as to transformer core assembly and coil windings. They have been successfully tested out a number of times and closely approximate the theoretical dimensions given by formulas.

IF you have 110 volts, A.C. available you will be able to rectify it and reduce the voltage to make it suitable for charging storage batteries by means of either one of two rectifiers to be described herein. The first one is a two ampere size and is suitable for charging small batteries of from ten to fifty ampere hour capacity. For those who have large capacity batteries and want to have them charged more rapidly a six ampere model will be described.

The bulbs used in the outfits described are known as Tungar or Rectigon tubes and may be obtained from almost any radio dealer at a cost of four simoleons for the two ampere size and eight spondulicks for the big fellow. These are two-electrode vacuum tubes, as distinguished from the three-electrode tubes used as detectors and amplifiers.

Get a two-ampere bulb first and obtain or buy an Edison porcelain base socket to fit the bulb. The next thing needed is a step-down transformer, having a 2 volt secondary capable of delivering 10 amperes and a 15 volt secondary capable of giving 2 amperes. The 2 volt secondary is for lighting the filament of the rectifier tube and the fifteen volt winding furnishes the alternating current to be rectified and used for charging the battery. As very few will have a transformer on hand to meet these requirements, one will have to be constructed according to the following data:

With any transformer the core is the first consideration. When designing a transformer, for amateur use, the only dimensions of importance are the height of the strips when piled up, as well as the width; in other words, the cross section of the core. The length of the legs or sides depend on the size of the coils to be wound upon them, so they should be made long enough to leave plenty of room for the windings.

The number of turns of wire in the coils is inversely proportional to the cross-section of the core in square inches, that is, as the core grows larger, the number of turns decreases. Therefore, a large core will cut down the cost of the wire to be used.

The core may be obtained from any company that manufactures transformers, for two or three dollars at the most. However, quite a few may desire to make the core. Black sheet iron may be used, although silicon steel is better. It should be about .016 in. in thickness (about sixty thicknesses to the inch). Any tinsmith will cut it into strips of the proper width for a nominal sum or you may even do this yourself if you are ambitious.

Table 1 gives cross-sectional dimensions of eight sizes, any one of which may be used. The core is built up by the usual overlapping method as shown

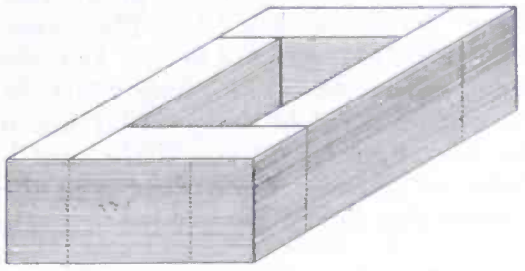


Fig. 1. Method of Stacking Core

in Fig. 1. The cross section of the core in this case was 1¼ in x 1 in. and was 5 in. long and 5 in. wide.

The coils are wound over blocks of wood, having dimensions 3/16 in. greater than the width and height of the core and as long as the coil is to be. These blocks should be split diagonally as shown in Fig. 2. The split allows the wood to be very easily removed from the winding after it is finished. The coil is then taped by threading the tape through the center of the coil and

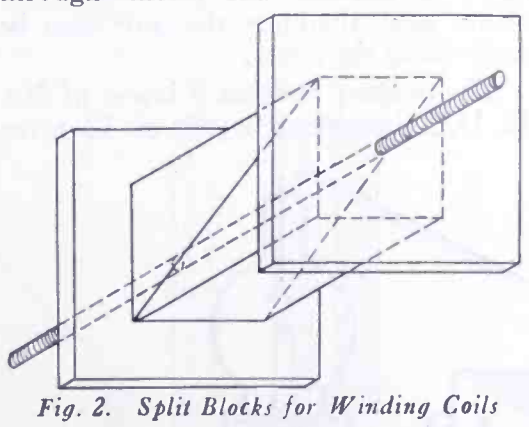


Fig. 2. Split Blocks for Winding Coils

around the outside, lapping each turn over the preceeding one until the whole coil is covered.

After the coils are finished the core is built up inside of them by putting in a strip one side and then one from the other side and vice versa until it is built up to the proper thickness. Some sort of wooden or metal frame should be built to hold and clamp the transformer core to keep the laminations from humming.

The primary coil of one of the transformers constructed had 605 turns of No. 20 D.C.C. wire, the secondary had 85 turns of No. 18 D.C.C. wire and the filament winding had 12 turns of No. 14 D.C.C. wire, tapped in turns of one from the seventh to the last, because of the variation in bulbs. Eleven turns are in use at present.

The wiring diagram is given in Fig. 3. The wire marked negative goes from the anode of the tube to the negative side of the battery.

The operation of the outfit is as follows: The 2 volt winding keeps the filament incandescent, while the 15 volt

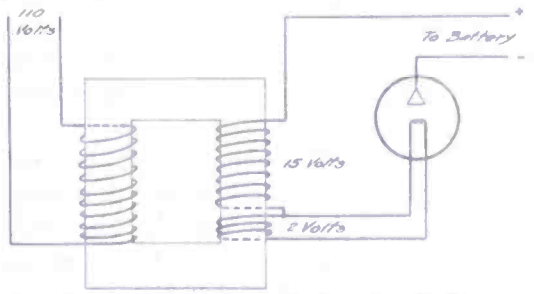


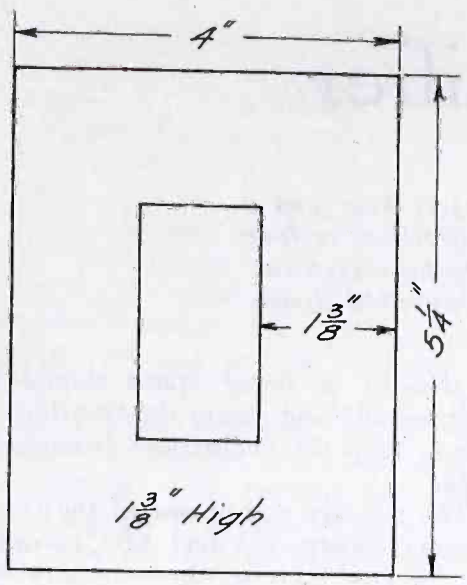
Fig. 3. Wiring Diagram for Small Tungar

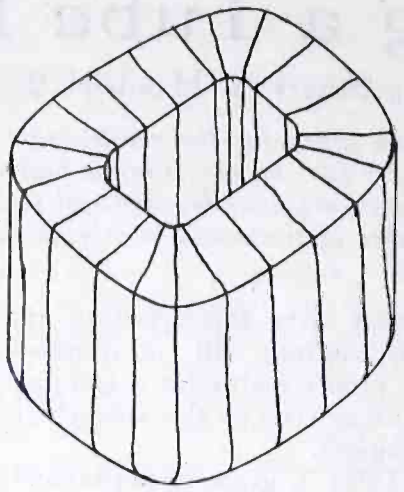
winding supplies the alternating current of which only half passes through the bulb, which acts as a valve, thereby supplying a pulsating direct current which is suitable for battery charging. A blue glow directly above the filament indicates that the rectifier is connected to the battery and is working properly. If the blue glow fails to appear, the end of the 15 volt winding should be connected to the other side of the filament, instead of the side it happens to be on. If then the blue glow fails to appear, the filament should be lighted more brightly, or more turns of wire put on the 15 volt winding to give a higher voltage.

The transformer may be mounted in a box, but the bulb should be on the outside, as it develops heat while being used. This little rectifier consumes about fifty watts; filament 20 watts,

TABLE 1

Cross Section of Core in Inches					
Silicon Steel	Black Iron	Turns per volt	Turns of No.14 Fil.	Turns of No.20 110V Pri.	Turns of No.18 15V Sec.
1 ½ x 2	3 x 2	2.5	5	275	38
1 ¼ x 2	2 ½ x 2	3.	6	330	45
1 ½ x 1 ½	1 ½ x 3	3.5	7	385	53
1 ¼ x 1 ½	1 ¼ x 3	4.	8	440	60
1 x 1 ½	2 x 1 ½	4.5	9	495	68
1 ¼ x 1 ¼	2 ½ x 1 ¼	5.	10	550	75
1 x 1 ¼	2 x 1 ¼	5.5	11	605	83
1 x 1	1 x 2	6.	12	660	90





How To Tape Coils

Fig. 4. Core and Coil for 6-Ampere Outfit

copper and iron losses 20 watts and charging current 10 or 12 watts. A 6 volt-60 ampere hour battery will cost about 12 to 16 cents to charge, including depreciation of the bulb. With careful handling a bulb will last two or three years. The rectifier may be used to charge any 6 volt battery.

As a suggestion, the 15 volt winding may be tapped in the center during the construction, thereby giving two 7½ volt secondaries, which may be used for filament lighting purposes in your new C. W. outfit. Of course you cannot charge your battery while using the C. W. set.

With the foregoing data any one ought to be able to construct this rectifier, which certainly will be the most useful piece of apparatus in your station.

Six Ampere Outfit.

The transformer in this case should be an auto-transformer, that is, all the coils are in the primary circuit and parts of them are also used as secondaries at the same time. This saves much space and time in construction.

Only one size of core is given, that being shown in Fig. 4. The cross-section is 1⅜ in. x 1⅜ in. and the winding legs are 5¼ in. long while the other sides are 4 in. long. This size is for silicon steel only and if the core is made of common black sheet iron the cross-section should be doubled or made 1⅜ in. x 2¾ in. The length of the sides will remain the same. Sheet iron has only one-half the permeability of silicon steel, therefore the core must be made twice the size.

The primary coil has 9 layers of No. 16 D.C.C. wire, 8 layers of 32 turns and 1 layer of 24 turns, which will make a total of 280 turns on the primary.

The secondary coil has 5 layers of No. 12 D.C.C. wire, 4 layers of 24 turns and 1 layer of 3 turns, which makes a total of 99 turns on the secondary.

The filament winding is put around the outside of the secondary winding and is made up of 9 turns of 3/16 in. x 1/16 in. copper strip, which gives a voltage of 2¾ and 20 amperes for lighting the filament.

The coils should all be wound in the same direction and when connected in series great care must be taken to get them connected so as not to have the flux from one coil going in the opposite direction of the others.

From Fig. 5 it will be seen that this rectifier may be used for 12 volt batteries as well as 6 volt batteries or 2-6 volt batteries in series. Fig. 5 also shows how the windings are connected.

The primary is put upon one leg of the transformer and the secondary on the opposite one with the heavy filament winding on top of it.

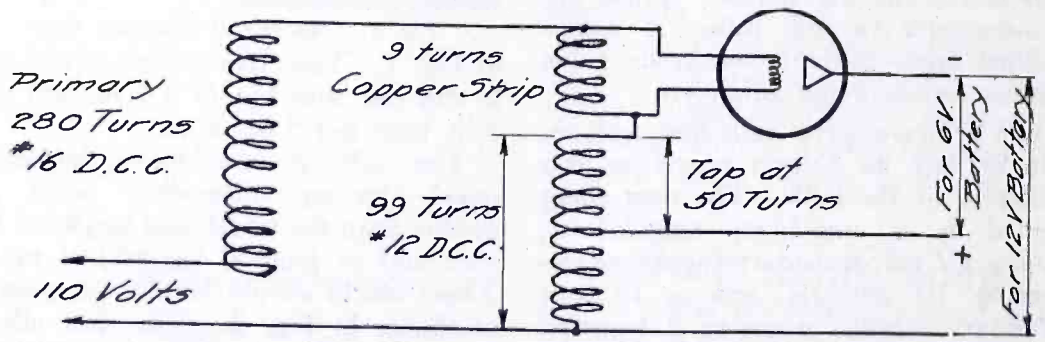


Fig. 5. Hook-up of 6-Ampere Tungar

In all cases the large rectifier is recommended because it does the job quicker and gets the battery back into service sooner than would be possible with the smaller one. Besides, in all probability, you will build the large one when you get a bigger battery, so why not build it at first?

Several of these rectifiers have been built and in every case the person who took the trouble to build one was more than satisfied with the results obtained. So, therefore, go ye and do likewise.

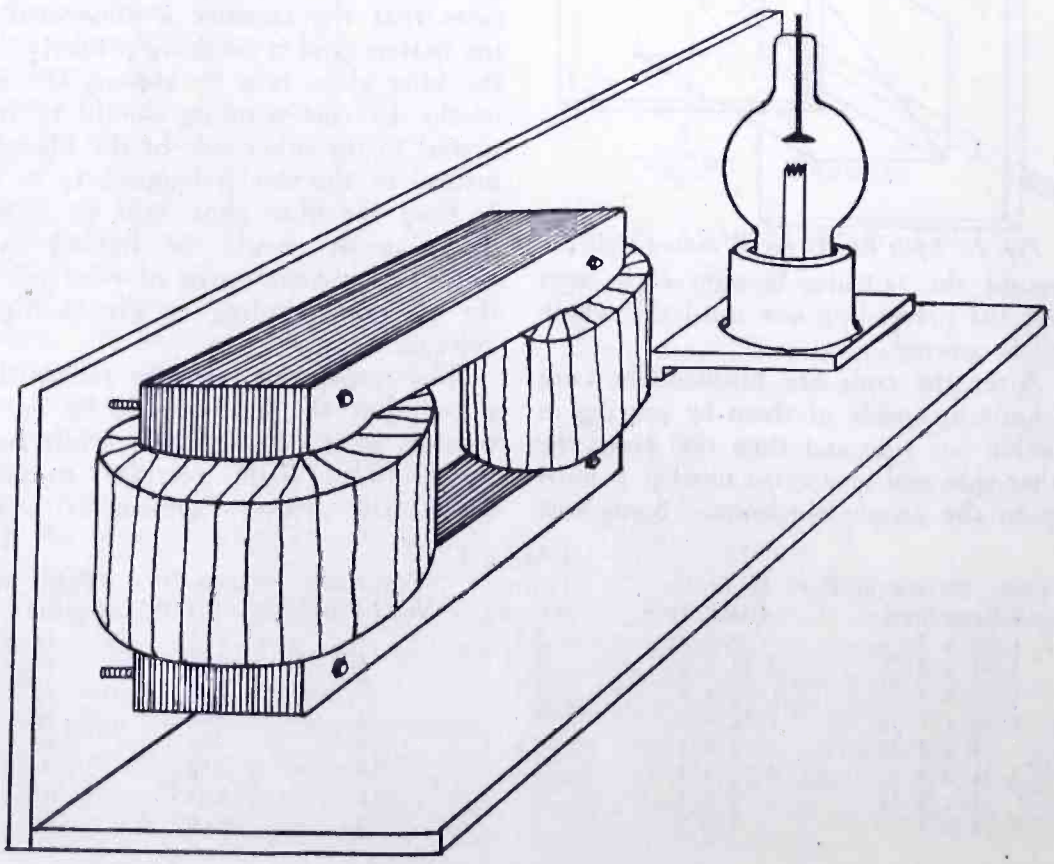


Fig. 6. Method of Mounting Tungar

THE NEW SODIUM TUBE

A new detector tube using metallic sodium as the electron source was recently demonstrated before the Institute of Radio Engineers by Harold P. Donle, chief engineer of the Connecticut Tel. & Tel. Co., Meriden, Conn. This tube employs a filament to heat a sodium anode the electrons from which are collected on a U-shaped plate whose potential may be varied from 10 to 30 volts without noticeably affecting the strength of the signals. Although it employs no grid it is claimed that this tube gives louder signals for wavelengths below 1000 meters without distortion than does the usual gaseous-content three electrode tube. Furthermore it does not radiate from a receiving set so as to interfere with nearby receivers, nor is it affected by body capacity.

How to Build a Loop Aerial

By Ortherus Gordon

To avoid the usual unstable botch resulting from novice efforts to construct a loop aerial the directions and dimensions given in this article should prove effective. It is designed for broadcast reception.

THE advantages of a loop aerial to those who have two or more steps of amplication are so numerous that many amateurs are taking to making their own. A loop, for instance, reduces static to a minimum, while its directive powers bring in one particular station to the exclusion of others. On the other hand, however, a loop is a poor absorber of radio energy, and therefore requires a sensitive set of instruments. For this reason, it finds its greatest usefulness with the super-regenerative receiver. It cannot be used with a crystal detector.

Building a loop is not as easy as it looks. It must not only stand upright but it must also revolve, a combination of demands which puts the ambitious amateur in difficulties. Too many home-made loops are either top-heavy or not heavy enough, with the result that the cross arms sag, the wood splits and the whole affair looks as if it had been hit by something more destructive than a radio wave.

The design presented in the accompanying drawing shows a loop construction which will stand a reasonable strain on all of its parts. Wood is used throughout and the dimensions are those which have proved about right for broadcast reception. The actual loop is 3 ft. square and has 11 turns of wire spaced ½ in. apart. It stands 5 ft. high when fitted with a base as shown in the sketch. This height, however, can be regulated by increasing or decreasing the length of the central rod.

The material for the loop frame is all 1½ in. x 1 in. stock, preferably of oak, although a softer wood will do. Twelve feet of this stock is enough, and it is sawed into one piece 3 ft. long, another 5 ft. long and four others 7 in. long. These pieces are then cut as shown in the detail drawings, so that when the frame is ready to go together, one piece fits into another without any trouble.

All the joints ought properly to be riveted, but they may be bolted. Do not use screws. Right angle joints of this nature and screws do not get along very well together, and experience warns one to steer clear of the mixture. If the 7 in. cross pieces do not rivet solidly as they should, the use of angle irons or shelve brackets is suggested. These may be procured at any hardware shop.

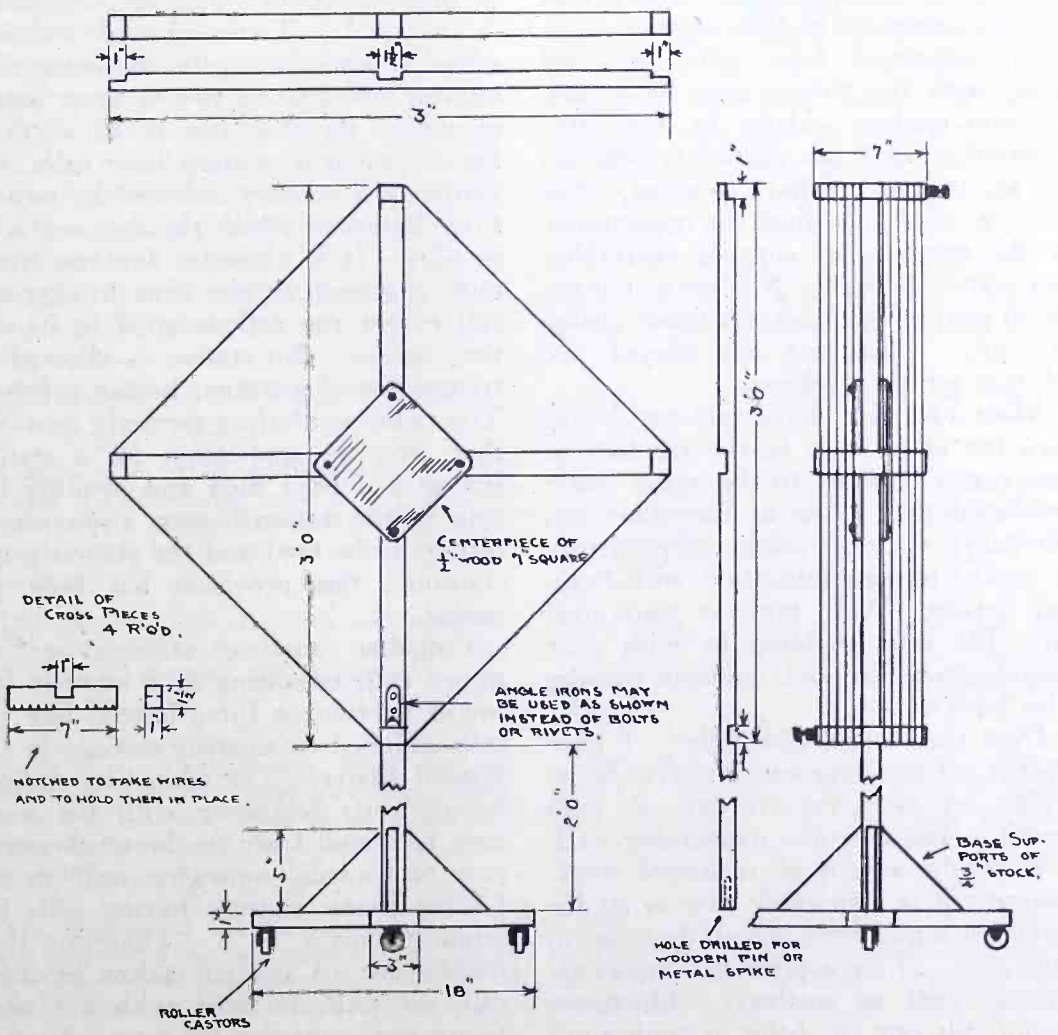


Fig. 1. Details for Loop Aerial Construction

The need for the two square centerpieces is obvious. Otherwise there would be nothing to strengthen the extremely frail joint at the center. These reinforcing "plates" may be of wood or metal. They are shown here as ½ in. wood, and are either riveted or bolted in place.

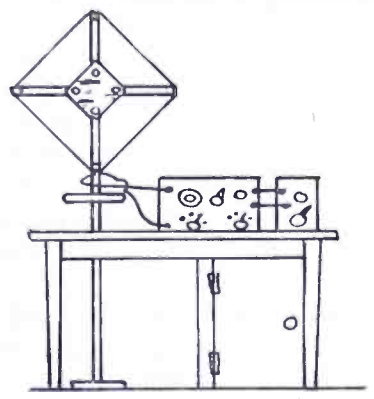


Fig. 2. Suggested Loop Mounting

The windings are spaced ½ in apart, and there are 11 turns on the frame. The wire may be thick or thin, insulated or uninsulated. If bare wire is used, all the woodwork should be well dried and varnished. About No. 18 is right, for the size of the wire, while No. 22 is the smallest that can be used with any success. For 11 turns on a 3 ft. loop, 95 ft. is the length of wire needed. Binding posts may be placed as suggested by the drawing, or clips may be used to vary the number of turns—providing, of course, that bare wire has been used for winding the loop.

The dimensions given may be changed to suit the wishes of the builder. Remember, however, that as a general rule, a large loop with a small number of turns gives better results than a small loop with a great many turns. A 4 ft. loop, for instance, needs only 6 turns of wire to make it about right for broadcast reception.

The base is an individual problem. If the loop is to stand upon its own feet, perhaps the one offered in the drawing embodies as practical an idea as any. The amateur who dreams of a loop that will turn on a baseboard with the ease of ball bearings has another dream coming when he tries to work such a thing in actuality. If, however, the central rod of the instrument can be passed down through the top of a table, and then set into a socket on the floor, the problem is simplified to some extent (See Fig. 2.) Then the loop may be turned by means of a handle or a wheel, placed within easy reach of the operator.

"Preserving Your Ear"

By H. MacD. Hassell

Knowing the "why" of things aids the doing thereof. The author tells why good operators go stale in copying code and gives some practical corrective suggestions. As he is senior operator on the "H. F. Alexander," ex "Great Northern," he knows whereof he writes.

THE few ideas I am going to set forth here are addressed chiefly to commercial operators. However, amateurs who look forward to pounding brass commercially will do well to note these facts for future use. Standing watch on a commercial station, ship or shore, is a treasured dream of many a boy who will surely realize his wish if it is accompanied by several grains of stick-to-it-iveness. But, your hopes will be realities only in so far as you submit to considerable self discipline. All commercial operators will admit numerous sins of ommission. Very many will admit that they are not as good operators as they have been at some time during their career.

Any operator who has stood a fair number of watches in his time will bear me up in saying that there comes a period when his ability to copy fast sending shows a marked falling off. Something appears to be wrong with the workings of his hand in conjunction with his brain. Whether the traffic is being copied on a typewriter or with a pencil, the operator is quite aware of the sense of what he is copying but his hand refuses to get it down properly. The whole trouble is this: he lacks coordination of all his faculties.

Coordination of brain and muscles to the nth degree made Jack Dempsey what he is. The same is true of Bill Tilden, tennis champ, and many others whose name is legion. Good coordination is nowhere more important than in telegraphy. To retain this faculty is extremely hard under the conditions involved in a wireless operator's job.

Explained simply, copying amounts to this: his education has taught the operator that when he hears "di dah" to inscribe the letter "a." He does it almost unconsciously. The nervous system employed in that action is just as substantially a circuit as that of his receiving set. The operator's ear receives the stimulus, "di dah," and an impulse courses along the neurones to the brain. From having done the same thing many times before, the brain immediately communicates through the neurones with the muscles necessary to inscribe the letter "a."

That is a long explanation for so simple a process. But the same action takes place in all copying. The lines of communication between ear, brain and muscle are very delicate and are interwoven in an extremely complicated manner. Each stimulus has its corresponding muscular reaction. When an operator gets stale—"isn't as good as he used to be," the lines of communication have become blurred; the stimuli shoot off on the wrong tracks.

Consider for a moment a simple analogy. When someone digs your ribs unexpectedly, you jump skyward. Next time he digs you don't jump quite as high. If he continues to dig, it soon does not worry you at all. What has happened? You have become negatively adapted to the stimulus.

An operator becomes stale because he lets signals buzz in his ears without copying them. Worse still, he often does not even get the sense of them. His faculties become dulled. His senses lose their ability to react quickly. When stimuli come, they get off the tracks and often reach no muscles at all in the maze of communicating nerves.

The above situation is when the operator lacks coordination. His machine-like nervous system is out of gear.

Why is it that an experienced operator hangs his phones on the wall when he is typing a letter? Why does the Associated Press operator turn off his set when he is through receiving? The answer is the same: the operator must have all his senses alive and active when he turns to copying again. His nerves must be responsive to their stimuli.

All operators have tried to read books with the phones over their ears. To stop reading and try to copy after a period of time has elapsed is difficult.

I say it is an evil hard to avoid. Not every wireless job offers the opportunity or the necessity of copying everything that comes through. Neither is it feasible to turn off one's set when one wishes to read. Experience has offered one solution for the problem.

Most operators have one ear better than the other, that is, the faculties of one organ appear to be more fully developed than those of the other ear. Obviously the ears work independently in regard to communication with brain and muscle. Well, preserve your good ear. Do your standing by with your second grade ear and do your copying with both of 'em.

Does that sound like folly? I have tried it out standing watch twelve hours a day for twenty-seven days in each month. And it works remarkably well.

With the advent of radiofone entertainment it is deplorably easy to sit listening to music with signals buzzing in one's ears. This applies to commercial men as well as amateurs. Operators should cultivate the habit of tuning out the code altogether when listening to radiofonic entertainment, especially if receiving on both ears.

Getting stale is no joke. I have known men to learn the code and make no attempt to copy what was coming over the air continuously. Result was, when he did want a license, all his powers of concentration were not sufficient to undo the bad work wrought by becoming quite negatively adapted to the code. Of course, the ailment isn't incurable, but it behooves all those who are stepping up in the ranks to be careful of that very serious bugaboo.

STATION CALL LETTERS

The station license issued for the operation of an amateur transmitting station in the United States designates a call which is to be used by that station at all times. This call consists usually of a number followed by two letters, as 1AB, but may consist of a number followed by three letters, as 1ABC. The number is the number of the radio district in which the station is located. Experiment stations have calls consisting of a number followed by two or three letters of which the first one is X, as 1XA. Technical and training-school stations have calls consisting of a number followed by two or three letters of which the first one is Y, as 1YA. Special amateur stations have calls consisting of a number followed by two or three letters of which the first one is Z, as 1ZA. It is unlawful for any transmitting station at any time to sign any call except the call assigned in its station license. No station is allowed to transmit until a station license is issued. The radio regulations formerly provided that after an application for a station license had been filed and pending the issue of the station license, a provisional call could be used and the station could transmit; this provision has been repealed.

Canadian amateur stations are assigned calls consisting of a number followed by two or three letters, like the calls assigned to amateur stations in the United States. The Canadian stations having calls beginning with the numbers 1, 2 and 3 are in the southeastern part of Canada, somewhat near to the United States stations having calls beginning with 1, 2, 3. Therefore it is possible for a Canadian station having a call, say 1AB, to work with a United States station having the same call 1AB.

Reading Wavelengths on the Receiving Set

By B. F. McNamee

Here is a method whereby any amateur with a receiving set can determine the wavelength of incoming signals from a transmitter. Simple directions for construction and hook-up are given.

A SIMPLE wavemeter consists of a coil and a condenser connected as in Fig. 1. When used to measure the wavelength of a sending station a sensitive high-frequency current meter is added to it as in Fig. 2.

At the sending station there is a large amount of energy available, and the coil

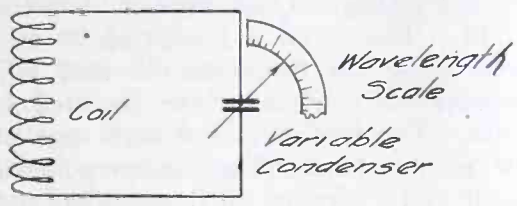


FIG. 1

Fig. 1. Simple Wavemeter

of the wavemeter is brought near the output coil or even near the ground lead. The wavemeter condenser is then varied until the greatest current is shown by the meter. The wavemeter circuit is in tune with the station at this point, and the wavelength is usually marked on the condenser scale or dial.

This method cannot be used at the receiving station because the amount of energy received is too minute to affect the current meter. With a regenerative receiving set, and a simple wavemeter as shown in Fig. 1, it is possible to measure accurately the wavelength of the received station.

Increase the regeneration until the station in question is being received the loudest with the set oscillating. In the case of a C. W. or telephone station, the usual heterodyne note will be received, and it should be tuned just half way between the two loud points. Then, without changing the adjustments in any way, bring the coil of the wavemeter near the secondary or grid circuit coil. Vary the wavemeter condenser until a click is heard in the telephones. If the click is not at a well defined point, or if a double click is heard, the wavemeter coil is perhaps too near the secondary. Remove it until the click is just audible and sharply defined on the scale of the condenser. The wavelength is then read directly from the condenser scale.

The reason for the click is a change in the plate current. When the wavemeter circuit is tuned to the wavelength at which the set is oscillating, it receives energy and causes the set to either stop oscillating, or produce weaker oscillations. In other words it has the same effect as placing the finger on the grid condenser terminal, and the resulting click is the same.

If one wishes to be even more accurate, a sensitive galvonometer may be connected across the grid condenser to measure the direct current in the grid circuit. The filament end of the secondary must in this case be connected to the negative side of the filament. When the set is oscillating there will be a flow of direct current through the galvanometer, and this current will decrease as the wavemeter circuit is brought into tune. Take the reading on the wavemeter when the grid current is lowest.

A wavemeter may be easily constructed. An enclosed variable condenser, .001 mfd. capacity, very rigidly built, should be obtained. Remler-Giblin inductance coils may be used; they should be taped, and heavy leads not more than 8 or 10 inches long brought out for connection to the condenser. One or more coils may be used, according to the wavelength range desired. A group to cover the entire range of used wavelengths with a .001 variable condenser is as follows:

35 turns, 150 to 550 meters.
150 turns, 550 to 2300 meters.
600 turns, 2300 to 10,000 meters.
1500 turns, 5000 to 24,000 meters.

The wavemeter must be calibrated from a standard, or from one which has

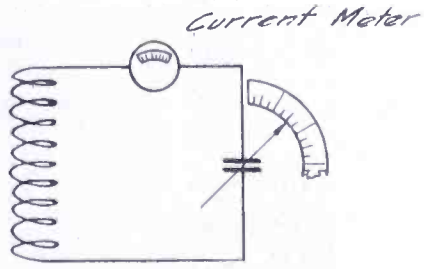


FIG 2

Fig. 2. Wavemeter with Current Meter

been so calibrated. One can usually find in each locality a radio firm or a college laboratory fitted up to do such work, and who will make only a small charge for it. The dial on the condenser may have a different row of figures on it for every coil, or it may be marked off in degrees, and a curve may go with each coil, giving the wavelength corresponding to each degree for that particular coil.

A loose-coupled regenerative receiving set may have its secondary condenser dial calibrated in wavelengths, but it will not be as accurate as the meter mentioned above. It will serve nicely, however, to find any particular station when we know its wavelength. The reason it is not accurate is because a change in the coupling, the regeneration, the grid leak, the plate voltage, or the filament current, will alter the setting of the secondary condenser sometimes several degrees, for any particular wavelength.

BROADCAST FROM RADIO "KNUT"

(Being actual letters received in the daily mail of a Radio Editor who is at present in a nice, sunny sanatorium with nothing to do but play with an Armstrong super-regenerative circuit.)

Dear Mr. Editor: How far will a crystal work and what is the battery cost per day if I use it all the time during concert? Could you give me a dealer or so?—MMJ.

* * *

Dear Sir: Thanks very much for yer consert las p.m. the moderlation was xellent but it was not vary clare in partz. we are entitle to better and hop you will shrtly. Yrs—SFT.

* * *

Mr. Editor: I am living in an apartment where the landlord objects to an aerial for radio. Could I sneek up on the roof at night and use a clothesline or is this prohibited? Several friends are waiting for your reply.—Sincerely, KL.

* * *

Mr. Editor: Which is better—catwhisker or variometer? I can bye both as money is no object only that I want to hear well.—Very truly—HJF.

* * *

Mr. Editor: My wife's sing very good, with little training but good nice voice for radio. Could you use? I request ans.—Very yrs—TG.

* * *

Radio Editor: Can you tell me does the grid leak go in antenna or across A battery. I have tried both, but cannot see any difference as set will not work either way. Yrs truly—FDS.

* * *

Editor sir: You make me sick. I buy radio which I make from diagram as shown, and by wrong connection burn up three lamps—fooey! If you had not printed, it would have been in for me $15 ot less. Your connection maybe all right but not for ignoramus like self. Thanking you, remain, yrs—GHK.

* * *

Dear Sir: Could you please tell me, not for publication, if it is all right to run a still in same house with radio? Would this annoy receiving coils? The still is copper.—Yrs—JFG.

* * *

Editor Radio: If I learn the radio code could I get a position as lady operator with gentlemanly captain, on liner? I am eighteen but not a flapper and mean business. Would like to go to sea with right man. Would appreciate reply. Yrs.—Miss FGH.

* * *

Radio Editor: In hanging aerial can I cross high tension wires and how do I get over without killing myself? My wife's brother is a pole climber and I can arrange that, if I know just how.—Yrs.—GYT.

Continued on page 30

Eliminate the Ox Drivers

By Geo. C. Tickenor, 6AQA

WHAT would you say if a stone wheeled ox cart, a couple of centuries out of date, went lumbering down the main street of your "home town" tying up all traffic, delaying all street cars and holding back hundreds of automobiles? Not only that, but suppose the driver absolutely refused to get out of the way saying, "Well, I get there just the same, don't I?" If it did happen, the chances are that you would like to wring his neck, and undoubedly would if you found the opportunity.

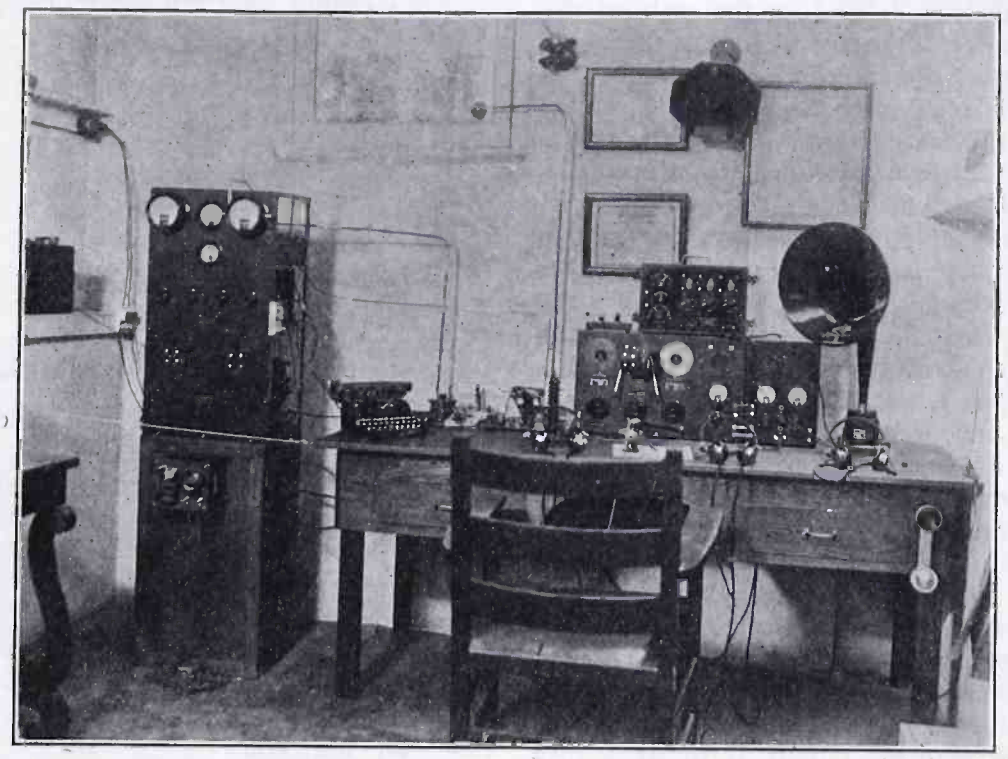
Now then, what has the above to do with radio? Just this: the above is taking place every day in amateur radio, and as yet no one seems to have the nerve to "wring the ox cart driver's neck." To get down to plain facts, the ox cart driver is the narrow-minded fellow who today transmits with a spark set!

Sit down at your set—put on the phones—and listen in. From the minute the kids get out of school until their folks make them go to bed, which isn't half as early as it should be, they "play around" with their pre-historic outfits, "testing" or working the fellow in the next block on one kilowatt.

You may listen any afternoon to spark sets on full power running continuously for from five to ten minutes. Then the word "TEST" will be sent for a half hour or so, and finally he will call his friend and ask "H-O-W D-O I C-O-M-E I-N T-O-D-A-Y ?" Now I used to have a spark set a few years ago, but I'm darned if I had to run the thing for three hours each afternoon in order to keep it working right. Don't any of these poor, dumb specimens of humanity know that if they would keep off the air and listen-in for a change they could hear stations that are hundreds of miles away, and possibly surprise themselves by working those stations? So much for the fellow who "tests." Now for the one who does work fairly distant stations and handles messages but who also does it on a spark set.

Don't come whimpering and say "A C. W. set costs too much." It costs no more than a spark does,—and we all know it. It does take a normal amount of intelligence to build and properly work a tube set, and the lack of this intelligence is undoubtedly the reason a few mentally deficient beings in every town still pollute the air with the infernal crash of an antique spark set. There can be no other reason. The only thing I can't understand is why those who *have* normal reasoning powers put up with the others. The autoists would never permit the antediluvian ox cart on the streets today; then why is the spark fiend permitted to rend the air from 150 to 600 meters with a din that makes riveters in a boiler factory sound like a churchyard at midnight in comparison? Please understand me,—I'm not advocating the use of force against the spark-hound, but when the innumerable advantages of a tube set are set forth, and are universally recognized, as they are today, I fail to see how any person can be so ancient and narrow-minded to persist in using a spark.

Lest some of you who read this and "feel hurt" should imagine it is written "by some old crab who wants to listen to the broadcasting stations and can't read code," I want to tell you you're wrong. I started in the game in 1911, holding the call "3NG" (which was most appropriate at the time) in 1913 at Swarthmore, Penn. The early days of the war found me at NAF, Newport, R. I. Today I am "6AQA" *on C. W.* and am hoping that the day will come soon when all amateur *sparks* will be forced off the air by government legislation if they won't "come around to C. W." of their own free will.



Twenty-Watt Transmitter and Receivers at 6AQA

My station, as shown in the accompanying picture, is located on the roof of the Athletic Club at Los Angeles, Calif. The aerial is supported by two steel masts 58 ft. above the roof and consists of 5 wires in the inverted L type. The lead-in is a 6-wire cage of 10 in diameter. The counterpoise is made of 14 wires on 26 ft. spreaders and lies directly under the aerial. The height of the aerial above the street is 208 feet.

The transmitter uses four 5 watters in a Hartley circuit, the radiation being 3.8 thermo-couple amperes on straight C. W. and 1.2 on voice, moving up to 2.1 when the voice is impressed on the circuit. The plate voltage is about 550. The motor-generator is mounted behind the lower part of the panel, following the practice of most commercial transmitters.

The receiving sets are a Kennedy Universal (on the table at the extreme left of the picture) and two stage amplifier to match,—a home-made "Universal" set and two step using the CR-5 circuit for short waves and duo-lateral coils for long waves. The small set on top of this is a special portable outfit (also home made) with a range of 150 to 3000 meters. It consists of detector and two steps and has the "B" batteries inside, there being 22 volts on the detector tube and 60 on the amplifiers. There are four 6-volt storage batteries of Willard make; two being of 150 amp. hours capacity each and the other two of 80-100 amp. hours capacity. These are "kept in spirits" with a Homcharger which is mounted on the transmitter pedestal. There are four pairs of Western Electric headsets, two Radio Magnavox and a special wall type of loud speaker. The "mill" is a Corona.

BROADCAST FROM "KNUT"

Continued from page 29

Editor of Radio: I am Chinese boy L. H. of 10 yrs and thinking of building radio. Can I hear American music if I use Chinese material buy locally? Please response for stamps attach. Sincerely yrs.—LH.

* * *

Editor Radio: In your diagram printed yesterday you say positive of B bat must go to plate. Is this always? I have heard signals without B bat at all. Is this a freak or a cheaper system?—Thanking you for a reply, remain—yrs—ADF.

A Practical Radiophone

By Philip R. Tarr, 8ALT

There are few amateur stations that in appearance and performance excel 8ALT. The author gives the salient features of his station's equipment and control.

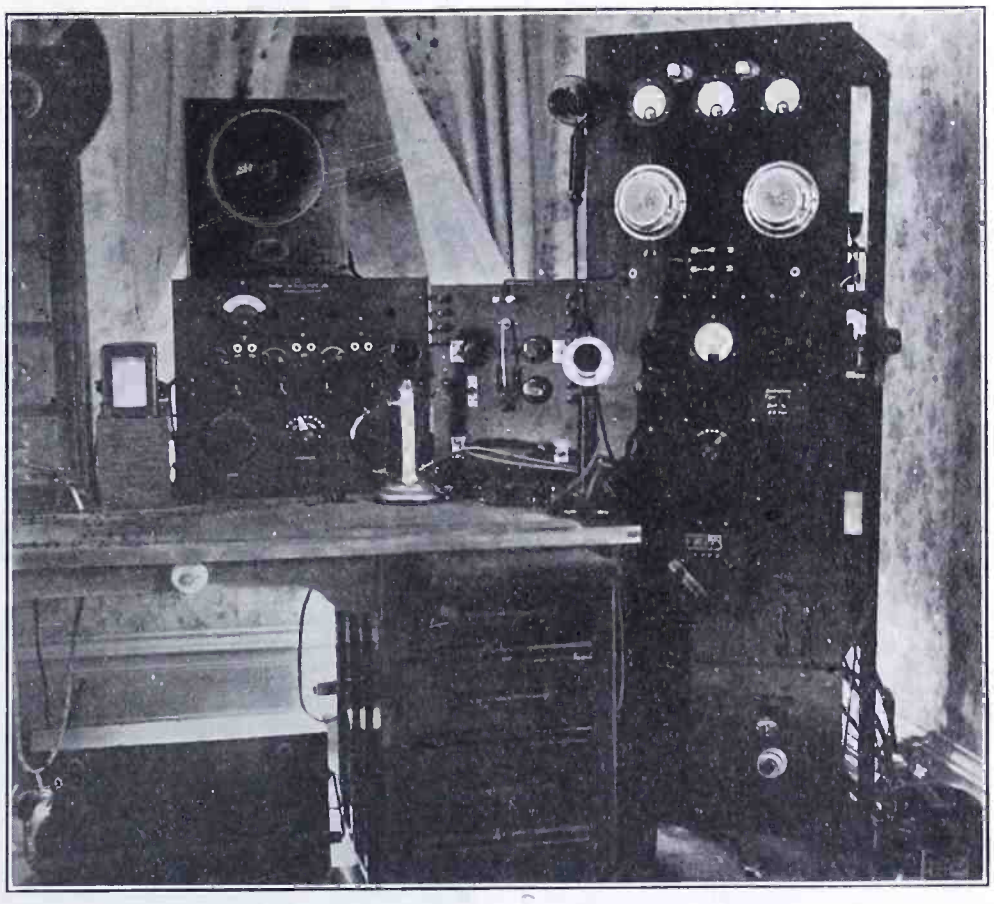
BEFORE going into detail concerning the set in question, I wish to impress upon those of you who may take interest in this construction that you will be more than repaid by building along these lines. It was built with three objects in view, namely, looks, ease of operation, and efficiency. Quite a few beside myself have operated this set and all fully agree that I have attained the three objects.

All controls are within half an arm's length of the operator, and the motor generator set is well isolated three floors below, thus effecting perfect quiet while operating.

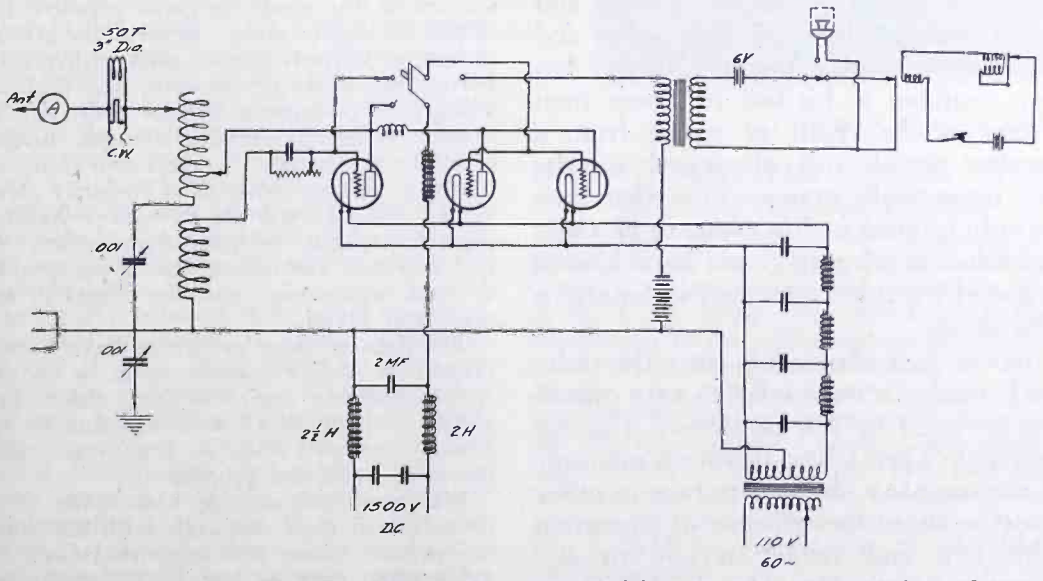
I cannot go farther without thanking those who have been so kind as to write me lengthy reports and send me cards concerning the reception of my signals. With no exceptions all have reported the signals as loud, good of tone and steady. All districts except the sixth and seventh have been worked (on voice). The continuous wave signals have been reported several times in British Columbia and California and have been logged in Hawaii. 6XAD was worked November 18th 11:12 PCT, and again November 21st 3:55 a.m. PCT. Each time his signals rolled in in the best of shape though through local QRM. I wish to state that 8ALT has also been heard in Plymouth, England, on a single circuit receiver with detector only. The letter received is unsigned but requests me to operate at such times as specified therein. As 8ALT is a reassigned call and Mr. Hillman, the former holder of this call, was not at home at the time, he did not forward the letter to me until the scheduled dates were well passed. The log of the letter and my log coincide. The writer, also, states that he logged 3AQR, 3BG, 8BSS, and 8AQO on September 12th.

The antenna at this station consists of a four-wire box, 4 ft. across and 70 ft. high at one end with a slight slope to the other. A wood mast with a section of 10 ft. pipe is used for support. The counterpoise is fan-shaped and well spread out under the antenna. Ground connection is also used, this connection being directly below the operating room and consisting of buried metal sheets and water pipe connections. The lead-in is also a box type and at no point do the incoming leads of counterpoise and aerial come closer than ten feet until on the binding posts of the set.

Three receiving sets may be used at will. The large set, which can hardly be seen at the left of the picture, consists of Reinartz tuner or variometers. The output of each detector may be switched to an included two-step. The equipment used ordinarily is a straight regenerative and detector with three steps of amplification. Western Electric tubes are used in the amplifiers in connection with a 180-volt unit made by Ki-Ko.



Radiophone Transmitter and Receiver at 8ALT.



Transmitter Circuit at 8ALT using Tickler with Heising Modulation and either Speech Amplifier or Two Modulators.

The transmitter circuit is the tickler arrangement with Heising modulation and either speech amplifier or two modulators. At present, however, 350-watt tubes are used and a radiation of 4 amperes (thermo couple) is obtained on voice, using one oscillator and 6 amperes with three tubes in parallel.

The constant current choke is of the 6 henry type with a variable air gap in the core. The high frequency choke is mounted on a Micarta tube 4 in. in diam. with 260 turns of No. 18 DCC wire.

The plate and grid condensers are of copper and mica, 3 x 5 in. with four plates in all.

The filament filter is of the Campbell type "low pass." The high voltage d.c. filter system is made ultra efficient by "building up" the high voltage side.

When tuning for modulation the set is adjusted so that radiation will increase at least ¼ ampere when speaking in the microphone. Bias battery is then cut in until the increase when modulating is approximately 2% that of the total radiation. Although a little against theory, this system has never failed to give the best of results.

The microphone is a 229 Western Electric and is mounted in a piece of 3-in. tubing, 5 in. long. This is bad practice, however, unless experienced in using a microphone in this form. Nine times out of ten when this method is employed only high notes are heard and a jumble results. But by practice, I will guarantee this to surpass the open microphone in all ways. The lips should be placed at the upper part of the front and inside with a slight downward tilt of the tube. The breath must be depressed and a strong monotone should be used. Care should be taken to pronounce each word slowly and distinctly. All DX tests have shown this arrangement to be far superior. In fact, this arrangement will give a deflection equal to 80% that of a well adjusted buzzer, while the average microphone deflects little over 40%. In every case mention of the fine qualities of the voice have been made.

Magnetic relays are used for change over and can be operated from the microphone, or control board to the left of the set.

The motor generator is of Esco make and is driven by a 1 h.p. General Electric motor. This unit supplies 1500 volts d.c. for the plates. A large field rheostat allows a range from 900 to 1500 volts, which is controlled from the radiophone panel. Adequate circuit breakers and fuses have been installed with all inside wiring encased.

In conclusion, I wish to again thank those who have given me aid in numerous tests conducted here. I wish to thank, in particular, Mr. Armstrong of the Radio Specialties Company for his aid and information in construction. Others hearing this station, or desiring to conduct tests, please write to P. R. Tarr, Dawson, Pa.

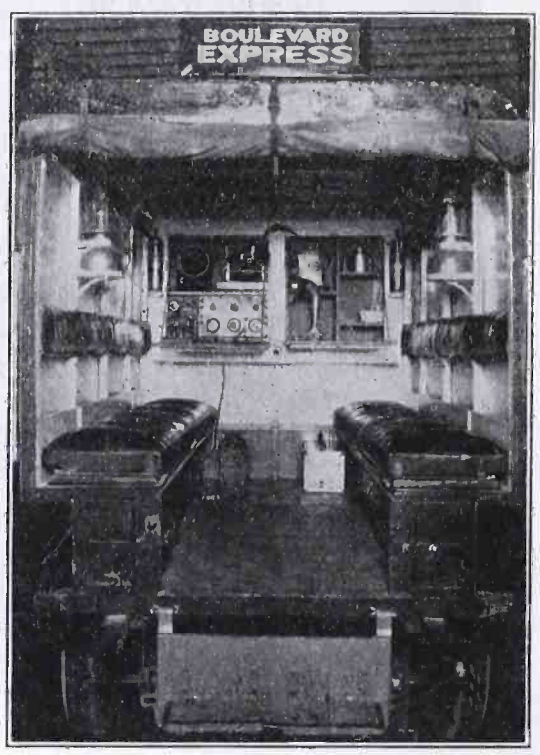
POLAND'S TRANS-OCEANIC RADIO STATION

Direct radio communication between Warsaw and New York will be possible with the completion early in 1923 of a high-power station at Warsaw and a receiving station at Grodzisko, 20 miles to the west. The stations are being constructed under the direction of the engineers of the Radio Corporation of America. Two 400-ft. towers support the aerial. Power is furnished from a 750 h.p. station turbo generator unit and a 750 h.p. Diesel engine unit. Remote control allows all sending and receiving to be done at a central office in the business center of Warsaw.

MOTOR FIRST AID VIA RADIO

Motor first aid via radio is being being furnished autoists along the coast route between San Diego and Los Angeles. An automobile truck, equipped with radio apparatus for both sending and receiving and carrying auto parts, supplies and accessories, is on the road 24 hours a day furnishing free service to motorists in trouble. The driver-operator, W. H. Long, is on the payroll of the Boulevard Express company, and is constantly in communication with both the Los Angeles and San Diego offices of the firm.

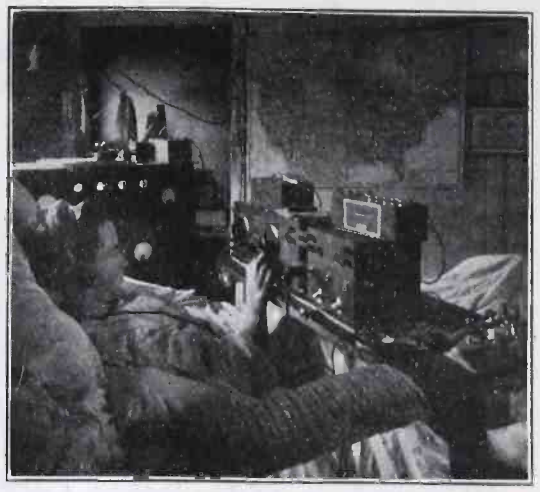
At the San Diego office of the express company there is no radio sending outfit. So Lester Picker, 16-year-old crippled boy, known throughout Southern California as the "radio cop," was



Radio Equipped Trouble Truck

pressed into service. He has one of the finest outfits in the country and, although he is bed-ridden, his outfit is placed so that he can operate it without trouble. He communicates with the Boulevard Express company's office and relays messages between their office and the radio truck. Young Picker has been confined to his bed for more than a year as the result of a fall from a wireless aerial and physicians say he may never walk again. Since that time his only interest in life seems to be radio and wireless telegraphy and he is known as one of the finest operators in Southern California.

It was first planned to have the radio truck render service only to cars owned and operated by the Boulevard Express company. Then Chas. Boynton, manager of the company, decided to take in other firms to share the expense of operation with him and render service to any motorist in trouble. U. S. Grant of the U. S. Grant Auto Equipment company of San Diego, furnishes the tires for the truck. Ralph Hamlin, Inc., furnishes all lubricating oil and the



Lester Picker, the "Radio Cop"

Pickwick Stages contribute monthly toward the gasoline expense.

The car is fully equipped to render almost any kind of service and has been doing exceptionally good work during rainy weather pulling stalled machines out of the mud in the Capistrano detour. The truck is a GMC with a covered body. Inside are kept supplies and accessories, besides a complete camping outfit and the radio paraphernalia, with the exception of the aerials, which are stretched across the top of the car.

Long, the driver-operator, also furnishes market reports on produce to ranchers along the route of travel each day. The sending power of his apparatus is 20-watt C. W. transmission and 10-watt telephone transmission, with a wavelength of 200 and 550 meters.

PROPERTIES OF ELECTRICAL INSULATING MATERIALS

Technologic Paper No. 216 from the U. S. Bureau of Standards treats of the "Properties of Electrical Insulating Materials of the Laminated Phenol-Methylene Type," being written by J. H. Dellinger and J. L. Preston. These materials are made by building up sheets of paper, fiber or fabric which have been previously inpregnated or coated with phenolic varnish (bakelite, condensite or redmanol) to some desired thickness and then subjecting the stack to great pressure in a heated hydraulic press. Reports are given as to tests of radio-frequency phase difference or power loss, dielectric constant, and flash-over voltage, direct-current surface resistivity and volume resistivity, tensile strength, modulus of elasticity (tensile), proportional limit, modulus of rupture, modulus of elasticity (transverse), Brinell hardness, scleroscope hardness, impact strength, permanent distortion, density, moisture absorption, machining qualities, thermal expansivity, and the effects of heat, acid, and alkali.

The data on these properties have been arranged in such a manner as to be conveniently available for reference, either by a person desiring detailed information or by a person interested only in a general way in the more important properties.

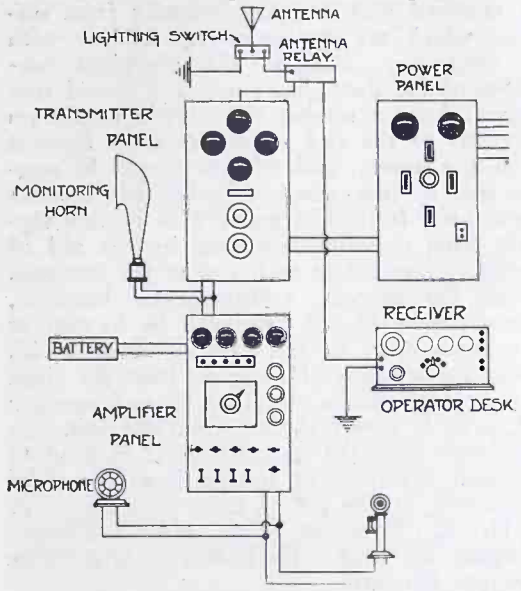
Brief comparisons are also made of the properties of these materials with the properties of hard rubber and vulcanized fiber. This publication may be obtained for 30 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

NEWS OF THE BROADCASTERS

BROADCASTING AT HAVANA, CUBA

By B. H. WURM

STATION PWX, located at Havana, Cuba, is owned by The Cuban Telephone Company, associated with The International Telephone and Telegraph Corporation of New York. The inauguration of this station took place on Oct. 10, 1922, with an address to the people of the United States, delivered by President Zayas of the Republic of Cuba, and has been presenting regular programs every Wednesday and Saturday nights since. The program commences at 8:30 P.M. Havana time, which is one half hour earlier than Eastern Standard Time. These programs are broadcasted on a wavelength of 400 meters. A feature is that announcements are made in both Spanish and English.



Station PWX Layout

Results from this station have been exceptionally good, reports having been received from all parts of the States, the most distant point being Prince Albert, Saskatchewan, Canada, about 2300 miles. The writer attributes these good results to the good location of the station. Cuba is surrounded entirely by water and has no mountains to speak of to distort the waves on their travel. There are no steel buildings, metal structures, bridges, etc., to absorb the radiated energy.

The station is laid out as follows. A large room is set aside to receive the artists. In this room is placed a Western Electric horn which is connected to receiving apparatus in the operating room. This allows the artists, who are waiting for their turn, to hear the other parts of the program.

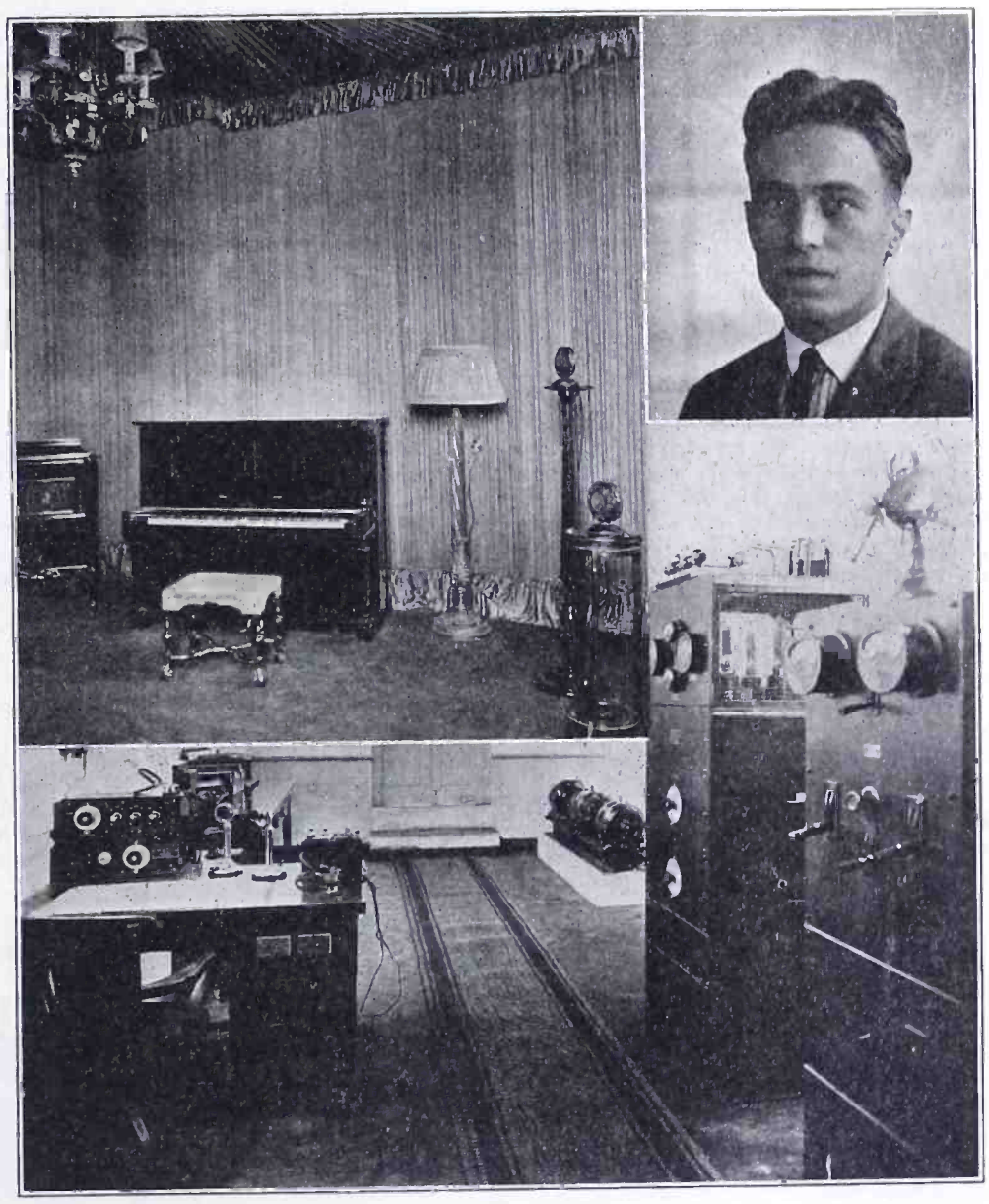
Next to this room is the studio, arranged for proper acoustic conditions. Here we also find sounding boards which can be arranged in any location desired. The operating room is next to the studio, communication between the two rooms being maintained by a light control and telephone system which enables the operator to keep in constant touch with the announcer and vice versa. One telephone light, used instead of a bell, operates with the lift of the hook.

The aerial consists of three wires supported by two steel towers 120 ft. apart. The lead-in is 170 ft. long, taken from the center of the antenna, making a T. The towers are built upon a building which is 65 ft. high.

The transmitter consists of a standard Western Electric 500 watt outfit. This apparatus employs a 5 h.p. motor generator which supplies 1600 volts to the plates and 15 volts to the filaments. The transmitter proper has one 50 watt speech input tube, two 250 watt oscillator tubes, and two 250 watt modulator tubes. The Heising circuit is used for modulation.

WGY HEARD ACROSS ATLANTIC

WGY, the General Electric Company's radio broadcasting station in Schenectady, N. Y., has successfully transmitted a musical program across the Atlantic Ocean, according to word received from Dr. W. R. Whitney, director of the company's research laboratory who is traveling abroad. Dr. Whitney states that he talked with Chief Radio Operator Black of the S. S. America, who stated that while the ship was docked in Cherbourg, France, he picked up an entire evening's program from WGY and that the signals came in so clearly that when he laid the phones on his table the music was audible in the radio cabin.



PWX, Havana, Cuba, B. H. Wurm in Charge

BROADCASTING WITH THE PALLOPHOTOPHONE

Christmas greetings to the people of the United States from Vice President Calvin Coolidge, to the active and ex-service men in the U. S. Army from Secretary of War Weeks and to the active and ex-service men in the U.S. Navy from Secretary of Navy Denby were broadcast on Christmas eve from WGY, the high power radio station of the General Electric Company at Schenectady, N. Y. This was the first time that three leading executives of the country ever attempted to extend their greetings in a way that reached the four corners of the country simultaneously.

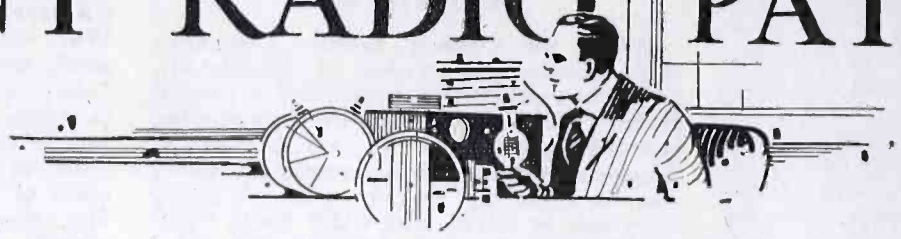
This feat was made possible by use of the Pallophotophone, a new General Electric device for photographing the voice and later reproducing it with perfect clearness. The machine was set up in a hotel in Washington ten days before. The Vice President and the War and Navy Secretaries spoke into a small recording horn. As they did their voices caused a small diaphragm to vibrate to which is attached a tiny mirror, scarcely smaller than the head of a pin. This oscillation or flickering of the mirror reflected a beam of light upon a moving photographic film, thus recording the human voice accurately with the overtones, the delicate shadings of speech, and other characteristics which make one voice sound different from another.

The film was taken to Schenectady and was broadcast twice on Christmas eve from the WGY studio, the first time at 7:30 o'clock during the regular Christmas program and again at 10:30 o'clock for radio fans in the western states who were listening.

In reproducing, the film is passed before a strong ray of light and the zig zag markings on it—the sound waves photographed—create electric waves which pass through an arrangement of vacuum tubes and produce sound waves again which are sent directly into the radio broadcasting apparatus without the use of a microphone or any sort of a pick-up device ordinarily used.

This feat of recording the speech of a person in a distant city is believed to have introduced an entirely new element in radio broadcasting—the possibility of making a master record and broadcasting it days or weeks later from any radio station in the country.

DIGEST OF RECENT RADIO PATENTS



R. Brown, Pat. No. 1,433,599: Oct. 31, 1922. Radio Circuit.

In order that signals may be transmitted from Antenna *A* at the same time that signals are received from antenna *RA* where both antennae are relatively close, an arrangement is provided for alternately rendering these antennae ineffective at a rate intermediate between the signaling frequency and the carrier frequency. To accomplish this result, thermionic commutators *T1* and *R1* are inserted in both circuits, and the grid potentials of these tubes are controlled from a source of high frequency in an alternate manner, so that while commutator *T1* is active, commutator *R1* is inactive, and vice versa. In order to secure as good results as possible, a distorting tube *DT* is inserted between source *O* and the commutators, whereby potentials of flat-topped wave form are supplied to the commotator grids.

H. W. Weinhart, Pat. No. 1,432,931: Oct. 24, 1922. Electric Discharge Device.

In order to increase the power of a thermionic device, the anode *4* is made in the form of a tube which may be kept cool by the circulation of water or oil. In this way the effect of the electron bombardment to raise the anode temperature is nullified. The grid *3* is shown in the form of a helix surrounding the anode, and the incandescent cathode as a filament placed near the grid.

W. H. Nottage, Pat. No. 1,432,354: Oct. 17, 1922. Radio Signaling Apparatus.

This scheme is used to relay a signal sent by wire, by the aid of radio, or, vice versa, to relay a radio signal over a wire circuit. A Wheatstone bridge arrangement having arms *A, B, C* and *D* is used for this purpose; arms *A* and *B* are connected respectively to a wire system *E* and to an artificial line *F*, the equivalent of *E*. The other two arms have impedances *C'* and *D'*. The radio receiver is connected between arms *A* and *B*, and between arms *C* and *D*, while the radio transmitter is connected to the other diagonal of the bridge. Radio signals from the radio receiver cannot affect the radio transmitter if the circuits be properly proportioned. On the other hand, audio signals from the system *E* can affect only the radio transmitter, since the receiver is tuned to be sensitive only to radio frequencies.

E. W. Kellogg, Pat. No. 1,434,707: Nov. 7, 1922. Radio Receiving System.

A number of widely separated receiving antennae *1, 2, 3, 4, 5* is provided, each connected by lines to a central control station. By choosing properly those antennae which happen to receive under most favorable conditions, the effect of static may be almost eliminated. In order that the signals from more than one antenna may be properly combined when necessary to obtain the best results at the main receiving apparatus *28*, phase, shifters *27* may be provided in each antenna control circuit; furthermore a source *16* of comparatively low frequency transmits to the antenna detectors a control current, which with the aid of apparatus *18* is in-that the shielding is effected at audio frequency, so that whenever a disc tooth is interposed between the coils, there is not a complete interchange of energy between the two circuits. In order to maintain the load on the source *J* constant, another circuit *U-S* may be used, which has characteristics similar to the antenna circuit, and arranged near disc *L* so as to be coupled to the generator circuit whenever the antenna circuit is decoupled, and vice versa.

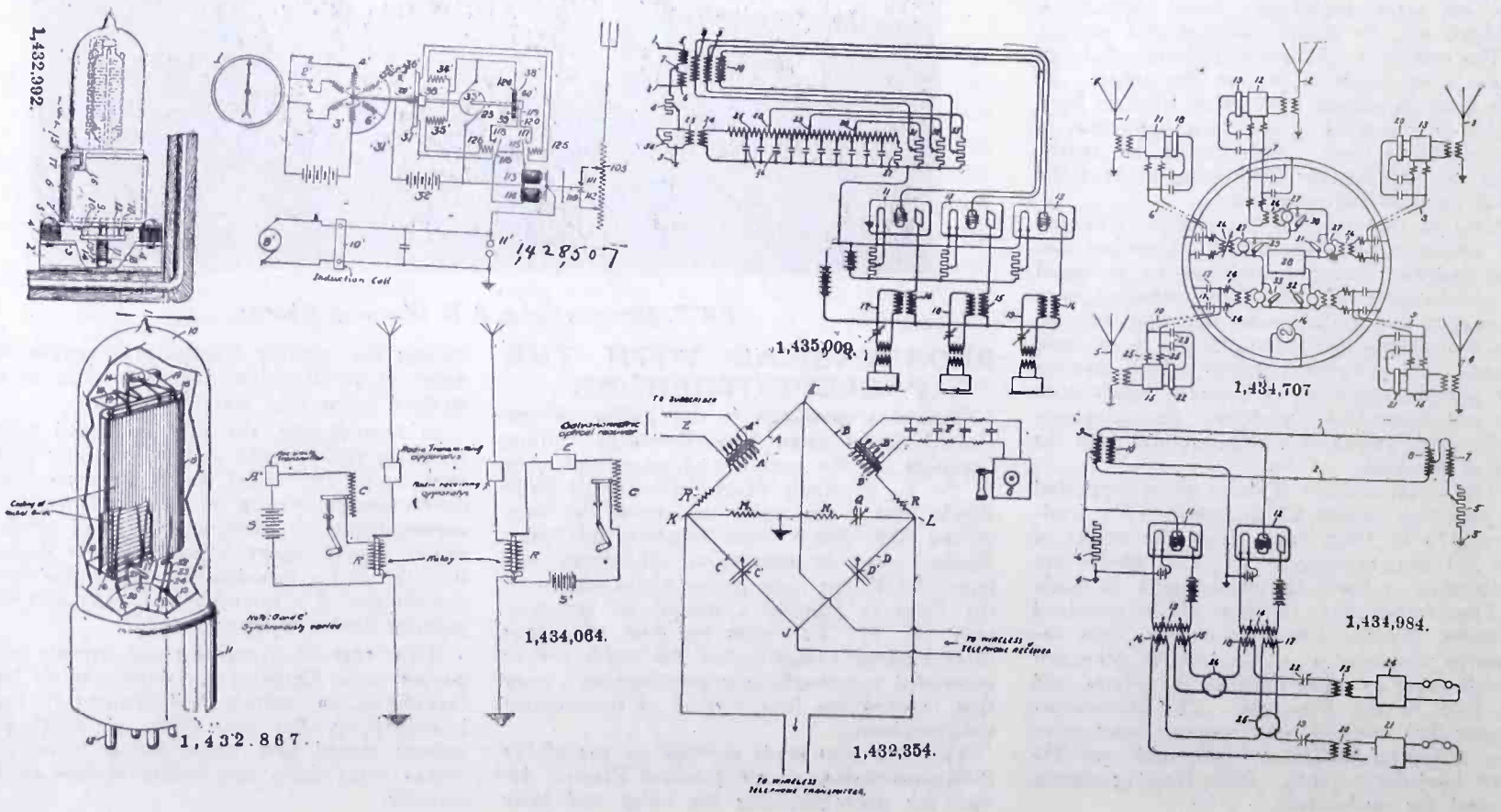
H. H. Beverage, Pat. No. 1,434,984: Nov. 7, 1922. Radio Receiving System.

The described scheme involves the use of a long horizontal antenna *1, 2* grounded at its ends. With such an antenna signals may be received with greatest intensity from stations which are approximately in line with the antenna. Due to the electrical constants of the lines, however, it is found that signals from a station reach their maximum intensity at the end of the antenna farthest from the station, and this effect may be augmented by the proper choice of antenna constants. It is thus possible to receive signals from opposite directions by the aid of detectors inserted at each end of the antenna. With the present arrangements, however, the detectors *21, 24* may both be located at the same end; in the case of detector *21*, using the amplifier *11*, signals from the right are received, while amplifier *12* and receiver *24* serve to detect signals from the left. In the latter case the antenna itself is used to transmit the received signals from the right hand end, by the aid of the transformer *7-8*.

H. C. Egerton, Pat. No. 1,426,826: August 22, 1922. Re-Electron Discharge Device Circuits.

Since an excessive positive charge on the grid of a three-electrode thermionic device such as *5* is undesirable, it is proposed to permit this charge to leak off through a unilateral conducting device. Thus a two-electrode device *15* may be connected between the grid *17* and the filament *19*, so arranged that current can pass only from *17*, through *16, 18* and to *19*, but not in the opposite di-

Continued on page 55



QUERIES & REPLIES ON C.W. PRACTICE

BY

Gerald M. Best

TECHNICAL ADVISOR

Please publish a circuit to efficiently operate a detector and 2 stages using WD-11, Westinghouse tubes, with loud speaker and Ducon plug.

E. W. S., Waldwick, N. J.

The circuit you wish is shown in Fig. 1. You will not get enough energy out-

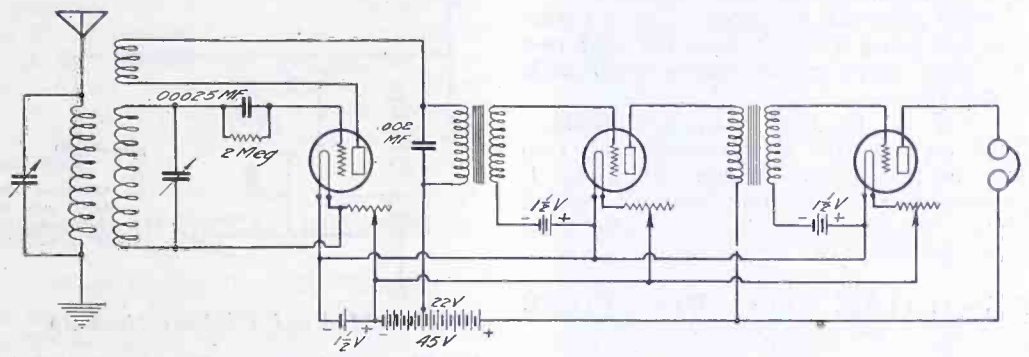


Fig. 1

put from a WD-11 tube to give very much volume with a loud speaker. Suggest your using WD-11 tubes for the detector and first stage, and one of the larger tubes for the last stage, if you wish to have considerable volume in the loud speaker.

I have a ½ k.w. Packard transformer, the secondary of which is wound in two sections. Could I use one of the secondary sections alone for supplying plates of two 5-watt tubes, by rewinding the primary with more wire?

G. W. K., 9BTJ, Amherst, Wisconsin.

Such an arrangement would be pure guesswork, and I would advise you to make new windings for both primary and secondary. If you will tell me the cross sectional area of the core, and whether it is of silicon steel or iron, I will give you the necessary information to wind the coils.

Please publish a circuit using two 50-watt tubes, with 5-watt speech amplifier, with the reversed feedback system, for C. W. work. B. L., Los Angeles, Calif.

The circuit is shown in Fig. 2.

Where and from whom can I buy moulds for casting the standard size lead plates for storage batteries? Is stove-pipe iron as good for making transformer cores as silicon steel? What causes one cell of a storage battery to run down faster than the other two?

—P. G., Lemoore, Calif.

Would suggest that you write to one of the many storage battery companies who advertise in this issue. In general a core made of stovepipe iron requires about twice the area of one using silicon steel, when using the same design formulae. If one cell of your battery runs down faster than the others, it is probably defective, and should be taken to a repair shop. Sediment in the bottom of the cell, or poor separators generally contribute to such troubles.

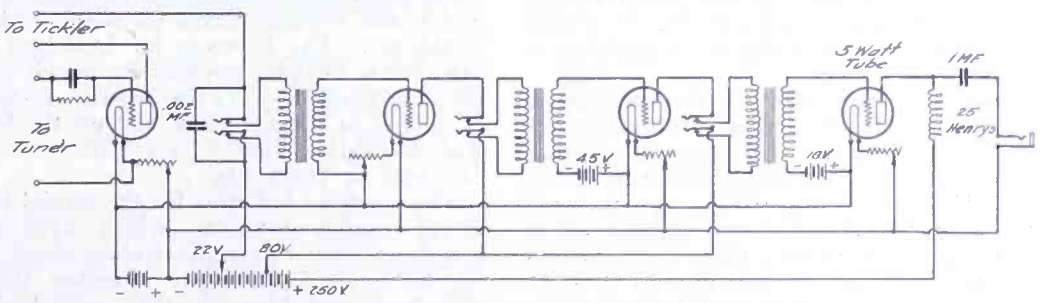


Fig. 3

What is the difference between an Audion detector and a Radiotron detector? A. J. N, Hamilton, Wash.

The Audiotron tube was made by the Audiotron Mfg. Co., of San Francisco, Calif., its manufacture being discontinued some time ago. It is a soft tube, and is used mostly as a detector or oscillator. The Radiotron and Cunningham tubes, which are identical, replaced the Audiotron, and have the advantage of a base, and improved operating characteristics.

I would like to have some information relative to Armstrong's new super-regenerative circuit. R. D., Miami, Texas.

Two articles on the super-regenerator were published in September RADIO. Another appears in this issue.

Kindly furnish me with a circuit with detector and three stage audio frequency amplifier, using plugs and jacks for cutting out the various stages.

M. L., Yakima, Wash.

The circuit appears in Fig. 3. The choke coil in the last stage is a Wayne bell ringing transformer, using the primary winding only.

Please tell me, through your columns, what is wrong with my circuit, as I cannot hear anything except the local stations. O. A. C., San Francisco.

Your circuit appears to be correct and your trouble probably lies in the method of tuning. Perhaps your tube is a poor oscillator and will not regenerate with the tickler you are using.

Please furnish me with a circuit for phone and C. W., using Mullard English valves, two 40's as oscillators, and two 40's as modulators, and one 20 as speech amplifier. J. F. A., Grand Forks, N. D.

See Fig. 2 for the circuit, which should fit in with the English tubes without trouble.

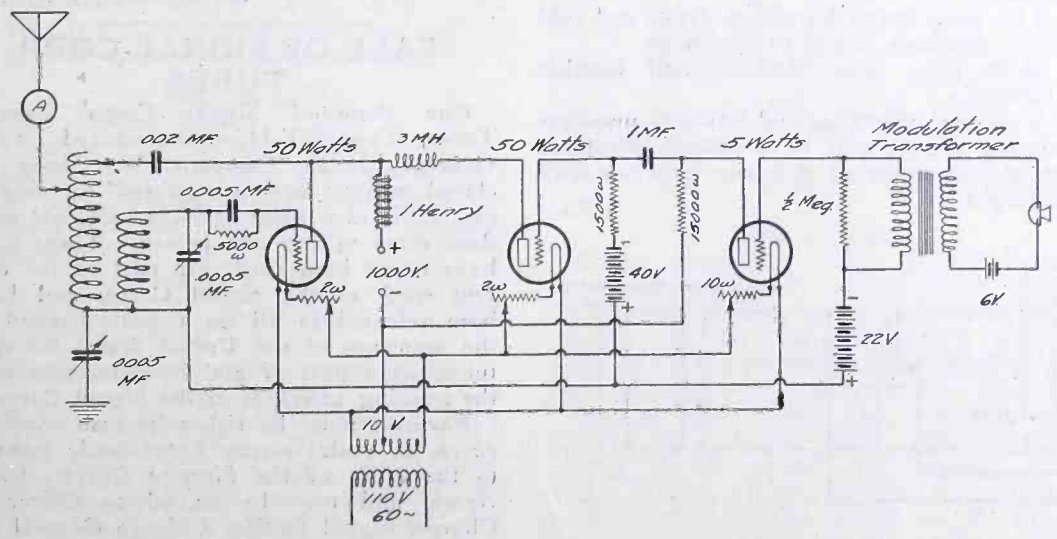


Fig. 2

Starting at 140 meters, the number of turns on tubes 3, 3½ and 4 inches, and size of condenser with regards to low decrement and sharp tuning in a wavemeter. Also probable range of coils.

R. K., San Francisco.

Your question is not at all clear, as you do not state what the maximum range of the wavemeter is to be be.

Please publish a circuit for an efficient two-circuit tuner, for use with my detector and two stage amplifier. Please give me a circuit for C. W. and phone, using a 5 watt tube. What voltage should the transformer be, and how many cells for the rectifier?

L. L. P., Sultano, Calif.

The article by D. B. McGown, in January RADIO, presents a fine two-circuit tuner of the type you wish. Fig. 5, on page 35 of the same issue shows a

circuit for a one-tube transmitter. The transformer secondary should be 550 volts, and you should have at least 12 cells in your rectifier for that voltage.

Please advise where fish paper of 5 mil thickness may be purchased. This paper is for use in winding a 10 watt C. W. transformer.

E. M. D., Orange, Texas.

Suggest you using ordinary tracing cloth such as is used for blueprints, for such cloth would furnish good insulation where the voltage between layers is as low as yours would be.

Is it likely to damage my 5 watt tube if I use it without grid condenser or leak? The radiation is doubled by omitting them. R. H. P., Riverbank, Calif.

Not unless the plate becomes excessively hot. It is probable that there is enough capacitance in the leads of your set to make a grid condenser unnecessary.

Please publish a circuit for a one stage audio frequency amplifier to go with the "Sphinx" receiver described on page 22 of August RADIO.

M. C. B., Wheatland, Calif.

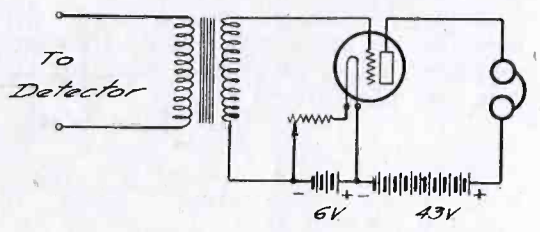


Fig. 4

This circuit is shown in Fig. 4.

Is it possible to add a Radio frequency amplifier to the Gibbon's receiver described recently in your magazine?

G. E., Berkeley, Calif.

Yes, but if you do you lose all the advantages which the receiver is supposed to possess, namely, simplicity, regeneration and economy. If you wish to use radio frequency amplification, it would be necessary to use different apparatus in the detector circuit.

Please tell me what is the best type of telephone transmitting circuit for use with a portable set, for very short distances. H. H. W., San Francisco, Calif.

See the article by the writer in next issue of RADIO, on a transmitter using the same filament and plate batteries as the receiving set. This should answer your purpose and transmit over a considerable distance.

Please tell me what is wrong with the enclosed circuit, for a one stage audio frequency amplifier connected to the Gibbons receiver described in August RADIO. N. C., Los Angeles, Calif.

You have your "B" battery in the wrong place. See Fig. 4 for the correct circuit.

Would like to have a circuit for a Magnavox, with two-step amplifier, for use with an ordinary telephone transmitter, so that the Magnavox could be used in addressing a public carnival which our school is to have.

K. G. S., Spokane, Wash.

The circuit, with the necessary data, is shown in Fig. 5.

Please publish a circuit using two 50-watt tubes, for C. W. and telephone. Also publish a circuit for a 2 k.w. spark set. What is the difference between a radio and an audio frequency amplifier.

J. G., Beechview, Pittsburg, Pa.

See Fig. 3 for the phone circuit. This department does not publish circuits dealing with spark sets. A radio frequency amplifier is one which amplifies the incoming signals at the frequency with which they were transmitted, which is usually of a value inaudible to the human ear. The detector is attached to the output of such an amplifier. An audio frequency amplifier is one which amplifies the signals after they have been rendered audible to the ear, in the detector circuit, and usually has a frequency range of from 400 to 3000 cycles.

Kindly give me a diagram for a three-globe set using a VT-1 detector and two VT-1 amplifiers, using honeycomb coils for the tuner.

S. E. S., San Francisco, Calif.

The circuit for a detector and two stage amplifier is shown in Fig. 1. Vacuum tubes are not usually called globes, although literally they could be classed as such.

SCHEDULES OF WEATHER REPORTS BROADCAST

From Naval Radio Station (NAT), New Orleans, La.

Beginning January 1, 1923, weather forecasts and warnings for each of the States comprising the New Orleans forecast district, river forecasts, and a summary of weather conditions over the United States at 8 a.m. and 8 p. m., respectively, will be broadcast daily from the Naval radio station (NAT) at New Orleans, La.

The weather forecasts issued from New Orleans are for Louisiana, Arkansas, Oklahoma, eastern Texas (east of the 100th meridian), and western Texas (west of the 100th meridian). The forecasts for Louisiana and east Texas include, respectively, winds along the Louisiana and Texas coasts. Forecasts of stages on the Ouachita and on the lower Red and Mississippi Rivers will be broadcast only at 10:30 a.m.

The localized bulletins for the special benefit of marine interests, which have been broadcast from this radio station since June 10, 1921, as described in Weather Bureau Circular dated May 28, 1921, will be continued as heretofore.

The complete schedule (75 meridian time) is as follows:

Wavelength, 1,832 meters, spark.

10:30 a.m., State forecasts, river forecasts, and weather summary.

11:00 a.m., localized bulletin for marine interests.

5:00 p.m., storm, hurricane, frost, and cold wave warnings issued in afternoon.

10:00 p.m., State forecasts and weather summary.

Hurricane warnings and advisory messages relating thereto will be broadcast whenever issued and continued at 2-hour intervals until midnight,

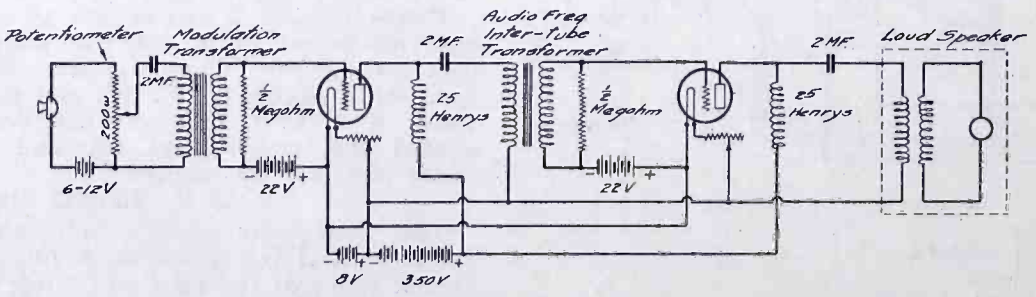


Fig. 5

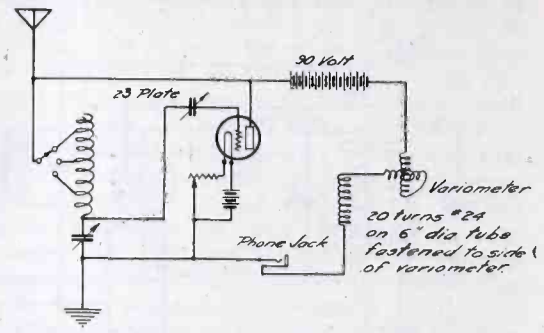
LETTERS TO THE EDITOR

His Own Mother Wouldn't Know Him.

Sir: I take strong exception to the statement of G. Earle in his letter in January "RADIO," concerning the Gibbons receiver. He states any more improvements will spoil it. I differ with him. Add a few things I have used with great success in DX reception and you have an unbeatable hook-up that drags in those eastern C. W. stations every night.

As Mr. Gibbons originally stated, it was not so much on C. W. the way he had it. But I fussed around and here's the dope that'l hawl in those 5 and 8's like local stuff on tube.

Instead of a fixed grid condensor put a variable 23 plate cond. in. It can be set to tune out either spark or C. W. Sparks can



Modified Gibbons Hook-up

be eliminated absolutely. In the plate circuit we have added an inductance of 20 turns of cotton covered wire. The smaller the better, 24 is about right. Attach this inductance to your variometer in inductive relation on the side so the primary of the variometer acts as a primary on tickler affecting the inductance. Place the variometer in series with the inductance in the plate lead directly from the plate of the tube. This serves to control the oscillations very well and tunes out broadcasting QRM.

Instead of running the aerial to a honeycomb coil of 400 turns, have a tap off to the plate. I used a spider web coil of 25 turns which is tapped in 3 places, on the 6th, 10th and 15th turns. This small inductance will bring the wavelength way down, enabling one to pull in the short wave 200 DX. Arc mush will not affect his hook-up at all. I use no grid leak with this tube circuit.

I have copied 1XM, 1CIF, 1BOI, 1AAW, 1CMK, 2BKA, 2ASO, 2BQS, 3CA, 3OT, 3ZW, 4EH, 4BY, 4XG, 4ED, 4GH, 5s too numerous, 6's too numerous.

This is just to show that Gibbons hook-up can be fixed up to work on 200 meters C. W. Try it out, gang, you'll be amazed to hear those C. W.'s pouring in. 5XA at 2:30 in mid-day over 1100 miles. This was done at 6SQ on duplicate receivers.

Hoping you will print this, as I think it will help us out in our copying traffic.

SID GLASSON, 6AOR.

SALE OF SIGNAL CORP TUBES

One thousand Signal Corps Vacuum Tubes, Type VT-11, manufactured by the General Electric Company, have been declared surplus and are offered for sale to the public at a price of $5.50 each, not more than three to any one person. These tubes have never been used, are part of the current stock of the Signal Corps, and have been released to fill an urgent demand of the amateurs of the United States for such tubes, as a part of and in connection with the training activities of the Signal Corps.

Payment must be either in cash, *certified check,* or postal money order made payable to the order of the *Finance Officer, U. S. Army,* and may be mailed to Officer in Charge, Signal Section, Chicago General Intermediate Depot, 1819 West Pershing Road, Chicago, Ill.

WITH THE AMATEUR OPERATORS

TRANSATLANTIC TEST RESULTS

Through the courtesy of K. B. Warner, Secretary of the American Radio Relay League, the results of the trans-Atlantic amateur radio tests for the twenty-day period, from Dec. 12 to 31, 1922, are herewith presented. During the first ten nights American and Canadian amateurs transmitted while European amateurs listened. During the last ten days the Europeans transmitted and the Americans listened.

Preliminary reports indicate that 316 American and Canadian amateurs were heard across the Atlantic. The British heard 162 stations, the French and Swiss 240, while 86 American call letters were heard both in the British Isles and on the Continent. About 20 American amateurs heard European amateur signals, principally from French 8AB and from British 5WS and British 2FZ.

HEARD IN GREAT BRITAIN

First Night, Dec. 12, 1922

On schedule, code letters verified: 1BGF, 1YK, 1BCG, 2BML, 2EL, 2BQU, 2GK, 2UD, 2NZ, 2XAP, 2ZK, 2ZL, 2AWF, 3ZW, 8AQO, 8AWP.

During free-for-all period: 2BML, 2LY, 2NZ, 2ZK, 2UD, 3BGT, 3HG, 3ZY, 3BGJ, 4FB, 4OI, 4ZS, 4ZW.

Working DX: 2ZS, 2ZK, *on phone,* 2AWL, 2BMC, 2CJW, 3XM, 4BX, 4OI, 7PO, 8GQ.

Dec. 13, 1922

Codes verified: 1BDI, 1XM, 1AJP, 1BCG, 1BEP, 2GR, 2NZ, 2AHO, 2BML, 3BLF, 3XM, 3ZW, 8AQO, 8ATU, 8XE.

Free-for-all period jammed.

Working DX: 1BDG, 1GV, 1OR, 1YK, 2KL, 2LO, 2ZA, 2AWF, 2CSL, 2XMO, 2ZS, 3BL, 3BVL, 3ZZ, 5AAM, 5BV, 5GBZ, 8AR, 8BK, 8DB, 9IM.

Dec. 14, 1922

Codes verified: 1BDU, 1ZE, 1AJP, 1BCG, 1BET, 1XM, 1YK, 2AWL, 2LO, 2NZ, 2ZK, 2AWF, 2BQU, 2EL, 2HW, 3AUU, 3BG, 3ZW, 3ZZ, 4BY, 8AQO, 8ATU, 8UE.

Free-for-all: 1BCG, 1BDI, 1BET, 2CKL, 2AWL, 2BML, 2BQU, 3ZW, 3XM, 8BUM.

Working DX: 1CMK, 1CNJ, 2BDT, 2FP, 8AD, 8ATU, 9ZN; also 24 other stations, call letters not given.

Dec. 15, 1922

Codes verified: 1CMK, 1BET, 1BCG, 1ZE, 2AWF, 2CKN, 2FP, (incorrect; this station did not qualify and no code was assigned it); 2AWL, 2AYV, 2EL, 2ZK, 3BGT, 3ZZ.

Free-for-all: 1BDT, 1BDI, 1BET, 1RQ, 1CDX, 1CMK, 2EL, 2FP, 2LO, 2NZ, 8AQO.

Also 17 unnamed stations working DX.

Dec. 16, 1922

Code verified: 2BML.

Working DX: 2TSU, 5DWP.

Something wrong here; the French had a good night, but the British report only one genuine call, the last two being obviously impossible.

Dec. 17, 1922

Codes verified: 1BGF, 1ZE, 2EL, 2ZK, 2AWL, 2GK, 3ZW, 8ATU.

Also 14 unnamed stations working DX.

Dec. 18, 1922

Codes verified: 1ASF, 1BCF, 1BET, 1AKG, 1AZW, 1BKQ, 1CJA, 1CNF, 1GV, 1XM, 1YK, 2AWF, 2AWL, 2CQZ, 2GK, 2LO, 2EL, 2UD, 2ZK, 3CC, 3AFB, 3AUU, 3BGT, 3BLF, 3NH, 3XM, 3ZW, 3BG, 4BY, 6ZZ, 8AQO, 8AWP, 8SP, 8UE, 9AUL, 9DYN.

Free-for-all: 1AZW, 1BDT, 1II, 1ZE, 2BQT, 2GK, 3EB, 3XM, 4BY, 8AXC, 8ATF, 8BX, 8BXF, 8AXE.

Also 8 unnamed stations working DX.

Dec. 19, 1922

Codes verified: 1AGK, 1GV, 1GB, 1XM, 1AJP, 1ASF, 1BET, 1BEP, 1CNF, 1YK, 2AWL, 2GK, 2ZK, 2AWF, 2BML, 2EL, 2LO, 2NZ, 2XAP, 3AFB, 3ZW, 8AQO, 8UE.

Free-for-all: 1BET, 1CMK, 2AFP, 2CQZ, 2FP, 3BFU, 3HG.

Kenneth B. Warner, Secretary A.A.R.L., and the Two-Gallon Hat Won in a Wager with M. W. Burnham that American Amateurs Would Get Across the Atlantic.

Dec. 20, 1922

Codes verified: 1BCF, 1BEP, 1CNK, 1CNF, 1AHZ, 1ASF, 1BAS, 1BGF, 1BKQ, 1CMK, 1FP, (erroneous; no such station qualified); 1GV, 1XM, 1YK, 2GR, 2CKN, 2XAP, 2CQD, 2ZL, 2EL, 2GK, 2LO, 2KF, 2AWF, 2AFP, 2AWL, 2BRB, 2BQU, 2CQZ, 2GM, 3AUU, 3BGT, 3BG, 3BNU, 3CC, 3CG, 3FS, 3XM, 3YO, 3ZW, 4BY, 4KM, 5XK, 8AWF, 8AQO, 8AXC, 8BXH, 8UB, 8UE, 8SP, 8AWP, 8BK, 8KG, 8ML, 8YD, Canadian 9AL.

Free-for-all: 1ZE, 1BKQ, 1XM, 1AJP, 1OR, 1BDT, 1II, 1BEP, 1CMK, 1BES, 1BRQ, 1BET, 2GJ, 2XAP, 2CTN, 2AWF, 2CQZ, 2BML, 2EL, 2BLP, 2FP, 2BQU, 2KG, 2CKR, 2HW, 2NZ, 2UD, 2XAO, 3BYC, 3AFP, 3CC, 3AQR, 3HQ, 3AUU, 3JJ, 3BGT, 3XR, 3BLF, 3ZW, 4BX, 4EA, 4EB, 5NK.

Also "many" unnamed stations working DX.

Dec. 21, 1922

Codes verified: 1BEP, 1CWF, (erroneous; no such call); 1BGF, 1GV, 1XM, 2AWL, 2GK, 2LO, 2BLP, 2EL, 2NZ, 2ZK, 3AUU, 3BGT, 3ZW, 4BY, 4KM, 8AQO, 8BK, 8IBF (error somewhere; no such station qualified); 8SP, 8UE, 8ATU, 8BXH.

Free-for-all: 1XB, 1XK, 1RY, 1AJP, 1BDT, 1BEP, 1BES, 1BKA, 1BMK, 1BRQ, 1CDO, 1CKP, 1CKG, 1II, 1CMK, 1OR, 1XM, 2CBW, 2XAO, 2XAM, 2ZK, 2AXO, 2BRB, 2BYS, 2CKR, 2CQZ, 3AQR, 3BLF, 3HG, 3YO, 3BFU, 3BGT, 3BNU, 3ZW, 3ZZ, 4EA, 5XK, 8ADG, 8SP.

HEARD IN SWITZERLAND

Dec. 13, 1922

Free period: 8BSS.

Dec. 14, 1922

Code verified: 8AQO. Free-for-all: 2BGL, 2RP.

Dec. 18, 1922

Code verified: 1AZW, 1XM, 2AWL, 2GK, 3AFB, 4BY, 5ZA, 8AIO.

Free period: 1AZW, 1BDT, 2CKR, 2CPD, 2RP, 3HG, 8AXC, 8CJH, 8ML.

Working DX: 1ST, 1XY, 2EL, 4EA, 8AQO, 8BRC, 8UE, 8VQ, 9CM, 9DFB.

Dec. 19, 1922

Free period: 1BDT, 1II, 2AYV, 2CBX, 2CJN, 2CPD, 2XAO, 2XAQ, 3BFU, 3HG, 3OT, 3XM, 3ZW, 3ZZ, 8AQO.

Working DX: 3ZH.

HEARD IN FRANCE

Dec. 12, 1922

Codes verified: 1YK, 1BGF, 1BCG, 2XAP, 2BML, 8AQO.

Free period: 1NX, 2ZK, 2EL, 2ZS, 3HG, 3FX, 3HM.

Working DX: 1BRQ, 1MBG, 8MZ.

Dec. 13, 1922

Codes verified: 2ZK, 2AWF, 8AQO, 8ATU.

Free period: 8AQO. DX: 1BDJ.

Dec. 14, 1922

Codes verified: 1ZE, 2ZK, 8AQO.

Free period: 2NZ, 2ZK, 3ZY, 3HG, 3FA, 8UE, 8BU.

Working DX: 1BET, 1BDT, 2LI, 2EL, 8LA, 9OM.

Dec. 15, 1922

No codes verified.

Free period: 1BCG, 1YK, 1BDT, 1GV, 2AHO, 2BLF, 3XM, 3ZW, 8ATU, 8AQO.

Dec. 16, 1922

No codes verified.

Free period: 1BED, 1BGF, 1OR, 2AWL, 2BLM, 2HJ, 2XAP, 2NZ, 2ZK, 3ZY, 8ATU, 8XE.

Working DX: 2AW (probably British).

Dec. 17, 1922

Codes verified: 1YK, 2ZK.

Free period: 1BDA, 1BDI, 1BRQ, 1CDX, 1CMK, 1BCG, 2AYV, 2BGL, 2BLK, 2LI, 3BGT, 3HG, 3ZY, 6AV, 8AWF, 8AZO, 8BSL, 8BSS, 8LA, 8AQO.

Working DX: 1BAT, 1NI, 1BCG, 3XM, 8AQO.

Dec. 18, 1922

Codes verified: 1ASF, 1XM, 1BET, 2AWL, 2GK, 2LO, 2ZK, 3BLF, 9DWK.

Free period: 1BDF, 1BDK, 1BDT, 1YK, 1ZE, 1ARY, 1BCG, 2GK, 2NZ, 2RP, 2ZK, 3HZ, 3HG, 3ZW, 3ZY, 8AX, 8AZ, 8AQO, 8AWP, 8AW, 8BSY.

Working DX: 1XZ, 1GH, 1MV, 1XU, 1SOK (obviously n.g.), 2AF, 2EI, 2EL, 2AAA, 3XM, 6KA, 8AQO.

Dec. 19, 1922

Codes verified: 1AKG, 1AGK, 1ASF, 1XM, 1GV, 2GK, 2AWF, 2EL, 8AQO, 8AIO, 8BXH.

Free period: 1AGK, 1BDT, 1AKG, 1DNI, 1XU, 2CJW, 2ZK, 2CBX, 2CQZ, 2EL, 2CPD, 2ER, 2RP, 2XAP, 2XC, 2ZS, 3EX, 3HG, 3SG, 3FX, 3ZY, 6KB, 8AQO, 8AWP, 8BU, 8MZ, 9OM, 9DWC.

Working DX: 1ADL, 1AW, 1BS, 1OR, 1AGK, 1ZE, 2ZK, 3XM, 3BG, 8BTV, 8AQO, 8UE, 8BSS.

Dec. 20, 1922

Codes verified: 1BCF, 1BFP, (error; no such station qualified); 1CMK, 1CNF, 1GV, 2CQZ, 2EL, 2LO, 2XAP, 3ZW, 8AQO, 8AWP, 8BK, 8BXH, 8IB, 8ML 8UE.

Continued on page 90

REMARKABLE WORK ON ONE TUBE WITHOUT ANTENNA

By LAWRENCE R. BABIZE

I am located at Auberry, California, about 40 miles northeast of Fresno. Am operating telegraph line for Edison Co. and have installed a small receiving set and am sending a list of the amateurs I hear on one tube, without antenna. I am using telephone line 80 miles for a ground. It helps strengthen the theory of what can be done without use of an aerial.

On night of December 19th the following were heard: Homemade CR5, vry QSA. Other 6's too numerous. C. W.: 6BIQ, 6BKX, 6EB, 6EC, 6BBE, 6ZH, 6NX, 6BQ, 6BNV, 6BES, 6EF, 6BVE, 6PI, 6BQF, 6AWT, 6CC, 6GX, 6ARF, 6BM, 6BNU, 6DD, 6FE, 6BWP, 6BFP, 6AIY, 6VF, 6RM calling ZHBBA**, 6BHR, 6BAE, 5ZA Voice and C. W., 5CN, 7ZF, 7HJ, 7TH causes QRM HR, 7ZO vry QSA working 7TH, 8BFM HRD 7:50 p.m., 9DQA, 9AYA, Canadian 4BV.

Spark 6DA vry QSA, 6PL, 6MH, 6BJU vry QSA, 6BNU, 6ABX, 6BNT, 6AHR, 6BAJ, 6BAJ, 6AJU, 6AUD, 6AWX, vry QSA, 6TF, 6KC vry vry QSA, 6AW, 6BCNQ SA, 6BCN, 6OD, 6OM.

These calls only represent just a few hours of listening and hear many other sixes of short distances from me but too numerous to log. However, I keep log of everyone I hear and anyone wishing dope on their QRK please let me know.

Have had some interesting experiments here with the set trying different phone lines as aerials and grounds. Sometimes I use one leg of the line that runs to Big Creek for antenna and use another leg of another line as a counterpoise. Music from KHJ (L. A. Times) audible one foot from phones and 600 meter sparks too numerous to log.

"DX DOPE" FROM 6ZAG, WAILUKU, H. T.

By C. J. Dow

6ZAC is excellent QSO 9AWM nightly, handling msgs direct, and in good shape. Worked him as many as 6 consecutive nights. He gets me 15 feet from fones on one step and spider-webs, when no QSS. I get him 40 feet from fones 2 steps. He's using 250 watter; I'm using 50 watter.

Dec. 5th worked both 5TC and 5SF, of Ft. Worth, Texas. It's about 3,600 miles to 'em. Dec. 6th worked 5DI, Houston, Texas, further yet. Also worked 9BJI, in Denver, few weeks ago, and gave him a msg one sending. Sez "Vy QSA" consistently. 5TC used a 5 watter to work me, while 5SF uses ten watts, and 5DI 25 watts. Hi! I have used 50 watts entirely this season.

6ZAC is no more now, as I've sold out, and am leaving for the coast in a very short time. 6ZY will uphold the Hawaiian end of amateur radio very shortly with a 500 watt transmitter.

My last list of calls heard and worked follows: 1bet, 1cmk, 1xu, 2awl, 3blf, 4bv, 5aby, (5di), 5fx, 5cn, 5ik, 5ir, 5kp, 5nn, 5px, 5qy, (5sf), 5sm, (5tc), 5tj, 5wsy, 5xv, 5xad, 5za.

(6ak), (6ajr), (6arb), (6ajf), (6asj), (6avd), (6avr), (6awt), (6bsa, phone also), 6bbh, (6bjp), (6bgh), 6bqg, (6bql), 6bvq, (6bcr), (6cc), (6ea), 6eb, 6gf, (6gr), 6gx, 6cu, (6ka), 6jd, 6pi, (6tc), (6ti), (6tq), 6xb, phone, 6xaf, (6ze), (6zi), (6zn), 6zaf, 6zg, 6zz.

7abb, 7adp, 7bb, 7bj, 7bk, (7mf), 7ri, (7sc), 7sy.

8aa, 8ab, 8acx, 8aip, 8asv, 8axn, 8axc, 8bk, 8bdv, 8cp, 8cur, 8cgx, 8ib, 8ju, 8vq, 8zac, 8zag, 8cmi.

9aap, 9aav, 9aps, 9apw, 9aou, 9aog, (9awm), 9aul, 9bbf, (9bji), 9bed, 9bjv, 9bp, 9bgh, 9bvy, 9ccm, 9cxp, 9cuc, 9cgk, 9dtj, 9ou, 9qu, 9uu, 9xp, 9yaj, 9yw, 9zn.

Spark: (6ex), 9auu.

DX AT 6XAD FOR DECEMBER

By MAJOR LAWRENCE MOTT
Signal-ORC-USA

It gives me pleasure to add to my former DX lists—the following stations: (2FP), (3ARO), 1CNF, 1XZ, 1AUN, 2HW, 2BRD, (2BFX), 2BKJ, 2KF, 2AXF, (2EL)—Freeport, L. I., N. Y., 2AWM—East Orange, N. J., 2CMJ—New Rochelle, N. Y., H. Resch—Bayonne, N. J., J. H. Reynolds—Passaic, N. J., 2BSC, George Kline—Elizabeth, N. J., 2LO, 2AWF—in full daylight (Albany, N. Y.), 3XM, 3OT, 3BYA, 3IW, (3BLF), (3CC), 3ABW, 3TA, 3AUP, 3ZE, 4OI—Porto Rico, 4BX, Wilmington, N. C., 4BL—Lakeland, Flor., 4FS, "FZ", U. S. S. tran. *Canopus,* off North Carolina coast, 5WE, 5AU, 5ZAS, 5AL—Canadian, 5CI, 5LY, 5JL, 5AER, 5KC, 5AVH, 5CN, (7PF), 7AFH, 7RI, 8ZB, (8CKO), (8CPD), (8BVD), 8ACF, (8CQL), 8OC, 8AFK, (8AZF), 8UP, 8BDA, 8AAF, 8BM, 8ADB, (8QC), 8AOI, 8CMI, (9BYA), (9BRK), 9AVX, 9CPD, (9DMA), (9AOU), (9AZP), (9CNS), (9ZN), (9DNC), (9AXU), 9CP, (9BIK), 9AJH, 9BCH, (9ARZ), 9BTA, 9CXP, (9AAW), 9BPY, 9BIJ, (9BIE), 9HW, 9BCT, (9DSL), (9CJE), 9CNV, 9QF, 9BJB, 9AFN, (9KP), (9AAV), W. Meyer—Freeport, Ill., 9AIY, 9BUG, 9DXD, (9XAC), 9CJV, 9CGD.

The correct address of 6AGJ is Chas. W. Holdiman, 565 Spencer Ave., San Jose, Calif. The name and address is incorrect in the available call-books. He is now on the air with 100 watts C. W.

9ST has been assigned to W. W. Weedfall, 3407 Olive St., Kansas City, Mo.—10 watts C. W.

SOMETHING NEW FROM 6ZY, HONOLULU

By THOS. A. MARSHALL

Hawaii has the record for DX work. This is quite true in many ways. The writer has copied amateurs from every district in the United States. On December 13th 1BCG, Greenwich, Conn., was heard in broad open daylight, which was 3:54 p.m. Hawaiian local time, sending ZHCCN his secret code group. His signals were fairly QSA, even and dependable. This is a remarkable feat considering the power he employs and the distance of over 6000 statute miles which his signals had to travel to reach Honolulu.

The following amateurs and their secret code groups were logged on the nights of Dec. 12th and 13th.

Call	Code	Time	Location
1BCG	ZHCCN	3.54 p.m.	Greenwich, Conn.
1BDI	TEST	6.18 p.m.	Orono, Maine.
2GR	GE OM de 2GR	7.05 p.m.	Nutley, N. J.
2ZS	9LT de 2ZS	6.06 p.m.	Unlisted.
3AAO	DHYDY	6.14 p.m.	Washington, D.C.
3BV	SGTTI	4.50 p.m.	West Chester, Pa.
3BLF	2 msgs sent to 4CG intercepted.	4.15 p.m.	Richmond, Pa.
5PX	SPKKY	5.02 p.m.	Fort Worth, Tex.
5EK	AICCB	6.31 p.m.	Memphis, Tenn.
5XK	ZTVVV	5.15 p.m.	Knoxville, Tenn.
6KA	TAVVU	3.58 p.m.	Los Angeles, Cal.
6ARB	PWRRQ	6.47 p.m.	San Francisco, Cal.
6ZH	BZHEH	6.40 p.m.	San Ysidro, Cal.
6RM	ZHBBA	5.49 p.m.	Salt Lake, Utah.
6EN	GOKKI	7.10 p.m.	Los Angeles, Cal.
8ZY	CCIWG	6.58 p.m.	Defiance, Ohio.
8ATU	NVRRP	7.07 p.m.	Sydney, Ohio.
8BK	LURRW	4.16 p.m.	Cleveland, Ohio.
8AQ	SSAEE	4.58 p.m.	Detroit, Mich.
8BPL	OBBKY	5.11 p.m.	Swissvale, Pa.
8BEO	VTZZX	7.42 p.m.	Watertown, N.Y.
8SP	ALJJG	4.57 p.m.	Fairmont, W. Va.
9ZN	APPCX	6.23 p.m.	Chicago, Ill.
9GK	DTHHP	5.48 p.m.	Fargo, N. D.
9BEY	DRRZO	5.03 p.m.	Oak, Nebr.
9ASF	TEST	4.04 p.m.	Aberdeen, S. D.
9XAC	TFDDU	5.06 p.m.	Rock Island, Ill.
9AOU	GUIIC	4.56 p.m.	Eagle Grove, Iowa.
9YAJ	QGTTB	5.36 p.m.	Bedford, Iowa.
9CMK	VTXXS	4.30 p.m.	Unlisted.
9DSM	OCQQY	5.49 p.m.	Omaha, Nebr.

I have about 40 more "8" and "9" stations logged with their secret code groups but cannot publish these fellows due to limited space. Some of them are included in the following:

2pw, 2po, 3yo, 4id, 4kk, 4bv, 5ak, 5sm, 5uj, 5gi, 5tc, 5cn, 5lf, 5za, 6xad, 6cbi, 6boo, 6bcr, 6cc, 6brf, 6bvw, 6if, 6biq, 6xk, 6en, 6xu, 6bjq, 6bqf, 6bpx, 6zz, 6bqc, 6bjy, 6ku, 6anh, 6ajr, 6awt, 7bj, 7adp, 7an, 7hg, 7nm, 7sc, 7sf, 8ab, 8sp, 8vy, 8azd, 8bke, 8bqc, 8ey, 8fu, 8aiw, 8dae, 8na, 8aim, 8brm, 8cur, 8asv, 8axc, 8awp, 8bdw, 8cgp, 8cgx, 8caa, 8ft, 8qk, 8ue, 8xe, 8zy, 9dqu, 9dsd, 9ps, 9kp, 9aph, 9dqm, 9avc, 9aw, 9bju, 9bri, 9bed, 9abu, 9biw, 9afk, 9blg, 9anq, 9bxq, 9bgh, 9bbf, 9bkh, 9bqw, 9bbs, 9bkp, 9bhi, 9bch, 9cr, 9ccv, 9cde, 9dxn, 9dqm, 9lz, 9zn, 9yaj, 9bji.

NEW RADIO REGULATIONS IN AUSTRALIA

New regulations for the control of wireless communication in the Commonwealth have been approved by the Governor-General, and will come into force on December 1. These regulations are very comprehensive, and provide for the control of the many new branches of the science. Important alterations in the laws governing amateur stations are contained in the regulations, and, as a result of these alterations, amateur operators will enjoy a great deal more freedom than they have had since the war.

The most important clause relating to amateur stations is one removing the ban on amateur transmission. Under the new regulations, amateurs will be permitted to use transmitting apparatus, subject to certain conditions that will be imposed by the controller of wireless (Mr. J. Malone) for the prevention of interference with commercial stations. Mr. Malone proposes that amateur transmitters shall be restricted to two bands of wavelengths. One from 150 to 250 meters shall be used for all classes of transmitting stations, and the other band, 410 to 440, will be reserved for wireless telephone transmitters and continuous wave transmitters. The following restrictions as to type of transmitter and power will be imposed:

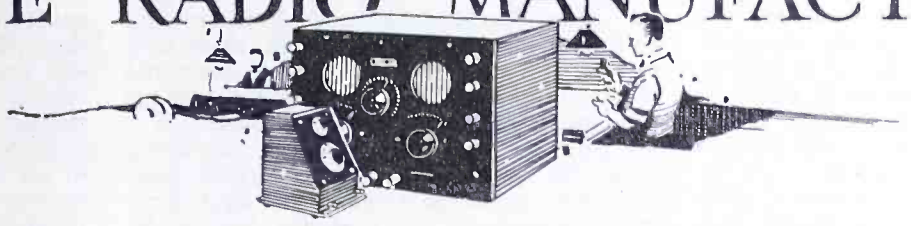
All stations within a radius of five miles from any defence or commercial station will be limited to a power of 10 watts, and only continuous wave transmitters, modulated continuous wave transmitters for Morse signalling, or wireless telephone transmitters will be permitted within this radius. The use of "spark" transmitters will be prohibited. Outside the five-mile radius and within a radius of 50 miles from a government or commercial station all types of transmitters except those of the "plain aerial" type, will be permitted, but the power of the transmitters will be limited to 20 watts. Outside the 50-mile radius any type of transmitter, of which the power does not exceed 250 watts, will be licensed. The regulations provide that before any transmitting license is granted the applicant will be required to show that he is a bona-fide experimenter, and he will be required to furnish particulars of the experiments he proposes to carry out. Applicants must also show that they have sufficient technical knowledge and operating ability to work their transmitters without causing interference with other stations, and if required to do so by the controller of wireless must sit for an examination to demonstrate their knowledge. A fee of 5/ will be charged for this examination.

FEES AND LICENSES

Another matter of importance to experimenters is the annual license fee. Under the new regulations this fee will be reduced from £2 a year to 10/ a year for a receiving license and £1 a year for a license for both transmitting and receiving. No age limit is

Continued on page 89

NEW APPARATUS & SUPPLIES FROM THE RADIO MANUFACTURERS



THE NEW CUNNINGHAM TUBE

Representing one of the most radical advances in the history of the vacuum tube design, the new Cunningham tube type C-301-A developed in the laboratory of the General Electric Co. has made its appearance this month and is available for general sale. This tube possesses three advantages over existing designs, in that it has greater power amplification, extremely low power consumption and longer life. In appearance, the tube is much like its predecessor, except that it is more rugged in construction, the elements being somewhat larger, and the plate having crimped edges.

The New ¼ Ampere Cunningham Tube

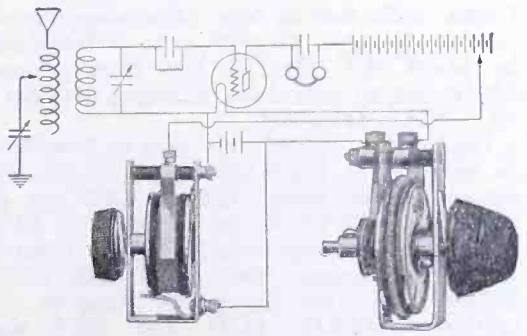
The filament current is .25 ampere at 6 volts, the filament resistance averaging about 25 ohms. The current can be varied from .22 to .28 ampere without affecting the amplification, so that the tube can be used without a filament rheostat, on a six volt storage battery, through its entire discharge period. However, as current in excess of .25 ampere will materially shorten the life of the tube, a filament rheostat of considerable resistance is recommended, in order to provide the necessary protection against too high a filament current. The ordinary filament rheostats of from 2 to 4 ohms will not provide sufficient resistance when used with this tube, and rheostats of from 10 to 20 ohms will be necessary for proper adjustment, where the maximum life is desired.

As the tube fits in the standard socket, it has an advantage over the so-called "peanut" or dry cell tube, which requires an adapter or special socket for use with existing radio equipment. The new tube has a high amplification constant, and will deliver a greater energy output than the older styles.

As a radio frequency amplifier it functions admirably, its low internal capacity permitting its use in radio frequency circuits. It is a good detector, requires 25 volts on the plate when used as such, and while the C-300 gas content detector is more sensitive, it will be very useful in detector circuits. As an audio frequency amplifier it will operate with plate voltages as high as 120, although a negative grid potential of at least 9 volts must be maintained with 120 volts on the plate. For a plate voltage of 80, the grid biasing voltage should be 4½ volts, and for 40 volts plate, the grid voltage should be 3 volts. At the higher plate voltages it has a plate impedance of about 12,000 ohms, rising to 18,000 ohms at 40 volts plate potential, so that it will fit in any circuit designed for the C-301 amplifier.

NEW POTENTIOMETER GIVES SUPERSENSITIVE RECEPTION

The range of most receiving units can be increased considerably through the use of a properly designed potentiometer shunted across the *A* battery. The vernier rheostat gives just the precise control necessary for the correct electron flow from the filament of the tube, but to obtain maximum efficiency all three circuits of the triode must be adjusted with accuracy.

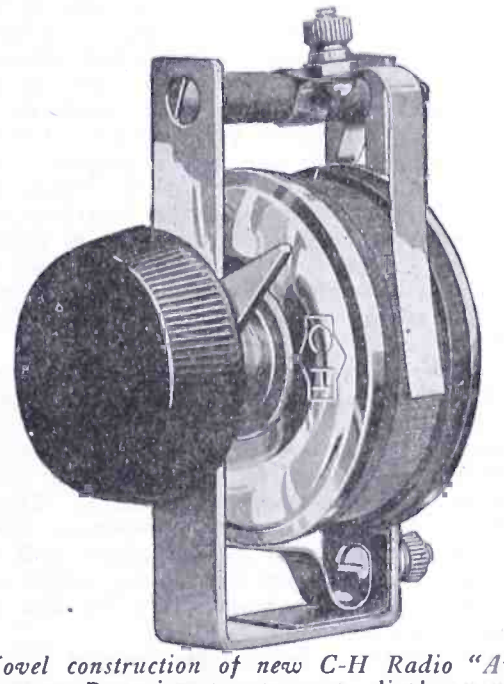


C-H "A" Battery Potentiometer — *C-H Vernier Rheostat*

Diagram showing use of vernier rheostat and potentiometer in radio receiving circuit.

The plate circuit is actuated by the *B* battery, which is usually of the dry cell type—18 to 24 volts. When properly connected, the *A* battery serves as supplementary voltage in this circuit, and through the medium of a potentiometer the *A* battery potential can either be added to or subtracted from that of the *B* cells. Since this potentiometer shunts the storage cell it must be of high resistance, and because of this high resistance, the control is extremely fine.

It is plain that in an instrument of this type for use in a radio receiving cabinet, size is an important item, and to condense a resistance of more than 200 ohms into a suitable panel type instrument entails considerable engineering. The Cutler-Hammer Mfg. Company, long known as builders of rheostatic control apparatus, has just brought out a potentiometer for this work which matches exactly their well known radio rheostats. It—like the rheostats—is of the revolving drum type and beautifully finished in dull satin



Novel construction of new C-H Radio "A" Battery Potentiometer prevents displacement and wear of resistance wire under constant usage.

nickel and ebony black. A highly polished nickel indicator and cone shaped knob of Thermoplax appear on the front of the panel, harmonizing exactly with those details of the C-H radio rheostats.

This new potentiometer is designed for long life and steady operation. A range of 300 ohms is provided and the broad, flat contact on the tightly clamped resistance unit insures that the wire will not be damaged or displaced under constant usage. The instrument is designed for panel mounting and is provided with binding posts to facilitate wiring.

NEW RADIO CATALOGS

A complete information book regarding Cunningham Vacuum Tubes is being distributed by E. T. Cunningham of San Francisco. This includes not only illustrations and specifications of the detector, amplifier and power (5, 50 and 250 watt) tubes, but also general instructions for their care and operation. A wide variety of hook-ups are given together with many graphs that will aid in getting maximum results and life.

The Radio Research Club of the Springfield (Ill.) High School is publishing an interesting four-page paper, *Radio Research,* as a local medium for exchange of experiences and ideas.

Radio Bulletin No. 180 from Betts & Betts Corp. of New York City is descriptive of the Betts visible detector amplifier type D2A, loud speaker and other radio apparatus.

RADION HARD RUBBER PANELS

So much misinformation has been broadcasted on the subject of insulating materials for radio use, particularly panels, due in part to a misunderstanding as to what are the real needs and requirements of the manufacturer, dealer and amateur, that it is well to put down some important phases of this subject for the consideration, particularly, of the man who builds his own set. Generally, insulation used in the radio industry can be divided into three broad classifications: hard rubber compounds, phenolic compounds and laminated phenolic compounds. The last two are somewhat similar in general characteristics and may be considered together.

Hard rubber is a compound of rubber with sulphur and other suitable ingredients mixed in certain proportions, depending on the use to which it is applied, and vulcanized over a pre-determined number of hours to obtain definite mechanical and electrical properties. Hard rubber has been used in the electrical industry for upwards of 70 years. It is perhaps more familiar to the consumer in the form of telephone receivers than any other electrical use to which it is applied, although there are a thousand different uses in the electrical industry where hard rubber is desirable, and from the very inception of wireless, hard rubber has been employed as insulation, particularly for panels. During the world war, for example, the American and allied governments used thousands of pounds of hard rubber for wireless work, and required very strict adherence to electrical specifications on account of the extremely high frequencies.

Radio engineers have definitely determined that there are four special characteristics which must be considered in any insulating material adopted. They are: low phase angle difference, low dielectric constant, high resistivity and non-absorbent qualities. Therefore whatever material possesses these characteristics to the greatest extent, plus the practical mechanical advantages which are also necessary, is undoubtedly the best insulating material for radio use.

Unless the best obtainable material is used, there are going to be certain current losses which substantially reduce the character of the results obtained in receiving or sending wireless messages, music or other broadcasting. In receiving, for example, the current impulses of high frequencies are all very low power, and consequently any losses whatever seriously effect the result, so it is most desirable to obtain the utmost protection by selecting an insulating medium having those properties which are most advantageous.

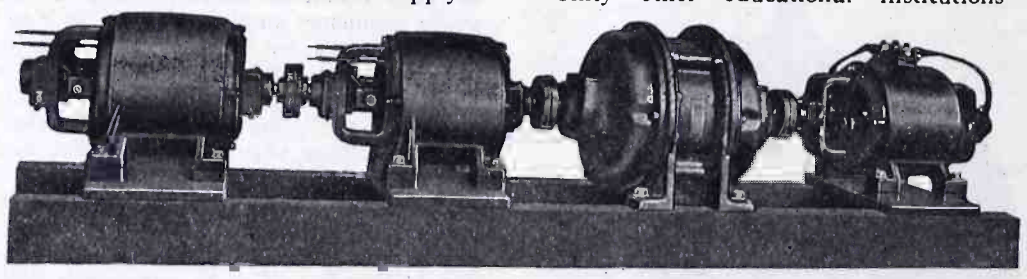
Hard rubber is produced in various grades for various purposes. Some grades are naturally better than others, so that merely the selection of a hard rubber panel is not enough to insure the best results. One must select the particular *grade* of hard rubber best adapted to the purpose. With this idea uppermost in mind, the American Hard Rubber Company some time ago conducted a series of experiments in their extensive research laboratories, utilizing the benefits of many years of experience in the production of hard rubber compounds, to determine the best compound that could be developed for radio work. The result of these experiments was the production of a material now known as Radion. Radion possesses excellent electrical values and definite mechanical properties for radio work.

Tests made by the U. S. Bureau of Standards show that Radion has a considerably smaller phase angle difference and dielectric constant and considerably higher resistivity than the phenolic and laminated phenolic materials tested. It also has a smaller absorption of moisture in air and in water. Furthermore Radion may be drilled without chipping and rough edges around the holes. It may be readily filed, sanded, engraved, stamped, etc. The panels have a high, satin-like polish, or by rubbing with sandpaper may be given a flat dull finish. It is regularly made in black, brown and mahoganite colors.

The manufacturers of Radion also make the dials, having the tapered knobs and drilled to take 3/16 in. or ¼ in. shaft with set screws; also the V-T socket, tubing and other moulded parts. The Radion antennae insulator is another item of importance, as it not only possesses the well known insulating properties of Radion to protect against leaks and losses, but it has a remarkable mechanical strain resistance for strength, having by actual test withstood a strain of ½ ton as against something like 400 lbs. for the ordinary aerial insulator of the same size. It is fitted with deeply imbedded galvanized, rust-proof eyelets.

ESCO 4000 WATT M.-G. SET

The latest product of the Electric Specialty Co. of Stamford, Conn., for the use of the radio transmitter is the form unit motor generator illustrated herewith. This is designed for an unusually large station. It has three generators, all driven by a 10 h.p., 220 volt, 60 cycle three phase motor. Two 1000 volt, 2000 watt generators are driven in series to produce 4000 watts at 2000 volts for plate current. One 12 volt generator furnishes 2000 watts to the filament current supply.



Esco Four-unit Motor Generator Set

The Electric Specialty Co. has recently received many letters from satisfied users of their radio motor generator sets. These include 1BCG, 1GR, 2NZ and 2CCD, all of whose C. W. signals have been heard in Hawaii and England. Others are 1BGF, 2ZK, 2ZL and 8AQU, all of whom were heard in England during the recent trans-Atlantic tests.

AMATEURS HEARD ACROSS THE PACIFIC

Howard A. Cookson, operator on the *China,* under date of Nov. 11, advises that on October 28, when 91 miles west of Honolulu, he heard 6CC Qsa 10 feet from phones, 6AHR Qsa all over room (Cussing MG Set), 6TI, 9ZAF (Denver).

On October 29, 361 miles west of Honolulu, he heard 8YD (East Cleveland, Ohio), and copied the following "Test de 8YD test de 8YD ex 8AGZ 8AGZ test test de 8YD 8YD ex 8AGZ" Sigs very clear and QSA. Coming in great. Distance from 8YD 5300 miles. Believe this new record for amateur reception. 6XAD, (5JH and 9ZN sigs doubtful).

October 30, 650 miles West Honolulu, 6TI.

December 7, off coast of Japan, 6CC, Colusa, Calif.

Erratta Note: Credit to William H. Smith, 1224 Taylor St., San Francisco, was inadvertently omitted in the caption of "The Radio Fisherman," as printed in January RADIO.

An illustrated descriptive price list from the Dubilier Condenser and Radio Corporation of New York City shows their various Radio Receiving Products, including their Ducon, their Variadon variable condenser, their Du-tec chemical rectifier to replace natural crystals and their Micadons.

RADIO EXTENSION TEACHING

The importance of radio broadcasting as a means of reaching a large number of listeners in the United States, otherwise inaccessible, is being forced home to us every day. There are in the United States between one and one and one-half million radio receivers, representing between three and four million radio listeners located within comfortable range of the speaker's voice of one of six hundred broadcasting stations, that is stations equipped to send out telephonic communications. These listeners are for the most part youthful—of school and college age. Their number is rapidly increasing and will undoubtedly, within a very few years, total many millions of such radio listeners.

The National Radio Chamber of Commerce appreciates the tremendous potentialities of this new channel of communication in the field of education and desires in some practical way to support colleges and universities in extending their influence through radio extension courses to these listeners, a large proportion of whom would not otherwise be reached. Several prominent institutions of learning in the United States have made a beginning in this direction and their reports of the encouraging success attending their efforts show us that the possibilities of the new method are not under-estimated.

Sixty other educational institutions are broadcasting educational and musical programs, forty-seven of them being colleges and universities. The combined area nominally covered by these institutions has been estimated to be seven or eight times the total area of the United States.

England and Germany, it may be of interest to note, have quickly grasped the significance of radio telephony as a means of educational contact and preparations are being made to broadcast university extension courses in those countries.

Extension lectures may be broadcasted from the college or university without in any way interfering with the local audience within the school, and it is not now necessary that the school have its own broadcasting station, but may use a powerful central station nearby connected therewith by the microphone in the lecture room. In some instances the lectures are being followed up by questionnaires and suggested reading, which are mailed to the listeners upon request and examination sheets following at the end of the course.

The pioneers are already active in the field and the situation seems to indicate not only individual but concerted action on the part of schools of recognized standing to take advantage of this wonderful opportunity.

There are, however, a great many intricate problems connected with the subject of broadcasting, which the National Radio Chamber of Commerce hopes to see solved within a comparatively short time. Their engineers have collected much data which they will cheerfully place at the disposal of those educational institutions interested and will be glad to render every possible assistance to them in reaching a clear understanding of the situation, as its only interest in the radio field is to see that radio broadcasting assumes, in the course of its evolution, a sound economic position of greatest possible usefulness.

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

By 6BEZ, Piedmont, Calif.

C. W.: 2zs, 3xn, 4eb, 4eh, 4ya, 5ek, 5hb, 5ir, 5ka, 5kc, 5mo, 5mt, 5my, 5nk, 5px, 5qy, 5rh, 5sm, 5tj, 5vo, 5vs, 5xad, 5xaj, 5xd, 5xk, 5za, 5zak, 5zas, 5zs, 7abb, 7aby, 7adf, 7adp, 7aem, 7afs, 7aft, 7agv, 7bj, 7cz, 7du, 7ex, 7ey, 7hm, 7lr, 7nf, 7nj, 7pf, 7qf, 7qn, 7ri, 7sc, 7sy, 7th, 7tq, 7tt, 7ud, 7wm, 7wx, 7zb, 7zk, 7zo, 7zv, 8aim, 8akc, 8asv, 8awp, 8axb, 8axc, 8azd, 8bdo, 8bdv, 8bef, 8bfm, 8bfx, 8bk, 8bke, 8bpl, 8bxa, 8bxh, 8caa, 8cf, 8cgx, 8coz, 8cgp, 8cur, 8ft, 8hn, 8ib, 8iq, 8jj, 8kg, 8ow, 8qk, 8sb, 8xae, 8xe, 8yd, 8zaf, 8zy, 9aap, 9afk, 9ahh, 9aix, 9ami, 9amu, 9ani, 9anq, 9aon, 9aou, 9apr, 9aps, 9arz, 9asf, 9aul, 9avc, 9avz, 9awm, 9ays, 9aza, 9bbf, 9bdb, 9bds, 9bed, 9bey, 9bik, 9biy, 9bji, 9bjv, 9bkp, 9bly, 9bm, 9bp, 9bqw, 9bri, 9bsq, 9bud, 9bvo, 9bxa, 9bzi, 9cba, 9ccv, 9cfy, 9chk, 9cns, 9cr, 9csc, 9djb, 9dky, 9dqm, 9dsm, 9dte, 9dyn, 9ei, 9ff, 9fm, 9gk, 9ii, 9kky, 9kn, 9kp, 9lq, 9lz, 9na, 9pi, 9ps, 9pw, 9qf, 9rc, 9xac, 9xaq, 9yaj, 9zaf, 9zn, 9zt; WGY.

C. W. Canadian—3co, 3dh, 3xn, 4bv, 5cn, 5ct, 9ac, 9al.

By 5XAD, 5QY, Orange, Texas, Dec. 10, While 100 to 150 Miles S. and S.W. Burwood, La.

C. W.: 5xv, 9bct, 5di, 5kc, 5yg, 9anz, 4iz, 5my, 5ji, 5vy, 1ajp, 9tm, 3bvl, 2avu, 3mb, 3bof.

By F. L. LaBarba, 623 No. Hill St., Los Angeles

All districts heard. All C. W.

C. W.: 1cmk, 1cvj, 2fn, 2zl, 2fp, 3oy, 3bv, 3ot, 4ft, 4oi, 5cn, 5di, 5ek, 5ir, 5kc 5ns, 5px, 5th, 5xd, c. w. voice-music, 5za, 5zak, 5zav, 5xr, 6zu, (cw voice, music) 6zac, 6's too numerous, 7ad, 7adp, 7aea, 7aem, 7aw, 7bcr, 7bj, 7fd, 7alg, 7fg, 7la, 7lr, 7mf, 7na, 7nx, 7om, 7qt, 7sc, 7to, 7th, 7ua, 7xl, (cw voice, music) 7yg, 7zt, 7zo, 7zu, 7zm, 8aaf, 8amt, 8anb, 8aqo, 8atc, 8bxx, 8sp, 8xj (cw voice, music), 8zy, 9abx, 9amb, 9aza, 9bed, 9bji, 9bp, 9bxq, 9cba, 9cf, 9cmi, 9cx, 9awm, 9dtm, 9gk, 9rk, 9rc, 9uu, 9xa, 9xu (cw voice, music), 9xv (cw voice music) 9zaf, (cw voice, music) 9zn, 9zt, 9yaw.

By 7RI, Montesano, Wash.

C. W.: Can.—4bv, (4dq), 5cn, (5ct), 9ac; U. S.—4hh, 5acf, 5ade, 5avr, 5di, 5ek, 5px, 5tj, 5za, (6ak), 6ar, 6aw, 6aat, (6abx), 6ajh, 6alh, 6alv, 6amw, 6amz, 6aoi, 6arb, (6arf), 6asx, 6atc, 6auu, 6avr, 6avv, (6awt), 6bbk, 6bc, 6bcj, 6bcl, 6bcr, 6bic, (6bin), 6biz, 6bjk, 6bjq, 6bkj, 6bmd, 6bsj, 6bob, 6boe, 6bum, 6bqg, 6bqc, 6bsa, 6bsy, 6bun, 6bvz, (6cc), 6cp, 6dd, 6ec, (6esm), 6ff, 6ft, 6gf, 6hm, 6jd, (6ka), (6ku), 6lf, 6lo, 6nx, 6pi, 6rd, 6rm, 6su, 6sz, 6tc, 6ti, 6uw, 6vf, 6vm, 6wm, 6xac, 6xad, 6xav, 6xwi, 6zzb, 6zf, 6zh, 6zi, 6zx, 7aad, 7abc, (7abb), 7abh, 7aby, (7adg), (7adm), (7adp), (7aea), (7aem), 7afb, (7afh), (7afs), (7ahw), (7aiu), (7bj), (7cz chopper), (7dp), 7eb, (7eq), 7fr, 7hm, 7hs, 7jf, (7ke), (7lr), 7lu, (7mf), 7ne, 7nc, (7ng), (7ot), 7om, (7qf), 7jg, (7jw), (7qt), (7rn), 7rw, (7pb), (7sy), 7sz, 7th, (7tq), 7tt, (7ud), 7vf, 7wg, (7wm), (7wq), 7xb, 7xg, 7zb, 7zk, 7zo, (7bz), 8ab, 8cur, 8ib, 8ahh, 9anq, 9asf, 9arz, 9bed, 9bji, 9bm, 9gk, 9lf, 9pi, 9pn, 9bbf, 9zaf, 9cmk.

Spark: 6abw, 6acr, 6akt, 6alx, 6amk, 6apw, 6ark, 6awh, 6aww, 6bcj, 6bes, 6bip, 6bjy, 6btb, 6bu, (6bus), 6iw, 6lu, 6tu, 6qr, 6qv, 7abh, 7abs, 7aea, 7aem, 7afw, (7ge), 7aic, 7ba, 7bh, 7bj, 7bq, 7bw, 7fq, 7ch, (7hd), 7jf, 7jw, 7mu, 7mw, 7ni, 7ny, 7ot, (7ro), 7tw, 7vq, 7wf, 7zg, 7zu, (7bz), 9ab, Can. 9bd.

Fone: (7aea), (7afs), (7mf), (7qf), (7rn), 7xi, 7xl, 7zu, (6ku), 6xac, 6xb, Can. 9ac.

By 9APR, Olds, Iowa, (One Tube)

C. W.: 1un, 2ud, 2xao, 3awf, 3bvl, 3sv, 4bg, 4lp, 4vn, 5aam, 5aas, 5ak, 5aec, 5afg, 5cy, 5di, 5ek, 5fv, 5hc, 5hz, 5ix, 5jl, 5kk, 5me, 5mx,, 5na, 5nv, 5pv, 5qi, 5rn, 5rr, 5sa, 5sf, 5ta, 5te, 5tek, 5ttu, 5uk, 5we, 5wu, 5xt, 7bq, 8ad, 8aea, 8aeg, 8afw, 8ago, 8aiw, 8anj, 8an, 8apn, 8aps, 8apw, 8atc, 8atu, 8bad, 8brc, 8bsy, 8bnj, 8caq, 8cdz, 8cws, 8dfm, 8dly, 8dr, 8dv, 8dzy, 8ib, 8tt, 8uz, 8vp, 8xt, 8zk, 8zz, 9aak, 9abv, 9acq, 9acu, 9aic, 9ail, 9ais, 9am, 9ap, 9ar, 9ard, 9ark, 9arz, 9asj, 9atc, 9atk, 9auk, 9auz, 9avk, 9aws, 9axt, 9ba, 9bar, 9bay, 9bbf, 9bcf, 9bdr, 9bed, 9bet, 9bfq, 9bie, 9bjn, 9bks, 9bq, 9bqt, 9brk, Can. 9bs, 9bud, 9bxt, 9btt, 9byt, 9bzi, 9bzu, 9bzz, 9cbq, 9cbz, 9ccs, 9ccv, 9ce, 9cfk, 9cip, 9bgh, 9cja, 9cjj, 9ck, 9coi, 9cp, 9cr, 9cs, 9csf, 9cvv, 9cwa, 9cxz, 9dag, 9daw, 9dcr, 9ddr, 9ddy, 9df, 9dgf, 9dgn, 9djb, 9dky, 9dl, 9dlk, 9dk, 9dpr, 9dsm, 9dsn, 9dsy, 9dtg, 9dtm, 9dtt, 9dun, 9dup, 9dw, 9dwp, 9dwq, 9dxt, 9dyu, 9dzu, 9dzw, 9dzy, 9dak, 9eb, 9ecz, 9edu, 9ff, 9of, 9pv, 9ii, 9qa, 9qu, 9qf, 9zt.

Spark: 9asq, 9bmu, 9dag, 9dwx, 9dx.

By 9CIP, 480 Grand Ave., St. Paul, Minn.

All C. W.: 1gv, 1qp, 1xu, 1adl, 1akg, 1alz, 1bet, 1bjn, 1bka, 1brq, 1bwj, 1cdr, 1cjh, 1cmk, 2bq, 2fp, 2gi, 2ke, 2kl, 2lo, 2ud, 2zs, 2afp, 2aho, 2aje, 2ajw, 2awl, 2bea, 2bfz, 2bgm, 2bmr, 2bqu, 2btw, 2bzv, 2cbw, 2ccd, 2cgt, 2ckr, 2cqz, 3ba, 3bv, 3bz, 3cc, 3cp, 3de, 3dh, 3fs, 3hg, 3hl, 3jh, 3js, 3ot, 3rf, 3su, 3tj, 3xm, 3yo, 3zo, 3zz, 3aag, 3afb, 3ajj, 3ans, 3aqr, 3auu, 3bec, 3bfq, 3bhm, 3bit, 3blf, 3bof, (3cbm), 4bq, 4cg, 4ea, 4eb, 4eh, 4ep, 4fg, 4hk, 4hw, 4jk, 4kc, 4kl, 4km, 4od, 4oi, 4xn, 4xy, 4ya, (5be), 5di, 5ek, 5fm, 5fv, 5gi, 5ib, 5jl, 5kc, 5kp, 5ma, 5mb, 5me, 5ml, 5mo, 5nd, 5ns, 5nv, 5pf, 5po, 5pv, (5px), 5qs, 5sf, 5sk, 5sm, 5sz, 5tc, 5tj, 5uj, 5un, 5vo, 5we, 5xa, 5xk, 5xt, 5xv, 5xy, 5za, 5zb, 5zs, 5abh, 5aby, 5acf, 5adq, (5aec), 5aer, 5agj, 5amk, 5anb, 5zam, 5zas, 5zaw, 6cc, 6en, 6if, 6ka, 6rm, 6zh, 6zz, 6abx, 6ajh, 6bjq, 6xad, 7cz, 7lu, 7sc, 7th, 7ud, (7zv), 7afw, 7bnv, 8bk, 8cf, 8cp, 8fq, 8ft, 8hj, 8ib, 8ij, 8ju, 8kg, 8kh, 8mz, 8nq, 8px, 8ue, 8uf, 8ui, 8uk, 8vy, 8zy, 8adz, 8ago, 8aim, 8aio, 8alc, 8alt, 8ame, 8anb, 8ann, 8aqc, 8ass, 8awp, 8awr, 8awu, 8awz, 8axb, 8axn, 8bde, 8bdv, 8bea, 8bec, 8bfr, 8bgl, 8bju, 8bny, 8boy, 8boz, 8bss, 8btl, 8bvt, 8bxa, 8bxh, 8bxx, 8byt, 8cbm, 8cfa, 8cia, (8cih), 8cjh, 8cjz, 8cko, (8cmi), 8cqx, 8cva, 8cws, 8dat, 9cd, 9cm, 9fm, 9ko, 9lq, 9ox, (9zy), (9abu), (9aey), 9amb, (9ami), 9amu, 9arz, 9bed, 9bfq, (9bhn), 9bhx, (9bof), (9bsi), (9bsz), 9buh, 9bxa, 9bxl, (9bxt). (9ceh), (9cgf), 9cpu, 9cpy, 9cwb, 9dcb, 9dpz, 9dtm, 9ebi, (9ebt), (ad7), cd7.

Canadian—3gk, 3jt, 3nb, 3sx, 4bv, 9aw.

By 6BRU, Route 5, Box 163B, Watsonville, Calif.

3xn, 3aqr, 4eh, 4bv, 5ac, 5cn, 5kc, 5px, 5uj, 5xa, 5xk, 5za, 5zb, 5zd, 5zj, 5zak, (6bf), (6cc), (6tc), 6abx, (6auy), (6bgh), (6bko), (6bkx), (6bow), 6atq, (6zh), 7bi, 7bj, 7cu, 7dp, 7ey, 7hj, 7hw, (7mf), 7nf, (7pb), 7pf, 7sf, 7sy, (7to), 7tq, 7tt, 7ud, 7zr, 7zo, 7zu, 7abb, 7abf, 7abx, 7acg, 7adf, 7aem, 7aft, 7agv, 7anb, 7atx, 8aw, 8bk, 8ft, 8ib, 8vy, 8zy, 8afc, 8aqo, 8avz, 8axc, 8cmi, 9ac, 9bm, 9bp, 9dp, 9dy, 9gk, 9lq, 9pf, 9pi, 9yw, 9aap, 9ala, 9anq, 9arr, 9aul, 9awl, 9awm, 9bed, 9bhm, 9bji, 9byg, 9ccv, 9cfy, 9dca, 9dtm, 9dsm, 9xak.

By R. W. Martindale, 1219 W. 24th St., Los Angeles.

C. W.: 1xu, 1xx, 2xap, 3bif, 3yo, 4eb, 4kc, 4jk, 4lp, 4xo, 5aar, 5ac, 5aec, 5be, 5di, 5ek, 5gj, 5ho, 5kc, 5ma, 5nn, 5ns, 5nz, 5qi, 5qm, 5qs, 5qy, 5rh, 5rn, 5uo, 5vj, 5xa, 5xd, 5xk, 5za, 5zae, 5zag, 5zas, 5zav, 5zay, 5zaz, 5zb, 7ad, 7adm, 7aem, 7awf, 7ba, 7bj, 7dk, 7hj, 7hm, 7mf, 7om, 7ot, 7pf, 7sc, 7tq, 7zb, 7zu, 7zv, 8aaf, 8abs, 8adt, 8adu, 8aim, 8aje, 8alt, 8apv, 8aqf, 8asc, 8asv, 8atb, 8avt, 8axc, 8azf, 8bbf, 8bfb, 8bgj, 8bgt, 8blt, 8bog, 8brd, 8bxh, 8bxx, 8byo, 8bxd, 8caz, 8cdz, 8cei, 8cez, 8cgx, 8dak, 8fm, 8ib, 8iq, 8ml, 8qk, 8vq, 8vy, 8xae, 8xj, 8yd, 9aap, 9aeq, 9aix, 9aiy, 9ajh, 9amh, 9ami, 9amt, 9anq, 9aog, 9aou, 9aph, 9aqr, 9asf, 9atn, 9avm, 9ayl, 9ayu, 9aza, 9bak, 9bbf, 9bcb, 9bch, 9bhz, 9bik, 9bji, 9bjn, 9brk, 9bsg, 9bsz, 9bto, 9btt, 9bun, 9bvy, 9bwf, 9bxa, 9bxh, 9bxq, 9bzi, 9ca, 9caa, 9cba, 9ccm, 9cfy, 9ciy, 9cjy, 9cm, 9cnv, 9cpu, 9cr, 9cte, 9ctg, 9cuc, 9dah, 9dca, 9dfb, 9dgn, 9dio, 9dkq, 9dky, 9dpd, 9dsg, 9dte, 9dtm, 9dug, 9dva, 9dwk, 9dxe, 9dxg, 9dxm, 9dyg, 9ei, 9ep, 9gk, 9hv, 9km, 9kp, 9lq, 9mc, 9of, 9ox, 9qr, 9rc, 9uc, 9uk, 9ur, 9vk, 9wa, 9xac, 9yaj, 9yu, 9zl, 9zy.

Spark: 7ya.

Phone: 5za, 7zu, 9ak, 9xac, wdaj, waal, waap, wlw, wgm, wjz, wbl.

Can.—3xn, 4bv, 4hh, 5cn, 9ba, 9ac.

By 8CP, 233 East 11st St., Holland, Michigan

Can.—3dh. (3ji), 3nb, (3yh). U. S.—1azw, 1bes, 1bjn, 1cjh, 1cmk, 1bka, 1jk, (1qp), (1sd), 1ze, (2aim), (2ayv), (2blm), (2brb), 2cbw, (2cfb), 2cnv, (2ig), 2su, 2vw, (2cqz), 2zl, (2zs), (3as), 3aag, (3afb), (3agc), (3anj), 3apt, 3auu, (3ava), (3bfq), (3bhm), (3bho), 3blf, 3brw, 3cm, 3ut, 3qv, 3pz, (4bb), 4bx, (4eb), 4fg, (4ft), 4jk, 4lv, (4lp), 4km, (4kc), (5aec), (5dn), 5eg, (5er), 5is, 5ma, (5mb), 5mo, 5nn, (5nv), 5pf, (5sm), (5tc), 5tj, (5uo), (5we), 5xa, 5zg, 5zs, 5zt, (8aig), (8aim), 8alc, (8aol), (8amr), 8atc, 8axb, (8axc), (8axn), (8awz), 8bcy, 8beo, (8bgl), (8bgo), (8bke), 8bjx, (8btl), (8buc), (8bwk), (8bws), (8bxx), (8caz), (8cgu), (8cjz), (8cjh), 8coi, (8cpd), 8cve, (8cwp), (8ctn), (8cxf), (8kg), (8nz), (8dat), 8sb, (8ss), (8rm), 8uz, (8vy), (8yn), (8zb), (8zf), (8wv), (9aaw), (9afk), (9aey), (9ahh), (9aip), (9aiy), (9ajp), (9alw), (9anq), (9aon), (9aot), (9ape), 9aou, (9apw), (9aqr), 9aqz), 9arr, 9ase, (9atn), (9bcf), (9bct), 9bds, (9bed), (9bey), (9bfg), (9bkj), (9bcx), (9bhq), (9blg), (9bqw), 9bra, 9bri, 9brx, (9bsp), (9bsz), 9brk, (9bvy), (9bvz), (9bxn), 9bxb, (9bvp), (9bzi), (9cda), 9cba, 9cfi, (9cfk), (9cgk), (9chf), (9chn), (9cjc), (9cmm), (9cpy), (9cte), (9ctr), 9cvr, (9cxs), 9czs, (9dge), (9dfb), 9djb, (9dbv), 9dkv, (9dlx), (9dnh), (9doj), 9dqu, (9dsl), (9dta), (9dyn), (9dyy), (9dwq), (dxn), (9ex), (gk), (9lq), (9uf), (9ox), (9pf), (9vk), 9vz.

By 6ASL, 1501 Sacramento St., San Francisco, Calif.

C. W.: 5za, 5xd, 5cn, 5go, 6zz, 6beg, 6fu, 6ahf, 6adl, 6apw, 6bmd, 6ajh, 6aeh, 6ku, 6cu, 6bko, 6pi, 6jj, 6bpz, 6xav, 6xaw, 6atg, 7lu, 7zb, 7tw, 7xc, 7sc, 7xa, 7uu, 7bk, 7zu, 7tq, 7lr, 7bj, 7zu, 7ny, 7jw, 7qt, 7acg, 7zv, 7aii, 7fr, 7th, 9zaf, 9amb, 9dtm, 9bji, 9aog, 9ccv, 9cfy, 9bey, 9cns, 9bm, qra?, 9dpm.

Spark: 6ku, 6awh, 6od, 7wg, 7zu, 7rt.

Can.—5ac, 9bd, 5cn, cfcn, kz, kfc, Walla Walla, Wash.

By 6UW

Can.—3bv, (5ct); 4cg, 4eh, 4jh, 4ya, 5ek, (5fv?), 5pv, 5tj, 5uj, 5xt, 5za, 5zs, 5aat, 5aec, (7bj), (7bk), (7hj), (7oo), 7qf, (7tq), 7th, (7ud), 7zb, 7zo, 8fq, 8ft, 8mz, 8ow, 8ue, 8xae, 8zz, 8asv, 8awz, 8axb, 8axc, 8azd, 8azf, 8bef, 8bgj, 8bpl, 8bwa, 8bxh, 8bxx, 8caz, 8cko, 8com, 8cur, 9ej, 9fm, 9fv, 9aas, 9aft, 9ajp, 9arz, 9avz, 9awm, 9axu, 9bbf, 9bds, 9bji, 9bvp, (9bxq), 9bxa, 9bxl, 9cxz, 9dky, 9dqu, 9dte, 9dwk, 9zaa, woi, wlag, wbap. If you hear 6UW pse qsl—you'll get an answer.

By 6ZT, Box 772, Salt Lake City

Canadian 4bv, 4hh, 5cn, 9ac.

4dq, 5di, 5ir, 5tj, 5aec, 5xd, 5za, 6ak, 6bh, 6cc, 6cu, 6eb, 6ec, 6ek, 6fh, 6ft, 6gd, 6gy, 6if, 6ka, 6ku, 6lv, 6nx, 6om, 6pi, 6rr, 6tc, 6ti, 6tw, 6uw, 6afh, 6agp, 6ahq, 6afj, 6ajr, 6akl, 6alu, 6alv, 6anh, 6aoi, 6apw, 6arb, 6ard, 6ark, 6asx, 6atc, 6avv, 6awt, 6bbh, 6bcr, 6beq, 6bez, 6bic, 6bin, 6bjj, 6bjq, 6bjy, 6bko, 6bkx, 6bod, 6bow, 6bqc, 6bqe, 6bqf, 6bqr, 6bqz, 6brf, 6bum, 6bun, 6bvg, 6bvq, 6bvw, 6cbi, 6xh, 6xk, 6xah, 6xas, 6zb, 6zh, 6zi, 6zn, 6zo, 6zx, 6zz, 7bj, 7pk, 7ex, 7hj, 7hm, 7ic, 7iy, 7lr, 7mf, 7nm, 7ot, 7qt, 7sc, 7tq, 7abb, 7adp, 7afw, 8zy, 9bm, 9fm, 9gk, 9ps, 9qf, 9aey, 9ahh, 9amb, 9ami, 9anf, 9anq, 9aog, 9asf, 9atc, 9avc, 9avz, 9awm, 9ayu, 9bbf, 9bey, 9bik, 9bji, 9bkp, 9bud, 9bvy, 9bxa, 9bxq, 9bxt, 9bzi, 9caa, 9ccj, 8ccv, 9cde, 9cfy, 9cmk, 9cns, 9cpu, 9dge, 9dqm, 9dsd, 9dsm, 9ebt, 9yah, 9yaj, 9zac, 9zaf.

By 6AVX, San Diego, Calif. (all C. W.)

1vj, 3blf, 3xn, 3hg, 4bv, 4hg, 4jm, 4km, 5aec, 5cn, 5cc, 5ir, 5jai, 5kc, 5kt, 5mt, 5px, 5qi, 5rh, 5sm, 5sf, 5ul, 5xa, 5xd, 5xk, 5xaj, 5za, 5zb, 5zag, 5zak, 5zas, 5zav, 6eb, 6csz, 6ze, 6zr, 6zn, 6zx, 6zq, 6zv, 6zg, 6zz, 6zt voice, 6zac, 7ab, 7abb, 7aem, 7ba, 7bj, 7bk, 7cz, 7dp, 7fr, 7gc, 7gk, 7gs, 7hm, 7jw, 7lr, 7mf, 7na, 7ny, 7ot, 7pf, 7qu, 7rk, 7sc, 7th, 7tm, 7to, 7tq, 7ud, 7ug, 7fr, 7zo, 7zu fone, 7zv, 8aaf, 8abc, 8azn, 8awx, 8aiv, 8ala, 8axc, 8ago, 8amm, 8alt, 8aoc, 8azq, 8aws, 8azd, 8arf, 8aic, 8asv, 8bum, 8bfm, 8byn, 8bvr, 8bvd, 8bxx, 8bdv, 8bde, 8bb, 8bk, 8cur, 8cmi, 8cgx, 8gh, 8boz, 8qy, 8qk, 8oc, 8dwk, 8qt, 8sb, 8ve, 8xae, 8zy, 8zo, 8zw, 9aps, 9anq, 9aon, 9aul, 9awm, 9asf, 9asa, 9aja, 9asu, 9amb, 9avs, 9avz, 9ami, 9afk, 9arz, 9aap, 9aiy, 9ayu, 9aav, 9acu, 9aou, 9adf, 9apw, 9aap, 9bm, 9bik, 9bji, 9bqt, 9bzi, 9bds, 9bey, 9bfb, 9bed, 9bhd, 9hju, 9bxq, 9bbs, 9bhk, 9bes, 9bsg, 9bdb, 9bxa, 9cl, 9cns, 9cfy, 9ccm, 9cxp, 9ccu, 9cde, 9cls, 9ccv, 9cyw, 9cte, 9cba, 9cvg, 9cpu, 9dfb, 9dky, 9dte, 9dtm, 9dsm, 9dio, 9dyg, 9fh, 9fm, 9gk, 9ii, 9lz, 9pi, 9rc, 9uc, 9xe, 9xaq, 9xak, 9yaj, 9zt, 9zn, 9zaa, 9zaf fone, Canadian 3gh, 3ht, 3gk, 3xn, 4bv, 5cn,

By 6ZY, Honolulu, T. H.

1adl, 1bkq, 2xap, 3cm, 3zw, 3hg, 4ea, 4ck, 5xv, 5zb, 5xd, 5my, 5acf, 5qi, 5zak, 5nk, 6bru, 6bjr, 6bpz, 6zaf, 6apz, 7zu, 7na, 8axc, 8ib 8ks, 8xae, 8yd, 8sb, 8fq, 8aea, 8cxw, 8bxa, 8pd, 8bde, 8zae, 8bfm, 8ow, 8ml, 8cy, 9aul, 9at, 9aau, 9arz, 9ox, 9yw, 9al, 9dwk, 9dyg, 9ami, 9am, 9djb, 9vk. Spark: bq3, Vancouver, Barracks.

By Canadian 5CT, W. F. Reeves, Duncan, Vancouver Island, B. C.

Spark, U. S.: 6awh, 6bgy, 7abs, (7aio), 7bg, 7cd, (7hd), 7ix, 7kj, 7ly, 7nw, (7oj), 7ro, 7vf. Canadian: (5ak), 9ax.

C. W., U. S.: 1fb, 1it, 2el, 2fp, 3ot, 4by, 5be, 5fq, 5gf, 5my, 5nk, 5px, 5rh, 5sf, 5sm, 5tc, 5uk, 5un, 5va, 5xv, 5za, 6abx, 6ahr, 6ajf, 6ajh, 6ak, 6alx, 6aor, 6asx, 6atc, 6atu, 6auy, (6awt), 6bcj, 6biq, 6bmd, 6bnt, 6bow, 6bum, 6cc, 6fh, 6ka, 6lv, 6nx, 6oh, 6rm, (6uw), 6vm, 6zh, 6zt, 6zx, 6zz, (7abb), (7acg), (7acx), (7ad), (7adf), (7adg), 7adm, 7ado, 7adp, 7aem, (7afh), (7afs), 7afw, (7agf), 7agv, 7aha, 7ahi, (7aic), (7aii), 7aim, (7ajc), (7bj), 7bk, 7dc, (7dp), (7eq), 7fd, 7ge, (7hj), 7hm, 7iy, 7jg, 7jw, (7ke), 7kg, 7lr, (7mf), 7na, 7nf, 7nj, (7nl), 7ny, (7pf), 7qf, 7qt, 7ri, 7sc, 7sj, 7th, (7to), (7tq), (7tt), (7ud), (7wk), (7wm), 7zk, 8ab, 8aea, 8ajx, 8apy, 8axb, 8azd, 8azf, 8bfm, 8bk, 8cyt, 8ib, 8uk, 8yd, 8zk, 8zw, 8zy, 8zz, 9aap, 9aau, 9aeq, 9aey, 9afk, 9ahh, 9asf, 9aul, 9ayu, 9bbf, 9bik, 9bji, 9bjv, 9bly, 9bm, 9bp, 9bri, 9bsg, 9bxq, 9ccv, 9cmk, 9cns, 9czz, 9dcg, 9dpl, 9dqm, 9dsd, 9dsm, 9dtm, 9ebt, 9gk, 9ig, 9kp, 9pw, 9uc, 9xac, 9yaj, 9ym, 9zn, ad7. Canadian: 3co, 4ab, 4br, (4dq), 4hh, 5ac, (5bq), 5cn, (5ej), (5go). Will qsl any enquiries. Anyone hearing 5ct ten watt C. W. pse qsl.

By 3RB, 1510 No. Gratz St., Philadelphia, Pa.

C. W.: 1abv, 1ahz, 1ajw, 1akg, 1akl, 1anr, 1asf, 1aw, 1awe, 1azl, 1bas, 1bdi, 1bdt, 1bep, 1bes, 1bet, 1bik, 1bjh, 1bjn, 1bka, 1bkq, 1bom, 1bqi, 1bwj, 1cbj, 1civ, 1cja, 1cmk, 1fx, 1gv, 1hk, 1ll, 1ok, 1pr, 1rd, 1xm, 1xu, 1xz, 1yk, 2anm, 2auz, 2awf, 2bjo, 2blp, 2brb, 2ccd, 2cfe, 2cgj, 2ckn, 2ckr, 2hj, 2ig, 2ke, 2nz, 2ry, 2xq, 2xu, 2zk, 3apr, 3bfe, 3blf, 3mk, 4bx, 4ea, 4ft, 4jk, 4lj, 4nt, 5ek, 5fv, 5sm, 5xk, 5zas, 5zb,

6zz, 8aaf, 8ab, 8abx, 8acf, 8adg, 8adt, 8afd, 8agc, 8ago, 8agr, 8aig, 8aim, 8aio, 8aiw, 8ajn, 8ame, 8amm, 8amp, 8an, 8anb, 8apn, 8apt, 8apw, 8ar, 8ard, 8asv, 8asz, 8atu, 8awx, 8axb, 8axc, 8axn, 8azf, 8bah, 8bcl, 8bdu, 8bef, 8beo, 8bfm, 8bho, 8bjs, 8bjv, 8bk, 8bke, 8blc, 8bnj, 8bny, 8bpl, 8brc, 8brq, 8bsf, 8bsy, 8bvt, 8bwa, 8bxh, 8bxt, 8bxx, 8bzy, 8cay, 8caz, 8cdn, 8cdz, 8cei, 8cf, 8cgx, 8cia, 8cjh, 8cko, 8cmi, 8cnw, 8cpx, 8crb, 8ctp, 8cud, 8cur, 8cve, 8cyt, 8czc, 8dae, 8dat, 8er, 8fq, 8hj, 8ib, 8ju, 8kg, 8lt, 8nb, 8ow, 8pt, 8qc, 8qn, 8sb, 8sp, 8sz, 8ue, 8uf, 8uk, 8up, 8vq, 8vx, 8vy, 8xe, 8xh, 8zd, 8zy, 8zz, 9aef, 9aix, 9ajp, 9akd, 9ami, 9aou, 9aps, 9arz, 9ase, 9atn, 9awf, 9awm, 9bbf, 9bcb, 9bds, 9bed, 9bie, 9bij, 9bik, 9bp, 9brk, 9bzi, 9cja, 9cmk, 9cp, 9cui, 9dcr, 9dcu, 9dfb, 9dge, 9doz, 9dwk, 9dzw, 9ei, 9hm, 9ii, 9io, 9jg, 9lq, 9nq, 9ox, 9uu, 9yaj. Canadians: 3bv, 3co, 3de, 3dh, 3ge, 3gk, 3jk, 3jt, 3xn, 9al, 9aw. Spark: 2om, 8bda, 8ew, 8mz, 8tj, 8uc, 9aaw. Transmitter here 10 watt C. W.

By 6BPP, 729 14th St., San Francisco

C. W.: 6bk, 6df, 6ec, 6if, 6jd, 6gf, 6lx, 6nb, 6oe, 6rd, 6rr, 6tc, 6apw, 6ard, 6arf, 6avd, 6beq, 6boe, 6biq, 6bcd, 6bjq, 6bkf, 6bqc, 6bqq, 6bvg, 6bvm, 6cbi, 6cac, 6cav, 5xd, 5za, 7aem, 7bk, 7bj, 7dp, 7iw, 7mf, 7jw, 7lr, 7nn, 7sc, 7xg, 7xi, 7vd, 8zy, 9aav, 9ac, 9dtm, 9zaf, bt3, cfcn, kdpv, 6zaa, 6za, 6zr, 6zn, 6zg, 6zo.

Spark: 6dp, 6acr, 6aey, 6ahf, 6blc, 6blt, 6bph, 6cav, 6zb, 6zs, 7bd, 7bh, 7gq, 7jp, 7ke, 7mp, 7ot, 7yg, 7zx, 9bm, 9bp.

Phone: kfaf, khj, kfbk, kdyl, kzn, kgg, kfu, kmc, kjq, kwg, kfc, kqw, kvq.

By 6BNV, Oceanside, Calif.; P. O. Box 228

4zi, 5ss, 5tj, 5vo, 5xd, 5zs, 5zh, 5un, 5aec, 5aar, 5alc, 5zss, (5zav), (6zac), (6bbh), (6zz), (6ec), (6ek), (6cc), (6zh), (6zx), (6ny), (6ahq), (6abx), (6aoi), (6alv), (6ame), (6biq), (6bix), (6bjg), (6bfy), (6brk), (6bun), (6bnt), (6bqz), (6zss), 7bk, (7bj), 7ly, 7ot, 7qf, 7dp, 7tq, 7lu, 7zv, 7afw, (7afs), 7aea, 7abs, 7aiu, 7bjr, 8bk, 8bx, 8ib, 8sp, 8zd, 8zw, 8zz, 8zy, 8wr, 8aqo, 8bcr, 8atu, 8bzy, 8boq, 8cgp, 8cur, 8bqz, 9pf, 9awm, 9ayu, 9bji, 9baz, 8bxa, 9bjv, 9bik, 9ben, 9bxt, 9bzy, 9bzi, (9bxq), 9uu, 9ccm, 9dtm, 9cfy, 9dky, 9dte, 9ddy, 9dqu, 9xa, 9zaa 9zaf.

By 6BNT, 225 Willard St., San Francisco

C. W.: 5za, 5qa, 6ak, 6ea, 6eb, 6ec, 6en, 6cc, 6gf, 6gg, 6gx, 6gd, 6le, 6nx, 6lk, 6lo, 6rd, 6tc, 6uw, 6wr, 6zh, 6zf, 6aat, 6abx, 6aeh, 6ahp, 6ahq, 6ajh, 6agp, 6alu, 6anp, 6aoi, 6apw, (6aqw). 6asq. 6atc, 6atq, 6atg, 6avv, 6xad, 6xah, 6bcd, 6bbc, 6bcg, 6bcj, 6beg, 6beq, 6bes, 6bic, 6bjq, 6bjx, 6bjt, 6bjr, 6bjc, 6bko, 6bmd, 6bnu, 6bjj, 6bpf, 6bpz, 6bqc, 6bqd, 6bqf, 6bqg, 6bqp 6bqz, 6brk, 6brg, 6btb, 6bum, 6bun, 6bdw, 6biq, 7dr, 7jf, 7lu, 7sy, 7tq, 7tc, 7tw, 7sc, 7ya, 7fd, 7jw, 7zu, 7zb, 7aea, 7afw, 7aft, 7bk, 7wx 7mf, 8zz. 9amb, 9pn, 9cns, 9dtm. 9dug, 9zaf, 9bsg.

Spark: 6cc, 6mh, 6hc, 6qk, 6od, 6ol, 6wi, 6aak, 6agq, 6aob, 6amn, 6ald. 6ahu, 6avr, 6bbv, 6bcn, 6bou, 6bfh, 6awx, 7ot, 7vf, 7abs, 7zu.

By 6BQP, 1928 Crenshaw Blvd., Los Angeles, Calif.

C. W.: 5if, 5za, 5nk, 5zh, 6ak, 6cc, 6cp, 6gf, 6gr, 6gx, (6gy), 6ik, 6iv, 6ji, 6lo, (6rd), 6rk. 6rv, 6ti, 6uw, 6vf, 6vm, 6vw, 6za, 6zf, (6zh), (6zj), 6zs, 6zx, 6zz, 6zam, 6aat, (6abx), 6ada, 6abr, 6aeh, 6agp. 6ajf, (6ajh), 6akl, 6akt, 6alv, 6alx, 6anp, 6aoi, 6aor, 6aqw, 6aqq, (6arb), 6arf, 6atc, 6auu, (6atq), 6awa, 6awt, (6bcd), (6bcj), 6bcr, 6bic, 6biq, (6bjy), 6bmu, 6bnt, 6bnw. 6bnu, 6boe, 6bpf, (6bqf), 6bql, 7fd, 7iy, 7jw, 7lu, 7mf, 7na, 7ot, 7pf, 7sc, (7tq), 7wm, 7xc, 7zb, 7zo, 7aae, 7aba. 8yd, 9dn, 9pi, 9amb, 9awl, 9awm, 9bey, 9bji, 9bxq, 9cns, 9dtm, 9xaq, 9zaf.

By 6EB, Los Angeles, Calif.

C. W. 5de, 5di, 5xd, 5xy, 5za and buzzer, 6ak, (6cc), 6cp, 6gf, (6gr), (6gx), 6gy, (6lo), 6lv, 6nx. (6rd and buzzer), 6zb, 6zf. 6zs, 6zx, 6aat, 6abx, 6ajh, (6aoi), (6aor), 6ajf, (6asj), 6arb, 6atc, 6atq. 6aub, 6avn, (6awt). (6bcr), (6bfe), 6bic, 6bjy, 6bmd, 6bob, 6boe, 6bpf, (6bsa), 6bql, (6bum), 6xaf, (6zac), 6zaf. 7bb, 7bs, (7dp), 7iy, 7lr, 7lu, 7ot, 7sc. 7th, (7tq), 7zb, 7zo, 7aea, 7aem, 8ck, 8bxh, Canadian 9ac, U. S.—9amb, 9awm, 9bji, (9xaq), (9zaf). kzn and music, kdpv, kdpu, kdpw, nrrs—buzzer, and wvx.

By 6UW

C. W.: 3nb, 4bv, 5ek, 5kc, 5nv, 5px, 5tk, 5za, 5zav, 6ak, 6bf, 6br, (6bz), 6cc, 6cu, 6eb, 6en, 6pi, 6aag, 6act, 6ait, 6ajh, 6akt, 6alu, (6apw), 6aqo, (6aqq), (6atq), 6atg, 6bbc, 6bcd, 6bcj, 6bcp, 6beq, 6bic, (6bjy), (6bpz), 6bql, 6bqz, 6brf, (6bum), 6bzd, 6xad, 6xas, (6zk), 6zz, 7bj, 7bk. 7iy, 7jw, 7lu, 7ny, 7ot, 7sc, (7tq), 7uu, (7wm,), 7aea, 7aem, (7aft), 7afk, 7aic, 7zb, 7zk, 7zu, 8cf, 8ml, 8aim, 8asv, 8axb, 8bef, 8cgx, 8cmi, 8ctp, 8yd, 8zz, 9cr, 9fm, 9gk, 9lz, 9alz, 9amb, 9asf, 9aul, 9avz, 9awm, 9bds, 9bji, 9bxb, 9cfy, 9cmk, 9cns, 9dim, 9dte.

By 7SY, 345 Mill St., Eugene, Ore.

C. W.: 5ct, 5di, 5zh, 6ak, 6ea, 6aat, 6aau, 6abx, 6ahp, 6ahq, 6ajh, 6akt, 6alu, 6amb, 6aoi, 6aqq, 6arc, 6arb, 6arf, 6asj, 6atq, 6auu, 6avn, 6avr, 6awt, 6bcd, 6bcj, 6bcl, 6bcr, 6beg, 6bes, 6bic, 6bid, 6bip, 6bjy, 6bjr, 6bjq, 6bko, 6bmd, 6bmn, 6bqc, 6bqd, 6bqg, 6bqp, 6bqz, 6brg, 6btb, 6bum, 6bun, 6cc, 6cp, 6cu, 6eb, 6eo, 6gf, 6gr, 6gx, 6lo, 6lv, 6lu, 6nx, 6pi, 6rd, 6sg, 6uw, 6vf, 6vm, 6wi, 6zf, 6zx, 7aft, 7afw, 7bk, 7bj, 7du, 7en, 7gh, 7hn, 7iy, 7lu, 7nc, 7ng, 7nh, 7ny, 7oo, 7pf, 7ri, 7rn, 7sc, 7th, 7to, 7uu, 7wm, 7zb, 7zu, 8cf, 8bef, 8cgp, 9aip, 9ajh, 9amb, 9ami, 9bcf, 9bji, 9brk, 9bxq, 9ckm, 9cfy, 9dtm, 9pi, 9xaq, fone, 6bcj, 6bic, 6bid.

Spk: 6alv, 6amk, 6amu, 6amw, 6ark, 6atu, 6bid, 6bin, 6bua, 6btb, 6gr, 6lu, 6oh, 6od, 6tc, 6tu, 7aea, 7adr, 7aff, 7agi, 7fh, 7fq, 7fr, 7ge, 7oh, 7zk. Anyone hearing my C. W. please QSL.

By 6AVX, San Diego, Calif.

All C. W.: 4by, Canadian 4bv, 5cc, 5cn, 5dx, 5ek, 5if, 5kc, 5sf, 5za, 6zh, 6avn, 6acr, 6asp, 6apr, 6awt, 6aju, 6aqw, 6avr, 6aat, 6avd, 6ahp, 6auu, 6asq, 6abx, 6ald, 6atq, 6ala, 6aon, 6aau, 6avv, 6ak, 6agp, 6apd, 6aqw, 6apd, 6arf, 6awh, 6aoa, 6alu, 6av, 6abw, 6avb, 6amn, 6asp, 6bvx, 6bjj, 6bir, 6bmc, 6bsa, 6bqd, 6bod, 6bvl, 6buq, 6bkl, 6bjg, 6bqr, 6bvq, 6brk, 6bqc, 6brf, 6bvd, 6bd, 6bnv, 6bpz, 6bes, 6bqg, 6bum, 6bun, 6bpf, 6bqp, 6bki, 6bvy, 6bak, 6bjx, 6bwx, 6bkb, 6bnw, 6bwp, 6bep, 6bmu, 6bej, 6bcl, 6bcd, 6cp, 6cu, 6cc, 6en, 6ea, 6eb, 6gy, 6gf, 6if, 6jd, 6ka, 6lv, 6mh, 6oo, 6pt, 6pi, 6qkg, 6rd, 6tj, 6vm, 6wi, 6xam, 6xad, 6za, 6zf, 6zi, 6zas, 6zy, 6zz, 6zx, 7aw, 7aic, 7bj, 7bk, 7du, 7dw, 7gh, 7iy, 7lu, 7na, 7ny, 7rn, 7sc, 7sg, 7sy, 7th, 7tm, 7tq, 7wm, 7ya, 7zb, (7zu spk), 8bwa, 8bxh, 8cf, 8cgp, 8qk, 8rp, 8wr, 8xe, 8xm, 8yd, 9amb, 9api, 9aja, 9aps, 9aul, 9awm, 9bz, 9bey, 9bjd, 9bji, 9bjv, 9bun, 9bxa, 9cj, 9ck, 9cfy, 9cns, 9dn, 9dtm, 9dwk, 9ii, 9pn, 9rk, 9xaq, 9zaf, 9zn, 9zx. Anyone hearing 6AVX 5 watts A. C.-C. W. please QSL.

By 6EC, Anaheim, Calif.

C. W.: 2zk, 2agc, 2lo, 3co, 3mb, 4eb, 4by, 5aat, 5fv, 5if, 5kc, 5nk, 5px, 5sm, 5tj, 5xa, 5xad, 5xy, 5za, 5zh, 7aea, 7aem, 7aft, 7bj, 7bk, 7gk, 7iy, 7jw, 7lu, 7mf, 7ny, 7th, (7tq), 7wm, 7zb, 7zk, 7zo, 8asv, 8aqo, 8azd, 8bef, 8bnw, 8bpl, 8bxh, 8cf, 8cgp, 8cmi, 8ml, 8nn, 8qk, 8sp, 8wr, 8xae, 8xe, 8zag, 9aap, 9ags, 9al, 9amb, 9anq, 9arz, 9aul, 9avz, 9awm, 9ays, 9bds, 9bhn, 9bik, (9bji), 9bri, 9bun, 9bxq, 9ccv, 9cfs, 9cfy, 9cmk, 9cns, 9cow, 9ctr, 9dge, 9dky, 9doz, 9dr, 9dte, 9dtm, 9dwk, 9dyn, 9gk, 9kp, 9pi, 9pn, 9tm, 9uu, 9xac, 9xaq, 9yaj, 9zaf, 9zx. Can.—3nb, 4bv, 4bh, 9aw.

By 6AJF, 1822 Hearst Ave., Berkeley, Calif.

C. W.: 4aj, 5bv, 5er, 5fv, 5kc, 5nk, 5qi, 5uj, 5xd, 5za, 6zz, 7bj, 7bk, 7gk, (7jw), 7lu, 7mf, 7ng, 7ot, 7qd, 7qt, 7ri, 7sc, 7sy, 7th, (7tq), 7ud, 7wn, 7vf, 7zb, 7zk, 7zo, 7zu, 7aad, 7abs, 7adf, 7adp, 7aea, 7aem, (7aft), 7afw, 7aic, 7aiu, 8zx, 8aft, 8apy, 8asv, 8azd, 8cgp, 8cgx, 9ac, 9dz, 9hj, 9gk, 9pi, 9afk, 9amb, 9anq, 9aps, 9arz, 9aul, 9awm, 9azd, 9bcb, 9bey, 9bhd, 9bik, 9bji, 9bly, 9bri, 9cfy, 9cns, 9dof, 9dpl, 9dyn, 9xaq, 9ym, 9yaj, 9zaf.

By 6BEZ, 407 Hillside Ct., Piedmont, Calif.

Using loose coupler, detector, and one-step audio, prior to Oct. 8. Spark: 7bh, 7bk, 7ga, 7ge, 7gj, 7hq, 7kj, 7mf, 7nw, 7nz, 7ol, 7ot, 7oz, 7tj, 7to, 7zj, 7zt, 7ya, cl8. Canadian—7kc, 9bd.

C. W.: 6za, 6's (too many), 7aea, 7dp, 7hc, 7iw, 7jf, 7jw, 7lu, 7mf, 7nn, 7nq, 7ny, 7qw, 7rn, 7sc, 7th, 7tq, 7wm, 7yj, 7zb, 7zk, 8azd, 8bcy, 8bke, 9amb, 9anq, 9apw, 9awm, 9ayu, 9bey, 9bji, 9bxq, 9xac, 9xaq, 9zaf.

By 3YO, Lafayette College Radio Club, Eastern Pa.

1agh, 1aij, 1ait, 1ajl, 1aky, 1ary, 1asf, 1auf, 1avk, 1aw, (1awo), 1ayq, 1bas, 1bgg, 1bet, 1bi, 1bkg, (1bxq), 1bnq, 1bog, 1boc, 1buj, 1bwj, 1cdo, 1cgq, (1chk), 1cni, 1cpn, 1cy, 1gm, 1gr, (1gv), 1il, 1ix, 1ll, 1pl, 1pr, 1pt, 1tr, 1tb, 1tua, 1xm, (1xu), 1yk, 1ze, 1zz, 2a, 2aqc, 2aho, 2air, 2aje, 2aj, 2ajn, 2apc, 2auf, 2ave, (2avv), 2awl, (2bbb), 2bfx, 2bld, 2bml, 2bmr, 2bqd, (2bqw), 2brb, 2brc, 2brt, 2bsh, 2byc, 2cbc, 2ccd, (2ckn), 2ckr, (2cmb), 2cmv, (2cnk), 2col, 2do, 2el, 2gk, 2go, 2gr, 2hj, 2hw, 2ke, 2lo, (2nz), 2or, (2om), 2onm, 2pt, 2qk, 2vg, 2vh, 2wb, 2xap, 2xat, 2xe, 2xq, (3aao), (3blf), 3afb, 3ah, 3aj, 3asp, 3atg, 3awc, (3awh), 3bb, 3bbu, 3bfe, 3bgt, 3bhl, 3bij, (3bnu), 3bny, 3bqk, (3bum), 3bnv, 3bv, 3bk, 3cbn, (3cdr), 3cge, 3co, 3dh, (3fh), 3gc, 3ge, 3gk, 3hlf, 3il, 3jv, 3jj, 3jk, 3ko, 3me, (3mk), 3ol, 3pz, 3sv, 3sm, 3vh, 3wy, 3wt, 3ww, 3yk, (3zo), 3zw, 3zz, 4bt, 4bv, 4bx, 4by, 4cg, 4dl, 4dq, 4ea, 4eb, 4eh, 4el, 4fg, 4ft, 4ge, 4gh, 4gv, 4id, 4jk, 4ki, 4km, 4la, (4lj), 4nv, 4pl, 4vd, 4xk, 5aag, 5abm, 5aby, 5ac, (5adl), 5al, 5am, 5atm, 5bb, 5da, 5di, 5ek, 5fv, 5hb, 5jb, 5kc, 5lk, 5mp, 5nk, 5nn, 5nv, 5oa, 5pl, 5pv, 5qi, 5sk, 5sm, 5tj, (5vx), 5wk, 5xa, 5xx, 5xv, 5za, (5sf), 6avd, 6er, 6xad, 7ad, 7zu, 8ab, 8abr, 8cf, 8adn, (8adt), (8afd), 8agc, 8aio, (8aim), 8aig, 8ajt, 8alf, 8ame, 8amg, (8an), 8anb, 8anj, 8aol, 8aqo, (8asv), 8ath, 8atn, 8awp, 8axc, 8axm, 8azd, 8azh, 8bba, 8bbo, 8bcl, 8bcq, 8bcy, 8bd, 8bda, 8bdo, 8bdm, 8bdo, 8bef, 8beo, 8bfh, (8bfm), 8bfx, 8bir, 8bmm, 8bnc, 8bnj, 8bo, 8bph, 8bpl, 8brl, 8brt, 8brz, 8bse, 8bum, 8bwa, 8byt, 8bzy, (8cay), 8cbm, 8cer, 8cfg, 8cgn, (8cgx), 8cjh, 8ckx, (8cli), 8clp, 8cnb, 8cnn, 8cnw, 8co, (8col), 8cqy, 8ctn, 8ctp, 8cud, (8cur) 8cum, 8cyb, 8cyl, 8cyn, 8cyt, 8cz, 8czc, 8dcf, 8dcg, 8dr, 8dw, 8eo, 8fl, 8hb, 8hgo, 8ibn, 8ix, 8ig, 8jq, 8kg, 8kgl, 8kp, 8lb, 8mtd, 8nb, 8ow, 8pg, 8qk, 8sm, 8sp, 8ss, 8tb, 8tj, 8uc, 8uk, 8uy, 8xac, 8xe, 8xh, 8xl, 8yd, 8yg, 8zal, 9aa, 9au, 9aab, 9aap, 9aau, 9aav, 9aaw, 9ace, 9adg, 9ae, 9afk, 9afu, 9ahk, 9aix, 9ajp, 9ajh, 9akt, 9ky, 9aml, 9amz, 9ang, 9anl, 9anf, 9aog, (9aon), 9api, 9app, 9aps, (9avs), 9awf, 9awm, 9awf, 9ays, 9ayp, 9ayh, 9aza, 9azr, 9bak, (9bed), 9bcb, 9bds, 9bfm, 9bhg, 9bik, 9bie, 9bij, 9brk, 9bkp, 9bos, 9cba, 9cbs, 9ctr, 9cxp, 9cpo, 9cv, 9cr, 9dcf, 9dcn, 9der, 9dio, (9dge), 9dgg, 9dhz, (9dky), 9dn, (9doz), 9dpl, 9dwk, 9dyn, 9dqn, 9dzn, 9dzy, 9ei, 9fm, 9ge, 9gk, 9hm, 9ii, 9io, 9xp, 9li, 9lz, 9of, 9ox, 9ts, 9pi, 9pu, (9uu), 9vk, 9wn, 9xl, 9ya, 9yn, 9yaj, 9zab, 9zap, 9zd, 9zn.

By 7LR, Eugene, Oregon

1bgf, 1cpn, 1cni, 3ot, 3bhm, 4bf, 4bv, 4hh, 5ar, 5aby, 5acf, (5ct), 5cf, (5di), 5ek, 5fj, 5gh, 5kc, 5nk, 5qi, 5sk, 5sm, 5uj, 5vo, 5za, 5zav, 5zh, (6bip), 6aat, (6abx). (6alu), (6atq), (6bcr), (6bic), (6bou), (6bx), (6ex), (6gr), (6rd), (6ti), 6bcj, (6xad), 6zz, 6zx and many more; (7aff), (7aea), (7fh), 7hm, (7iy), (7kj), (7lu), (7oh), (7qt), (7ri), 7rn, (7sc), 7th, (7vf,) (7wm), too many to log; 8ab, 8ow, 8qk, 8sp, 8aim, 8anb, 8bba, 8bfh, 8bfx, 8bda (spk), 8bnj, 8bvt, 8bxa, 8dwa, 8zk, 9ac, 9bd, 9ct, 9ei, 9ej, 9gk, 9ii, 9nx, 9pn, 9pi, 9rh, 9uu, 9aiy, 9adf, 9amb, 9ami, 9amu, 9awm, 9anv, 9anz, 9arz, 9avz, 9aul, 9baf, 9bbf, 9bam, 9bds, 9bed, 9bct, 9bhd, 9bey, 9bjd, 9bji, 9bxq, 9cni, 9cfy, 9ctv, 9cns, 9dlt, 9dtc, 9dtm, 9dpl, 9dyn, 9dmf, (9yw), 9yaj, 9zn, 9zaf, 9zif.

BY 2BUM

(1es), (1fb), (1fw), (gv), 1hx, 1jt, 1xm, 1xx, 1acu, 1agi, (1ajp fone), 1aju, 1anq, 1awb, 1azw, 1bes, 1bgf, 1bkq, (1bnt), 1cgs, 1chj, (1cmk), 1cpn, 2gk, 2adl, (2ann), 2awf, 2bml, 2cgj, 3ah, 3cc, 3bx, 3fh, 3fs, 3id, 3il, 3iw, (3lp), (3mk), 3mo, 3nt, (3ot), (3tj), 3tn, 3wf, 3zw, 3adx, 3aln, 3amq, (3aqr), 3atz, 3bfg, 3bgi, 3bif, 3bij, 3bit, 3bjg, 3bjy, 3blf, 3bnu, 3bvc, 3ccs, 3cdk, 3cdo, (4ea), 4bq, 4bx, 4by, 4dl, 4gs, 4lp, 4ns, 4nt, 5do, 8ab, 8bt, 8dt, 8dz, (8ft), 8hj, 8kg, 8kh, 8ki, 8ow, 8sb, 8sp, 8ts, 8uc, 8uk, 8vy, 8wr, 8xe, 8zn, 8zo, 8zq, 8zz, 8aby, 8aco, 8acf, 8adh, (8afd), 8ahk, 8aif, 8ajb, 8amb, 8amd, 8amf, 8amg, (8apt), (8asz), (8atu), 8avz, 8awp, 8bdo, 8bdu, 8bcz, 8bef, 8bfm, 8bfx, 8bio, (8bke), 8bnj, 8bnq, 8bph, 8brc, 8brt, 8bss, 8bvr, 8bwa, 8bxh, 8cay, (8ccx), 8cdz, 8cei, 8cgn, (8cjh), 8cjy, 8cid, 8ckm, 8cko, 8clc, 8cnu, 8cod, 8cso, 8cum, 8zaf, 8zke, 8zko, 9al, 9ei, 9ek, 9hw, 9ii, 9hu, 9xl, 9aap, 9aon, 9axf, 9bed, 9bya, 9dfb, 9cfi, 9cjj.

BY 6ALQ, 582 10TH AVE., SAN FRANCISCO

Spark—6ba, 6gr, 6ic, 6fh, 6ke, 6up, 6wi, 6od, 6aak, 6ahu, 6amw, 6apd, 6ald, 6ark, 6awa, 6awx, 6bae, 6baj, 6bfh, 6bip, 7ve, 7ot, 7awa, 7zk, 7zu.

C. W.—4aae, 5eb, 5sm, 6ak, 6cu, 6eb, 6en, 6ft, 6gx, 6cc, 6jd, 6ka, 6rm, 6pi, 6abx, 6agk, 6ahp, 6ahq, 6ajh, 6amn, 6apw, 6aqq, 6aqp, 6aqw, 6ajf, 6atg, 6atq, 6avx, 6avr, 6avv, 6anp, 6avn, 6bbv, 6bes, 6bqj, 6brk, 6brf, 6bgj, 6bun, 6bum, 6bmd, 6buy, 6bic,6blu, 6bqp, 6zx, 6zzg, 6zf, 6xad, 6xas, 7bk, 7iy, 7lu, 7lr, 7ny, 7vf, 7tq, 7th, 7sc, 7dp, 7bam, 7zu (voice), 9ii, 9aul, 9awm, 9bds, 9bdy, 9bey, 9bji, 9cns, 9anq, 9xaq, 9zaf, nrrs, kwh(concert).

Anyone hearing my spk. or C. W. pse qsl.

BY EARL SITAR, 6BJX, 1331 MILTON AVE., HOLLYWOOD, CALIF.

6cc, 6cp, 6ec, (6fh), 6gr, 6gx, 6ku, (6nx), (6rd), (6vx), (6zb), (6zf), 6aan, 6aat, 6aau, (6abr), (6abx), 6agd, (6agu), (6ahj), (6ajf), (6ajh), (6akl). 6aoi. (6asj), 6atq, 6aut, 6ave, (6awt), (6bcj), (6bcr), (6bjy), 6bao, 6bql, (6bsa), 6btj.

3co. 3mc, 5sm, 5xd. 5za, 5zh, 7la, 7lu. 7na, 7oz, 7tq. 9gk, 9ki, 9qa, 9amb, 9ami, 9awm, 9aue, 9bji, 9bxa, 9cjj, 9dky, 9dtm, 9zaf.

BY 6AUU, 316 RICHLAND AVE., SAN FRANCISCO, CALIF.

3co, Can. 4eb, 5qy, 5xa, 5za, 6en, 6er, 6gn, 6fh, (6gt), 6ka, 6od, 6rd, (6wi), 6zs, 6zc, (6aak), (6adl), (6ahp), (6awx), (6bae), 6beg, 6bjq, 6bfw. 6anq, (6ajh), (6bun), (7aea), 7ny, 7lf, 7lu, 7zu, 7zb, 7zk, 8cf, 8qk, 8ow, 8br, 8asv, 8cmi, 8zx, 8boz, 9bd, Can. 9cc, 9kp, 9ii, 9pi, 9amb, 9anq, 9aps, 9apw, 9aul, 9bbf, 9bdb, 9dof, 9dyn, 9bji, 9cns, 9yaj, 9zaf.

Plse. qsl if hearing my C. W. or spark.

BY 6RR, 415 N. GOWER ST., LOS ANGELES, CALIF.

1aw, 3abd. 4bf. 4jy, 5fv, 5fw. 5acf, 5xd, 5zh, 6zac, 7bj, 7bk, 7dp, 7jf, 7jw, 7lr, 7lu, 7mf, 7na, 7sc, 7sy, 7tq, 7wm, 7aem, 7xg, 7xc, 7zb, 7zo, 7zu, 8amg, 8bk, 8cf, 8ib, 8sb, 8bx, 8ow, 8wr, 8atf, 8asu, 8asv, 8azd, 8bvt, 8dte, 8xe, 8yd, 9aw, 9az, 9cc, 9gk, 9ii, 9kp, 9pi, 9ps, 9uu, 9amb, 9anq, 9aul, 9avz, 9awm, 9bcb, 9bds, 9bey, 9bgh, 9bhd, 9bji, 9bjv, 9cfy, 9cjj, 9cns, 9cow, 9doz, 9dtm, 9dte, 9dyn, 9xl, 9xm, 9xag, 9yi. 9yj, 9yaj, 9zn, 6's too numerous. Anyone hearing my sigs. pse. qsl.

BY C. C. BROWN, MANTON, CALIF.

C. W.: 5un, 6aja, 6ajh, 6asp, 6alu, 6alq, 6amf, 6abx, 6aem, 6agh, 6aqq, 6aiy, 6big, 6brk, 6bvx, 6bvg, 6brf, 6bcd, 6bis, 6bqc, 6boo. 6bjq, 6bcj, 6bko, 6bic(phone), 6bum, 6bun, 6brc, 6bjx, 6bou, 6bql, 6bqz, 6bip, 6cp, 6cc, 6en, 6ka, 6me, 6nx, 6ot, 6uw, 6xj(phone),

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CALLS HEARD

Continued from page 42

6xad, 6xav, 6xas, 6zal(phone), 6zf, 6zx, 7aea (phone), 7bj, 7dp, 7fx(phone), 7jw, 7lu, 7lk, 7mf, 7sc, 7sy, 7tq, 7ud, 7va, 9ax.

Stations worked: 6ak, 6abx, 6agn, 6atg, 6alq, 6arf, 6bcr, 6bkx, 6bmd, 6bql, 6ti, 7bb, 7bj, 7eq, 7ke, 7mf.

6ku worked 6bmd, of Taft, Cal., with just 1/10 of an amp, and was heard in L. A. at the same time. This is a distance of about 700 miles. Some low power DX. Was also heard in Ellendale, N. D., by 9ahc with .7 amp.

BY 6AME, RIVERBANK, CALIF.

2xap, 2zl, 3blf, 3co(Can.), 4by, 4cg, 4eb, 4id, 4bv(Can.), 5ac, 5di, 5ek, 5eo, 5er, 5fa, 5fv, 5kc, 5my, 5nk, 5pv, 5px, 5qi, 5qw, 5sm, 5uk, 5zaca(fone & C. W.), 5xa, 5xk, 5za, 5zh. 6's and 7's too numerous to mention. 8ab, 8bk, 8bp, 8bx, 8cf, 8dr, 8ib, 8if, 8iq, 8jf, 8kg, 8ml, 8ow, 8qk, 8tf, 8uk, 8wr, 8acf, 8afd, 8ago, 8aim, 8aio, 8amm, 8anb, 8apy, 8aqo, 8ard, 8asv, 8awz, 8axn, 8azd, 8bdo, 8bdu, 8bef, 8bfx, 8bjv, 8bnj, 8bpl, 8bxf, 8bxh, 8byh, 8bzy, 8cax, 8cep, 8cgx, 8cmi, 8cnw, 8cur, 8dak, 8czl, 8xe, 8yd, 8yk, 8ym, 8zp, 8zw, 8zx, 8zz, 8xae, 8xam, 8zaf. 9's too numerous to mention. Fone: wsb, whb, woc, ksd and many others. Anyone hearing my B batt 5 watter, pse qsl Hv wkd 75 miles daylite.

By 7RM and 6QS on Boat From Seattle to Alaska, 800 Miles North Seattle

Dec. 3.—4bv Can., 4br Can., 4ela, 5bd, 5uj, 5qy, 5xad, 5sf, 5hq, 5tc, 5px, 8dkk, 8aqf, 8bxx, 8zy, 9aht, 9ar, 9bqw, 9avc, 9aog, 9gk, 9rk, 9pw, 9aor, 9qf, 9ami, 9azi, 9cjj, 6s and 7s too numerous.

Dec. 4—550 miles north Seattle—5bz, 5cn Can., 5bq Can., 4bv Can., 9bxt, 9aul, 9ebt, 9aav, 8zy, 6s and 7s too numerous.

Dec. 5th.—At Ketchikan, Alaska—3ec, Call cq. 5za, 5akt, 5aec, 5cn Can., 5di, 6ak, 6arf, 6ark spk., 6apw, 6vm, 6cu, 6abx, 6pi, 6bqc, 6amk, 6aat, 6zz, 6biq, 6om, 6bjr, 6nh, 6aci, 6ku, 6rm, 6ik, 6avd, 6xad, 6ajr, 6bsa, 6ft, 6zh, 6eb, 7abb, 7jg, 7mf, 7mh, 7dc, 7aem, 7dp, 7bj, 7dl, 7ke, 7ahi, 7wk, 7mn, 7tq, 7exh, 7sc, 7fh, 7ud, 7wn, 7fr, 8zz, 8zy, 9ast, 9ami, 9dqu, 9dxn, 9ebt, 9dqm, 9dtm, 9uu, 9bvf, 9dp, 9gk, 9ccv, 9dkq.

Dec. 6.—At Juneau, Alaska—bt3, 5cn Can., 5ct Can., 6tu spk., 6bko, 6akt spk., 6bqz, 6en, 6abx, 6zh, 6bum, 6km, 6bft, 6ku, 6bbh, 6cc, 6acr spk., 6zi, 6fh, 6zo, 6vm, 6aag, 6nx, 6bbk, 6aat, 6arv, 7eq, 7du, 7fr, 7iy, 7afs, 7ahi, 7to, 7bj, 7hd spk., 7mf, 7qf, 7air, 7dp, 7arb, 7lr, 7afo spk, 7sc, 7ajz, 7wn.

Dec. 7th.—60 miles north Juneau—bt3, 5ac Can., 6ak, 6lv, 6cc, 6nx, 6aat, 6km, 6arf, 6ta, 6tu spk., 6cu. 6akt spk., 6tv, 6zz, 6zh, 6tc, 6dd, 6oz, 6km spk., 6sz, 6bun, 7mf, 7eq, 7bh spk., 7ve, 7aic, 7nx, 7afo, 7abb, 7bk.

Dec. 8th.—Dock Juneau, Alaska—bt3, 5cn Can., 5ct Can., 6cc, 6abt, 6abx, 6biq, 6nh, 6bow, 6xk, 6zh, 6ahq, 6bcr, 6tu spk., 6avv, 6fh, 6aoi, 6akt spk., 6hd spk., 6auy, 6ek, 6aqu spk., 6arx, 6bm, 6buf, 6gx, 6nx, 6dd, 6lv, 6bqc, 6en, 6bip, 6bju, 7sc, 7mf, 7bs, 7eq, 7uf, 7ud, 7abb, 7bj, 7agv, 7mh, 7rn, 7qf, 7kj. 7afh, 7ly, 7aio spk., 7jc, 7oj spk., 7om, 7bh spk., 7aft, 7jm, 7ri, 7wu, 7kf, 8zy, 9awm, 9avz, 9dky, 9zn (Sending all evening), 9bqw, 9bzi, 9ami. 9bbf, 9ebt, 9afk, 9dsn, 9amb, 9asu.

Dec. 11th.—300 miles south Ketchikan—2nz, 3co, 5zv, 5cn (Can.?), 4bv (sgtti), 4bv (thuuj)?, 5xad, 6tu spk., 6cc, 6ka, 6ark spk., 8axn, 8bxx, 8qk, 8kg calling cq, 8axb, 8btu, 8asv, 8cmi, 8ib, 8zy, 8sp, 8ue, 8aim (sbyyd), 8ow, 8cur, 8bei, 8bef, 9cxp, 9yaj, 9fy, 9awm, 9btt, 9bky, 9gk, 9bxy, 9al Can., 9awp, 9bri, 9io.

By 6AMX, 2716 Pacific Ave., San Francisco

C. W.: 5ek, 5za, 6ea, 6ec, 6en, 6ff, 6iv, 6jd, 6ka, 6om, 6pi, 6rr, 6zb, 6zg, 6zh, 6zn, 6zr, 6zs, 6zv, 6zz, 6aag, 6aav, 6abg, 6ada, 6aeh, 6agp, 6ahq, 6akl, 6alu, 6apw, 6auc, 6avr, 6baj, 6beq, 6bet, 6bfp, 6bgh, 6bjc, 6bjj, 6bjq, 6bjt, 6bjy, 6bkb, 6bko, 6bkx, 6blu, 6bmx, 6bqc, 6bqd, 6bqz, 6bvw, 7bj, 7bk, 7dc, 7ex, 7fr, 7hj, 7hm, 7jw, 7lu, 7mf, 7mh, 7ny, 7oo, 7ot, 7pf, 7qe, 7qt, 7ri, 7rn, 7sc, 7to, 7tq, 7tt, 7ud, 7uu, 7wk, 7aat, 7abb, 7aby, 7acg, 7adp, 7afs, 7afw, 7agv, 7ahw, 7aic, 7amf, 8bk, 9bg, 9pi, 9wd, 9ajp, 9amb, 9ami, 9apw, 9asf, 9aul, 9bji, 9cns, 9xaq, bq3, bt3. Canadian—4dq, 5bq, 5cn, 5ct.

Spark: 6gt, 6ny, 6od, 6ol, 6zh, 6zn, 6agk, 6ahf, 6atf, 6awx, 6baj, 7hd, 7kj, 7ne, 7qh, 7sj, 7yl, 7zu, 7abh, 7acn, 7adf.

By 6BEG, Los Angeles

(6ak), (6bf), 6cc, 6dm, (6fh), 6gf, (6gr), 6gx, 6gy, (6ku), 6lv, 6ng, 6nx, 6oh, (6aat),

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Small Current—Big Job!

Care in Selecting Your "B" Battery Cures a Whole Flock of Static Troubles

A LOT of radio bugs are missing a good bet when they fail to give the proper attention to the "B" Battery that supplies current to the plate circuit of the vacuum tube. In a good many cases—and this applies to the seasoned enthusiast as well as the newest novice in the ranks—it is wrongly set down that since this current is so exceedingly small it cannot be very important.

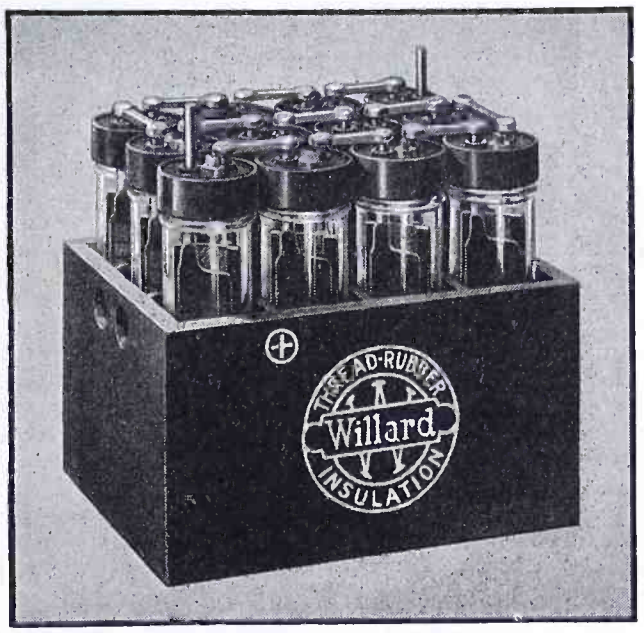
Nothing could more completely misrepresent the facts. True enough, the current supplied by the "B" Battery to the plate circuit is small—but it is precisely for that reason that even the slightest variations or disturbances are to be so carefully avoided.

In thinking of "B" Batteries keep this in mind: The current from these batteries goes directly into the fine windings of the coils of your phones. Therefore even the slightest disturbance or unbalancing of the battery is translated directly into *noise*.

Obviously the reason for carefully soldered connections, loop aerials, short leads and the elimination of useless wires is to do away with *noise* just as far as possible. The same reason should dictate the careful selection of "B" Batteries. It hardly pays to go to a great deal of trouble in taking the usual steps to eliminate static unless you also pick out a battery that is free from the hissing, sputtering and frying noises that are so often confused with static and that in common with static noises are multiplied six or seven times with each stage of amplification.

A "B" Battery that is completely in accord with the efforts of manufacturers of sets to do away with static disturbances is known as the Willard "B" Battery. This battery consists of a group of twelve glass-jar cells, assembled in oak cases and connected with heavy burned-on connectors. Due to the distance between jars electrical leakage from one jar to the next is practically impossible. As each of the cells has Willard Threaded Rubber Insulation between the plates there is no opportunity for leakage from plate to plate.

It is said by those who have carefully examined the construction of the Willard Radio "B" Battery that, in addition to its ability to give results without distracting noises, it will last—if not a lifetime—at least such a long period that it will show a material money-saving long before it begins to exhibit even the slightest sign of age.



The Willard Radio "B" Battery is a 24-volt rechargeable battery. Glass jars—Threaded Rubber Insulation—screwed-on covers.

The Willard 6-volt, All-Rubber Radio "A" Battery has one-piece rubber case—Threaded Rubber Insulation—special Radio plates.

The new Willard lower priced Radio "A" Battery (Type FW) Willard-quality plates—selected wood separators—tested rubber jars, specially-designed terminals.

Willard Storage Battery Co., Cleveland, Ohio

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(6abr), (6abx), 6ada, (6aeh), (6agp), (6ajh), (6apo), (6aqw), 6arb, (6asj), 6atg, (6atq), (6awt), (6bbc), (6bcd), 6bcj, (6bic), (6bir), (6bjq), (6bjr), (6bjw—hi), (6bjy), (6bju), (6bmd), (6boe), 6bqf, (6bql), (6bsa), (6bum—qra), (6xad), 6xam, 6za, (6zf), (6zh), (6zs), (6zx), 6zz, 6zaf, 6zam, 7lu, 7mf, 7sy, 7tq, 7zm, 9amb, 9dtm, 9zaf. 6beg is moving to a new location. Reports on qrk will be appreciated.

By 6TI, 414 Fairmount Ave., Oakland, Calif.

C. W.: (5px), (6cc), (6ea), (6eb), (6ec), (6ek), (6fh), (6if), (6iv), (6ka), (6ku), (6lo), (6om), (6pi), (6tc), (6xad), (6zh), (6zr), (6zx), (6zz), (6zac), (6aat), (6abx), (6agp), (6ahp), (6akl), (6atc), (6atj), (6bfy), (6bjc), (6bjq), (6bjt), (6bmx), (6bod), (6bpf), (6bqc), (6bqz), (6brf), (6brg), (6bsb), (6bto), (6bvd), (6bvg), (7bb), (7bj), (7jw), (7lr), (7ot), (7pf), (7sc), (7to), (7tq), (7wm), (7xc), (7adp), (9acs), (9awm), (9ays), (9bji), (9cns), (9cuc), (9axq), (bt3). Spark: (6ol), (6ahu).

C. W.: 1bas, 1bnl, 3bt, 4cg, 4ef, 4nt, 4iv, 4ati?, 5di, 5tc, 5tj, 5yy, 5zy, 6abq, 6ajr, 6aub, 6bbh, 6bbl, 6boe, 6zo, 7eq, 7hj, 7hm, 7hq, 7iy, 7lu, 7ml, 7nw, 7ny, 7qe, 7qf, 7qn, 7ri, 7sy, 7ud, 7zk, 7abb, 7aea, 7acg, 8cc, 8zy, 8bdu, 8bzy, 8cjh, 9gk, 9pn, 9ani, 9anq, 9ami, 9aul, 9avz, 9bed, 9ben, 9bik, 9dfb, 9dsl, 9dqy, 9xac, 9yaj, 9yat, w4y, Can. 9ac. Spark: 7yg.

6ti 50-watter was report by operator on the West Nosska while 1350 miles E.N.E. of New York. All hearing my C. W. psé. qsl.

By 9DSW, Gordon M. Larson, Fairmont, Minn.

5aby, 5atx, 5if, 5ix, 5sf, 5tc, 5tm, 5uo, 2aaf, 2ahs, 2hg, 3blf, 3wr, 8acf, 8adz, 8alf, 8ard, 8auu, 8ayu, 8bja, 8boa, 8bxx, 8caz, 8cmy, 8cgx, 8ft, 8sb, 8sn, 8zz (fone), 9ccv, 9bhx, 9dkq, 9nu.

By 8ZD, 5306 Westminster Place, Pgh., Pa.

1aw, 1bq, (1gv), (1ii), 1pr, 1qp, 1rr, (1xm), 1xu, 1xx, 1xz, 1agh, 1aun, 1azl, (1azw), 1bcf, (1bdi), 1bea, (1bes), 1bet, 1bgf, (1bjn), 1bka, 1bkq, 1bom, 1brk, 1brq, 1bvb, 1bvy, (1bwj), 1cdz, (1cjh), 1cmk, 1cnf, (1cxx), 2el, 2fd, 2fp, 2gr, 2hw, (2kf), (2ke), 2nz, 2qz, 2ry, 2ts, (2ue), 2wb, (2wr), 2xq, 2adl, 2aho, (2aim), 2aja, 2aly, 2anm, (2aqc), 2awf, (2awl), (2aws), 2ayv, (2azc), 2bbb, (2bfx), 2blp, 2bnh, (2bqb, 2brb, 2bsc, 2bue, (2bwo), 2ccd, (2cfb), (2ckr), 2cnv, 2coa, (2col), (2cqz), 3bx, 3bz, (3ca), 3cg, (3fs), (3hg), (3hx), (3il), (3iw), 3jj, (3ot), 3rf, 3sm, 3su, 3tj, 3ue, (3vw), (3xm), (3yo), (3zo), 3zw, 3zz, 3afb, (3ajd), 3ajj, (3bhm), 3biy, (3blf), 3blu, 3bnu, 3brf, 3brw, (3bsb), (3bsl), 3bup, (3bva), (3bvc), 3bvl, 3cqz, (4bx), 4by, 4cg, 4ea, 4eb, 4el, 4en, (4ft), 4gh, (4hi), 4id, (4jk), 4jy, 4kc, 4lj, 4nt, 4ok, (4xd), 4xk, 4ya, 5da, 5eg, 5ek, 5er, 5es, (5fv), 5hb, 5ik, 5nv, 5os, (5uk), 5xa, 5xk, 5zb, 5aaa, 5aag, 5aws, 5xad, 5zas, 5zaz, 6ka, 6zp, (qra pse?), 7ad, (8bk), (8cp), (8oe), (8pt), (8qk), (8vy), (8xe), (8yn), (8zy), (8zz), (8ach), (8aim), (8anb), (8awz), (8azd), (8blc), (8byn), (8byn), (8cur), (8zag), (8beo), 9al, 9ar, 9aw, 9cr, 9dz, 9eh, (9ei), 9fm, 9gl, 9gx, (9ii), (9io), 9km, 9kp, (9le), 9lh, 9lq, 9oe, 9ox, 9pf, 9pi, (9pn), 9uc, 9uk, 9us, 9ut, (9uu), 9xu, 9yaj, 9ym, 9zn, 9aap, 9ads, 9afn, (9ahh), 9aix, 9ajp, (9amh), (9ami), 9anq, 9aog, 9aoh, 9aps, 9aqm, 9aqo, 9aqr, 9arq, 9arz, 9ase, 9atc, 9awf, (9awm), 9awr, (9aws), 9bcb, 9bch, 9bct, 9bdb, 9bds, 9bed, 9bgh, (9bhd), 9bie, 9bik, 9bln, (9brk), 9bsz, 9bvp, 9bwm, 9bws, 9bya, 9bzi, 9cba, 9ccs, 9ccv, 9cgk, 9cgq, 9cja, 9ckm, 9cln, 9cte, 9ctf, 9ctr, 9cvd, 9cvo, (9bdv), 9dcr, 9dfb, (9dky), 9dlr, (9dpf), (9dpl), 9dqu, 9dta, (9dvn), (9dwq), (9dyi), 9dyn, 9eci. Canadian—3bv, (3de), 3dh, (3ds), 3go, (3je), (3jk), (3sx), 3xn, 9al. Pse qsl; all cards answered.

By 6ARB, 3029 Baker St., Berkeley, Calif.

C. W.: (5di), 5nk, 5ky, 5za, 5xad, (6cu), 6ea, 6ec, 6ef, (6gx), 6jd, 6ku, (6pi), 6rr, (6tw), 6za, (6zs), 6abx, 6agp, 6aok, 6aoz, 6apw, 6aqw, 6atg, 6atq, (6bbc), (6bcj), 6beg, 6bic, 6bfp, 6bjc, (6bjq), (6bjy), 6bkb, 6bla, (6blu), (6bmd), 6bmx, 6bnv, 6boe, (6bpz), 6bqc, 6bqf, (6bqg), (6bqp), 6bqz, (6brg), (6brk), 6btq, 6bum, (6bun), 6zac, 7bj, 7bk, (7dp), 7du, 7jw, (7lu), 7mf, 7na, 7ng, (7oz), (7ot), 7qw, 7sc, 7sy, 7th, 7tq, 7uu, 7zk, 7aea, 7aft, 8cf, 8ib, 8ml, 8ow, 8xe, 8cm, 9cu, 9cp, (9dr), 9hr, 9hv, 9gk, 9kp, 9lz, 9zn, (9ajp), (9amb). 9ami, 9aog, 9aon, 9aul, 9awm, 9bji, 9bjv, 9cfy, 9cns, 9dpl, 9dtm, 9dwk, 9yaj, 9zaf. Can.—4bv, 9ac, 9bd.

Spark: 6oo, 6ajh, 7nw, 7tj. Can.—5cn, 9bd.

By 6VD, 417 N. Claudina Street, Anaheim, Calif.

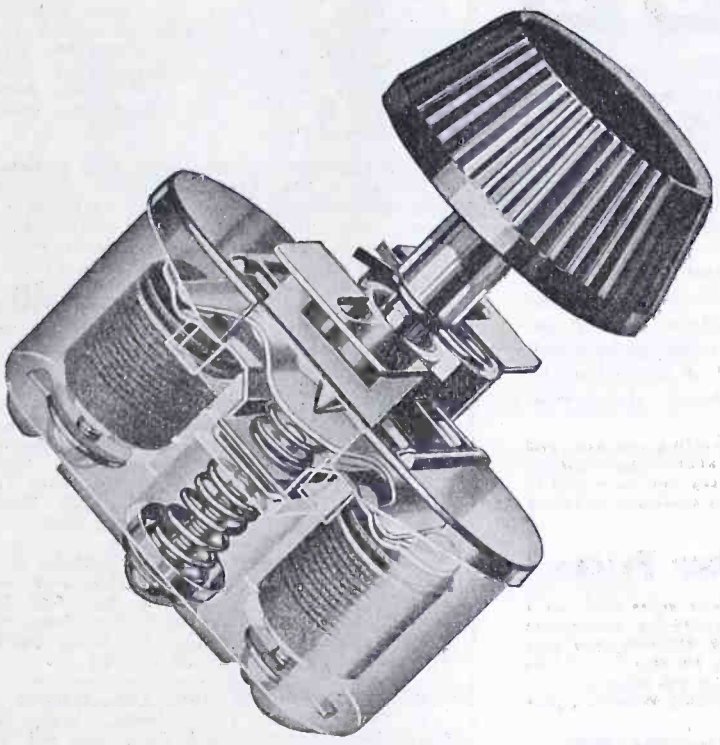
On a super-regenerative receiver using the circuit and constants given by Mr. Best in his article a few months ago in RADIO. The aerial used was a loop of five turns on a form 3.5 in. square. They are all C. W., spark being inaudible on the set: 6fh, 6km, 6ti, 6zi, 6zx, 6zz, 6akl, 6awt, 6bbh, 6boe, 6asj, 7bj, 7ot, 9bm.

By 6AVX, San Diego, Calif.

3blf, 3hg, 3gh Can., 4bv, 4bv Can., 4hg, 4jm, 4km, 5aec, 5cn, 5cn Can., 5ir, 5jai qra?, 5px, 5sm, 5xa, 5xaj, 5xk, 5za, 5zas, 5zav, 5zb, 6bbh, 6aub, 6zr, 6zt, 6zac, 7ab, 7abb, 7aenr, 7bj, 7bk,

Continued on page 48

The New Bradleystat —a Phenomenal Success



A Phantom View, Showing the Discs

These graphite discs, scientifically prepared, contain the secret of the Bradleystat. No wire rheostat can possibly give the noiseless, smooth control so eagerly sought by radio men. For both 6-volt and 1½-volt tubes, Bradleystat control is unsurpassed.

The discs have no inductance. They last forever, and laboratory tests reveal that they maintain better adjustment than the wire rheostat. Try one, tonight, and enjoy the supreme delight of Perfect Filament Control.

Allen-Bradley Co.
Electric Controlling Apparatus

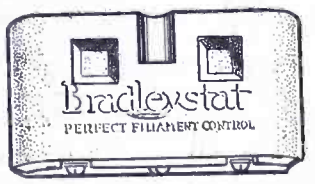
288 Greenfield Avenue · Milwaukee, Wisconsin

Member of the National Radio Chamber of Commerce

Some Distinctive Features

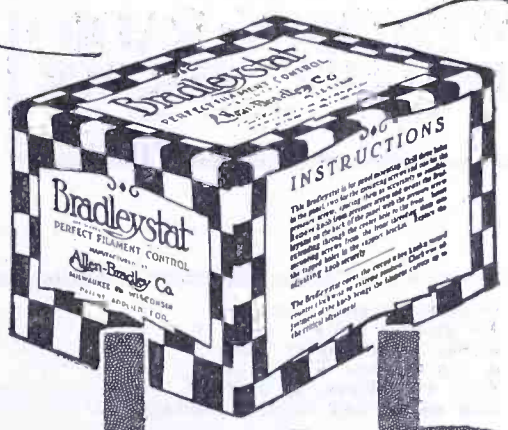
The new Bradleystat is creating widespread interest among radio enthusiasts. Several refinements in the new model makes the new Bradleystat pre-eminent in the field of filament rheostats.

The new knob, beautifully proportioned and fluted to match the finest radio equipment, distinguishes the new Bradleystat for its splendid appearance. The new porcelain container is smaller than the older model, but the range of control is better than ever.



The name, "Bradleystat" is embossed on the new container to protect you against spurious imitations. Safeguard your radio set by insisting on genuine Bradleystats. An adjusting screw has been added in the base for setting the "cut-off" switch as you desire.

Retail Price
$1.85
P. P. 10c extra



Bradleystat

REGISTERED U.S. PAT. OFF.

PERFECT FILAMENT CONTROL

Tell them that you saw it in RADIO

CALLS HEARD

Continued from page 46

7cz, 7dp, 7gc, 7gk, 7gs, 7jw, 7mf, 7ny, 7ot, 7pf, 7qu, 7rk, 7sc, 7th, 7tm, 7to, 7tq, 7ug, 7zo, 7zu, 7zy, 8aaf, 8abc, 8azn, 8awx, 8aiv, 8ala, 8axc, 8ago, 8amm, 8alt, 8bum, 8bfm, 8byn, 8bvr, 8bk, 8bvd, 8bxx, 8cur, 8cmi, 8gh, 8qy, 8ve, 8xae, 8zo, 8zy, 9aps, 9anq, 9aon, 9aul, 9awm, 9asf, 9asa, 9aja, 9asu, 9amb, 9avs, 9avz, 9ami, 9afk, 9arz, 9aap, 9bec, 9bik, 9bji, 9bqt, 9bzi, 9bds, 9bm, 9bey, 9bfd, 9bed, 9bhd, 9cns, 9cl, 9cfy, 9ccm, 9cxp, 9ccu, 9cde, 9dfb, 9dky, 9dte, 9dtm, 9dsm, 9fm, 9gk, 9ii, 9pi, 9xaq, 9yaj, 9zaa, 9zt, 9zn, 9zaf. Anyone hearing 6avx accw pse qsl.

By Robert Nagle, Van Nuys, Calif.

1alw, 4cg, 4eh, 4jm, 5de, 5di, 5ek, 5kp, 5sk, 5tc, 5tj, 5za, 5zav, 5zb, 7abb, 7aem, 7aic, 7afw, 7bj, 7bmy, 7bk, 7ex, 7jw, 7ke, 7lu, 7lr, 7mf, 7ng, 7ny, 7tq, 7ub, 7wm, 7xc, 7zr, 8ago, 8aqo, 8asv, 8axb, 8axc, 8azf, 8bx, 8bzy, 8cf, 8cur, 8sp, 8xe, 8yk, 8zy, 8zz, 9ajp, 9ami, 9apw, 9asf, 9aul, 9awm, 9bds, 9beo, 9bey, 9bik, 9bji, 9bjv, 9bm, 9bqw, 9brk, 9bxa, 9bxq, 9bzi, 9caa, 9ccv, 9cfy, 9cmk, 9dah, 9dfb, 9dhi, 9dky, 9dte, 9dtm, 9ei, 9fv, 9fi, 9fm, 9pi, 9ps, 9uu, 9xaq, 9yaj, 9yak, 9zb, 9zn, I. C. W.

By 6BQH, 2507 E. First St., Los Angeles, Calif.

C. W.: 5di, 5tj, 5zav, 5za, 6bf, 6cc, 6fh, 6gr, 6ku, 6aag, 6aat, 6abx, 6ajf, 6aqq, 6aqw, 6awt, 6atq, 6auu, 6aoi, 6aor, 6bbh, 6bjy, 6bmd, 6bnw, qra?, 6bob, 6boe, 6bql, 6bsa, 6bum, 6bvq, 6bvw, 6bwa, 6bwp, 6za, 6zb, 6zh, 6zo, 6zx, 6zz, vy qsa, 7bj, 7tq, 7ot, 7zo, 8bo, 8bcy, 9amb, 9aou, 9aul, 9awm, 9bji, 9dtm, 9dug, 9bxq, 9zaf (voice).

Spark: 6tu, 6qr, 6abw, 6awh vy qsa, 6zh, 7ya, cl8.

By 7JU, Eugene, Oregon

5ct, 6nv, 6ak, 6cv, 6lh, 6ti, 6vf, 6lu, 6rk, 6gp, 6gy, 6zx, 6pi, 6vm, 6nx, 6bcj, 6bko, 6bun, 6abx, 6aat, 6awh, 6bmd, 6brg, 6atj, 6bou, 6bum, 6bqp, 6atj, 6bpc, 6auu, 6bjr, 6alv, 6bip, 6ajh, 6gd, 6akr, 6bmy, 6ast, 6alu, 7bk, 7bj, 7ex, 7ge, 7gp, 7im, 7jg, 7kj, 7lu, 7qt, 7ri, 7ud, 7wm, 7aff, 7afh, 7aic, 9ox, 9uu, 9ami, 9bcf, 9ccv.

By 8KW 236 Barton St., Buffalo, N. Y.

1bka (fone), 2brb, 3bnu, 4bx, 4by, 4ea, 4ft, 4gl, 4kc, 4kt, 4lj, 5aag, 5da, 5ek, 5er, 5es, 5fv, 5jd, 5md (spark), 5nv, 5pv, 5sa, 5sm, 5tj, 5va, 5xa, 5xt, 5xk, 5za, 5zas, 5zx, 6acr, 6avd, 6xad, 7zo, 8bda, 9dky, 9zn, (3kp) Can.

By 9BJI, 3935 W. 30th Ave., Denver, Colo.

C. W.: 1bbc, 1bet, 2awf, 2bmr, 2el, 2oe, 3auu, 5acf, (5aec), 5aej, 5dn, 5ek, 5fj, 5ft, 5fv, 5gj, 5ia, 5if, 5ik, 5im, (5is), 5ix, 5jm, (5ib), 5me, 5mo, 5ou, 5pb, 5pf, (5pv), 5px, 5rj, 5rh, 5sf, 5sm, (5sr), 5nk, (5nv), (5tc), 5tj, 5tp, 5uj, 5uk, 5tm, 5un, 5uo, 5vm, 5vq, 5we, 5xd, 5xt, 5xv, 5zar, 5zh, 5zs, (6abx), (6ada), (6ahq), 6ajf, (6ak), 6alx, (6apw), 6aqa, 6arf, 6atq, 6avn, (6avr), (6awt), (6bcr), 6bet, 6bhq, 6biq, 6bjc, (6bjr), (6bjy), 6bko, (6boe), (6bqc), (6bqd), 6bqg, (6bqz), 6bsa, 6bum, (6bun), 6cc, 6cu, (6ea), (6ec), (6fh), (6gf), (6gr), 6gx, 6km, (6lo), (6lv), 6om, (6pi), (6tc), (6ti), 6uw, 6xav, (6zac), 6zaf, (6zs), 6zx, 6zz, (7bj), (7afw), 7hm, (7lu), 7ly, 7sc, (7th), 7xc, 7zo, 7zv, 8acf, 8ago, 8amm, 8ax, 8bcy, 8bdv, 8bef, 8bk, (8bke), 8brc, 8btv, 8bxh, 8bzy, 8cdz, 8cf, 8cmi, 8cve, 8dat, (8ib), 8qk, (8sp), 8sz, 8uk, 8uz, 8vd, 8yn, 8zw, 8zy, 9aao, (9abv), 9aeq, 9ahh, (9ajp), 9alr, 9anf, 9aog, 9aon, 9ap, 9aqh, 9aqm, 9arz, 9asn, (9atn), 9apw, 9aul, 9aua, (9avc), 9avz, 9aws, (9awz), 9avm, 9axa, (9baf), 9bbf, 9bcf, 9bds, 9bed, 9bfg, 9bgh, 9bhd, 9bhq, (9bie), 9big, (9biz), 9bik, 9bjm, 9bjv, 9bkm, 9bil, 9bkp, 9bkw, 9blo, 9bly, 9bp, (9bqw), 9bri, 9brk, (9bsz), 9btt, (9bud), 9bvl, (9bxt), (9bzi), 9byz, 9bze, (9ccv), (9ccs), 9cfi, 9cfk, 9chn, 9cip, (9ckm), 9clq, (9cmk), 9cns, 9coi, 9ctn, 9cvo, 9cxz, 9czf, (9cvv), 9cwc, 9dcg, 9dcr, 9dge, 9dgn, 9djb, (9dky), 9dlk, (9dpl), 9dqm, 9dqu, 9dsm, (9dta), 9dr, 9dvn, 9dwq, 9dxn, 9dyg, 9dzy, 9eak, 9dzw, 9ebt, 9fk, (9fm), (9ig), 9ii, 9il, 9io, 9lz, 9nu, 9pi, (9pw), 9qf, 9ps, 9sj, 9uh, 9xc, 9yf, 9zn-icw, 9zy. Can.—3co, 4dq.

By 6bui, Provo, Utah

C. W.:—5bv, 5de, 5za, 6cc, 6ea, 6ti, 6adm, 6agp, 6atq, 6bbh, 6bin, 6bjq, 6bjt, 6bnu, 6btj, 6bug, 6bvg, 6xad, 6zh, 6zo, 6zr, 7ad, 7ex, 7hj, 7hm, 7ot, 7tq, 7zu, 8aqo, 9dr, 9pi, 9pn, 9ahh, 9ami, 9anq, 9awm, 9aws, 9bbu, 9bik, 9bji, 9bjv, 9bpi, 9bun, 9bxq, 9cfy, 9ctw, 9dji, 9dky, 9dte, 9xaq, 9yah.

By 6BJC, 540 St. Andrew's Pl., Los Angeles

C. W. (during T. A. prelims): 2lo, 3yo, 5di, 5fv, 6px, 6sm, 5xad, 5za, 7aem, 7afw, 7aic, 7bj, 7bk, 7dk, 7dw, 7gk, 7jw, 7lr, 7lu, 7mf, 7ot, 7sc, 7sy, 7th, 7tq, 7zb, 7zo, 7zu, 8aqo, 8asv, 8azd, 8bef, 8bke, 8bpl, 8bxh, 8cf, 8cmi, 8ib, 8sp, 8tk, 8zz, 9amd, 9amb, 9aog, 9aps, 9aul, 9avz, 9awm, 9bds, 9bhd, 9bji, 9ccv, 9cfy, 9cns, 9dkx, 9dsm, 9dtm, 9dyn, 9gk, 9lz, 9pi, 9pn, 9zaf, 9zn. Can.—3co, 4bv, 9aw.

By 6BPB, E. N. Willis, 1254 10th St., Santa Monica, Calif.
(One tube.)

C. W.: 4km, 5za, 6aav, 6arf, 6alv, 6atq, 6bbh, 6bsj, 6bow, 6boe, 6bpr, 6cc, 6dd, 6lr, 6ti, 6vm, 6zaa, 6zac, 6zh, 6zo, 6zz, 6zt, 7bj, 7cu,

Continued on page 78

SIGNAL Radio Talks, No. 1

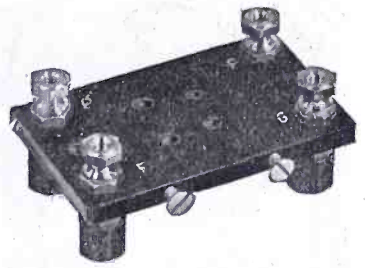
Facts from the Factory

YOU don't have to fuss and cuss every time you tune up the evening's Radio recreation—or have every other number on your program sound like a selection from *Inter Ference*.

Much of this "interference" is due to apparatus incorrectly, ignorantly, or carelessly manufactured. Do your best on assembling such parts, or manipulating such sets—you never *can* get satisfaction.

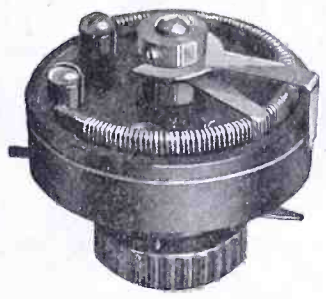
But with SIGNAL equipment—ah, that's different! Our folks have been making wireless apparatus for over thirty years. Men here have grown gray in our service. They take old-time pride in seeing that nothing but the best in materials, workmanship, and finish leaves the SIGNAL plant.

It is made right. It looks right. It works right. If you insist on SIGNAL when you're buying Radio equipment—you will buy Radio satisfaction.



SIGNAL Tube Base for WD 11 Tubes

Adapted for building receiving sets using a single dry cell for filament excitation. Does away with the troublesome 6 volt storage battery, but retains the efficiency of the 6 volt tube. Legs insulated for table mounting; screws provided for panel mounting.



SIGNAL Vernier Rheostat

The first successful vernier using a single knob for control. Fine adjustment is easily obtained. Simple in design and sturdy in construction. Furnished with or without knob and pointer, so dial to match others of set may be used.

(1953)

SIGNAL Electric Mfg. Co.

Factory and General Offices:
1913 Broadway, Menominee, Mich.

Atlanta Boston Chicago Cleveland Minneapolis Montreal
New York Pittsburg San Francisco St. Louis Toronto

You'll find our local address in your Telephone Directory

Information Coupon

Signal Electric Mfg. Co.,
1913 Broadway,
Menominee, Mich.

Please send catalog and bulletins giving complete information about SIGNAL Radio equipment to name and address written in margin.

_____

_____

_____

VERSATILE VACUUM TUBE

Continued from page 14

formation of parts due to heat or other causes.

By the use of repeaters in telephone lines over long distances, therefore, the range of such service has been extended to cover not only the mainland portion of our country, but it has been carried outward to include the islands of the sea. Cuba is joined to the general system by deep-sea telephone cables, and Catalina Island in the Pacific is joined up by means of a radio link between that island and Los Angeles, California, this link cooperating perfectly with the wire-line portion of the system. The vacuum tube has liberated an entire art in a very striking way.

Consider, if you please, the case of a passenger on a trans-Atlantic liner talking from his stateroom through the land line system of the United States to a regular subscriber's telephone on Catalina Island. This is entirely a possible task, and has been done in every technical detail. Here is the route: From the ocean liner telephone to a modulator, to an amplifier, to an oscillator, to the transmitting aerial on shipboard, through the ether to the receiving aerial on the Atlantic seaboard, to radio-frequency amplifiers, to a detector, to audio-frequency amplifiers, to the long distance line, to and through a series of repeaters in that line, each using a tube or tubes, to a modulator on the California coast, to an oscillator, to the transmitting aerial, through the ether to the receiving aerial on Catalina Island, to radio-frequency amplifiers, to detector, to audio-frequency amplifiers, to the local line and so to the receiving telephone. And through all this maze of apparatus the voice current is repeatedly extinguished, then replaced by a similar —and frequently an augmented—copy of itself, coming out into the final telephone receiver in satisfying volume and quality.

We are as keenly conscious as any reader that this has been a cursory view of a broad subject, but we hope that it at least hints at our respect for the device and its applications so far as yet made, at our hopes and beliefs as to its future applications, and at our regard for those minds that brought it into being, had faith in it and set it to work.

Let us paraphrase the words of the late Judge Taylor of Indiana: "Truly no man may add a cubit to his stature by taking thought. Yet here is an example wherein men, by taking thought, have added not cubits, but many miles, to the lengths of all men's tongues and ears."

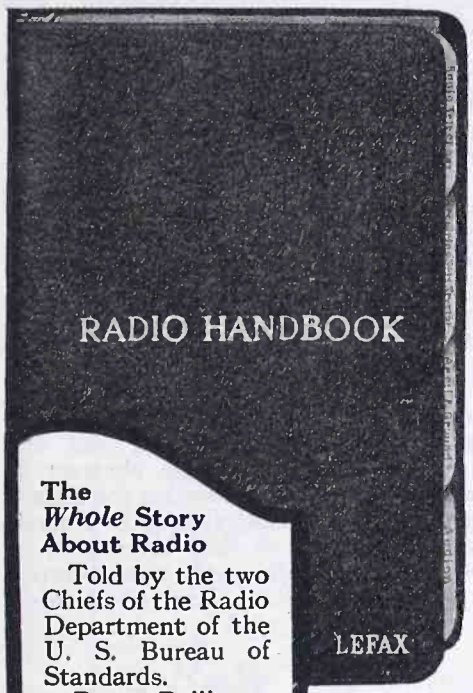
NEWS OF THE AMATEURS

The QRA of 5xAD-5QY is Orange, Texas, and not Austin, Texas.

Call 4DJ has been assigned to T. H. Nabors, Box 141, Heigh Point, N. C.

Lefax Radio Handbook—

Distributed in the West by Pacific Radio Pub. Co., Inc.



The *Whole* Story About Radio

Told by the two Chiefs of the Radio Department of the U. S. Bureau of Standards.

Dr. Dellinger, and Mr. Whittemore, the authors of the Lefax Radio Handbook are the only authorities who have access to all the facts about Radio as well as all the New Developments. They have not only written the most complete story about Radio obtainable, but will also write up all the new developments for the YEAR'S FREE SERVICE (to be continued after that at a small cost)

LEFAX Radio Handbook is the one Book on Radio that keeps abreast of developments. As quickly as the authors learn new facts about the subject, the information is passed on to you. It comes all printed in loose-leaf form, all pages numbered and properly classified. Lefax is the only Book on Radio that doesn't, cannot grow old.

Note the little rings in the center of the book. Those rings are hinged. They are instantly opened—by a slight finger pressure—to receive the perforated pages. Once an ordinary book is bound, it cannot be changed—but Lefax can. You buy Radio information *complete* when you buy Lefax. We furnish, free for a year, pages containing additional information. You need Lefax Radio Handbook.

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Herewith is $3.50. Send one Lefax Radio Handbook to:

Name .....

Address .....

ARMSTRONG "RADIO FLIVVER"

Continued from page 16

The loop should be rotated to various angles. In many cases, in metal frame buildings or in autos near wires, etc., its most favorable angle will not always be when it is pointing toward the station.

The loop tuning condenser, filament rheostat and plate variometer are of equal importance in tuning and should be adjusted alternately. The condenser and variometer adjustments bear a very definite relation to each other, which is properly indicated by a noisy rattle. The proper adjustment will be found somewhere in the middle of this noise and when the proper adjustment is found the noise will stop and the music or speech will come in clear. At this point it is interesting to note that when the broadcasting station stops the noise will commence, but if the adjustments are not disturbed, the station will come in again and the noise disappear automatically.

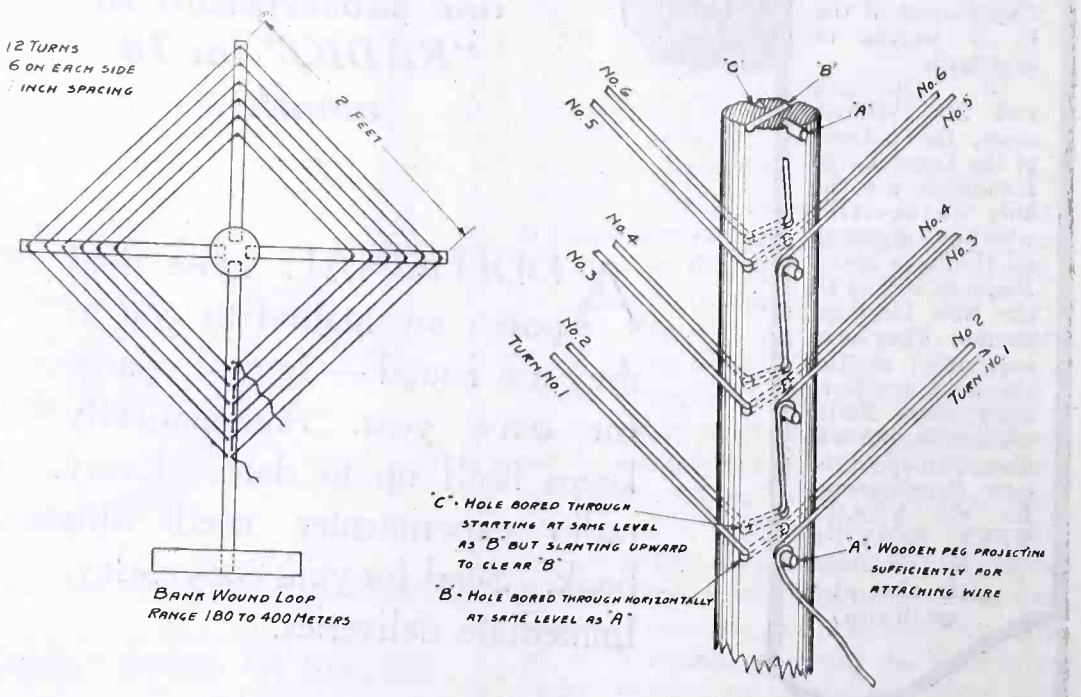

Fig. 5. "Bank-Wound" Loop

In conclusion, there is offered what is believed to be a novel design of a "bank-wound loop" which seems to have several advantages. The box frame loop is best for a sharp directive effect, but is cumbersome and clumsy. The spiral or pancake wound loop is simpler to construct but is inefficient, as the inner turns of smaller diameter are of little value. The bank-wound loop shown in Fig. 5 (360 meters) seems to combine the advantages of both types without any of the disadvantages.

BROADCASTING IN GREAT BRITAIN

The six principal manufacturers of radio equipment in Great Britain have incorporated a broadcasting company, stock ownership in which will be available to themselves and to any other manufacturer of radio receiving equipment in the British Isles. The broadcasting Company will have a capital of £100,000, which has been guaranteed by these six manufacturers. Any bona-fide British manufacturer of wireless apparatus may join the company by subscribing to one or more shares. The president of the Broadcasting Company will be Lord Gainford. Present plans call for the establishment of eight stations at London, Birmingham, Manchester, Newcastle, Cardiff, Glasgow, Plymouth and Aberdeen.

In Great Britain amateur receiving sets have always required a license from the Post Office Department, which has supervision over all forms of communication. The license fee is 10 shillings per annum, or about $2.20. The Post Office has agreed to pay to the Broadcasting Company half of this annual fee.

In addition to its share of the Government's license fee, the Broadcasting Company will receive from every manufacturer who is a member of it, fees, based on their sales of radio receiving apparatus for amateur use. It has been estimated that each broadcasting station will cost about $90,000 per annum for operating and program fees, and any profits which remain after the payment of all charges will be divided among the Broadcasting Company's stockholders up to a maximum of 7½ per cent on their investment.

In order to protect the radio manufacturers from foreign competition, the Government has agreed not to license for use any receiving station equipped with other than apparatus made by members of the Broadcasting Company.

Home-made sets can be constructed and operated under the new arrangements, provided they pay the stipulated 10-shilling government fee.

RADIO TRADE NOTES

Frank A. D. Andrea advises that T. R. Goldsborough, U. S. Patent Office, Wash., D. C., has been awarded a two-step amplifier as the winner of the prize contest recently conducted.

THE OPERATOR'S AUDION

Continued from page 20

harm in trying the company's offices direct, going if necessary to the highest official in the organization. There are all sorts of exceptions, of course, but as a general rule, the bigger the man, the quicker will he understand what you are trying to do. If no attention can be got anywhere, it is perhaps because the operator does not know how to set the matter forth convincingly. Ask your captain or your port-captain to read this article.

The steamship companies are keenly interested in anything that is to their advantage; that is why they put radio aboard their ships—their cargo ships at least—in the first place. The moment the ship-owner gets an idea of what the vacuum tube detector and amplifier means to the efficiency of his radio service, he will be glad to buy it. But how is he going to know of his lack, if no one tells him about it?

THE ROMANCE OF RADIO

RETURNING now to a brief concluding view of the life of the professional radio operator, some of the phases of which it has been the aim of these five instalments to discuss, it may truthfully be said that for the wireless operator who knows how to do his work, and does it; one whose merits as an officer and as a man have won for him the esteem of his fellow officers and of his captain; one who has sailed long enough to absorb the atmosphere of shipboard life and a little of the salt of the sea,—for such an one, if he be on a tramp steamer, there is a life as idyllic as ever was dreamed of by philosophers and poets, a being than whom where is none freer on earth.

And not only is he free. Travelling always, he learns much; his outlook immeasurably broadens; whereas the stationary mass of mankind see life through the figurative knot-hole of one locality or one country, he sees it standing outdoors commanding a full sweep of the horizon. Narrow beliefs, conventions, bigotry, all the cobwebs of restricted environment, are swept away. If he is likely to lose religion, of the creeds, he has the opportunity, so be he has the moral stamina, to gain a profound philosophy of life. Equally at home on a London tram or in a Singapore sampan; returning the smiles of petite Parisian style-pictures, viewing the marvelous engineering of the Panama Canal, buying a bolt of silk in Yokohama; from the cold white splendor of the Bering Sea wastes to the blazing heat of restless Mexico; today enjoying the latest musical comedy on Broadway; tomorrow gazing upon three-thousand-year-old stone giant-gods on the banks of the Yang Tse Kiang,—all these, and a

thousand things more, are of the sea-claimed man's daily life: he knows them not as the hurrying and hurried tourist, who sees little and feels less, knows them; but with the unexpressed and inexpressible understanding and knowledge of common kin with all the earth of one who lives among the constantly changing scenes of his many travels, become truly indeed an inhabitant of the world.

RECENT PATENTS

Continued from page 34

rection. The unilateral conductor in this instance is itself a vacuum tube, and its effect upon conducting away the positive charge on grid *17* may be controlled by properly controlling the resistance *24* or by inserting a source of potential *22* into the circuit.

H. H. Beverage, Pat. No. 1,434,986: Nov. 7, 1922. Radio Receiving System.

A long horizontal antenna *1, 2* of the kind described in the prior Beverage patent No. 1,434,984 is described, in which a receiver *10* is used to detect signal waves traveling from the right to the left, and there caused to affect the secondary *8* of a transformer. In order to make the detector respond only to the desired wavelength, tone traps *11, 12* and *13* may be provided between the two lines *1* and *2,* which traps are tuned to the wavelengths it is desired to eliminate. In this way these interfering waves are by-passed without going through the detector circuit.

J. H. Hammond, Jr., Pat. No. 1,418,-792; June 6, 1922. System for control of moving bodies by radiant energy.

A system is described in which the body may be steered automatically by the aid of a gyroscope, or else the control may be effected from a distant point by radiant energy acting upon a solenoid. This solenoid may be made to rotate the stem of a rotary valve in a step-by-step manner. Fluid under pressure from a tank is appropriately controlled by this valve to unclutch the gyroscope and to move a piston in a cylinder in either direction, and thereby to move the rudder. An auxiliary valve is used for operation in connection with the gyroscope control to check large movements of the rudder and thereby damp the oscillations of the steered body.

WORTH

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own get! And I guess I've made's much as any o' 'em in this county! You two git to bed—for ye've got to be up at 3. All that firewood on the hill, 'bove Otter Brook has got to be brought in—afore somebody steals it!"

Without a "goodnight" he clumped in a neighboring room, slammed the door, and the two heard him get in bed, vibrant snores ensuing, almost forthwith.

The boy got up, tiptoed to the girl: "You wont never, *ever* tell, will ye, Flora?" he whispered in her ear.

She smiled wanly and shook her head: "Ef he catches you again, he'll mos' *kill* you!" she said, very softly.

"I don't care! Rather *be* dead than know nothin'!"

And he slipped out in the bitter cold of the star-hung night, opening and closing the door so carefully that it made no sound.

Hurrying to the wagon barn, over which there was a steep-eaved loft, he climbed to it by a ladder. Moving with the sureness bred of long familiarity, he hunted in a corner, brought out a few inches of candle and a much frayed book. He struck a sulphur match, whose first blue splutter lighted his face in a ghostly way. The candle going, he stuck it inside a box, that its rays might not leak through any chinks; and then, with a little sigh of happiness, he sat cross-legged in his tattered overalls—thin hands and feet gray with the cold—and opened the book to a page whereon was printed the international code of signals.

"A=*dot-dash*, B=*dash-dot-dot-dot*, C=*dash-dot-dash-dot*, D=*dash-dot-dot*, E=*dot*. . . . . .

A MILE from the Ellison farm, situated on a high hill, with a sweeping view of the whole countryside, stood the pretentious country residence of U. S. Senator Briggs. From great distances its huge white colonial columns stood out sharply, and the many out-buildings, pergolas and so forth, caused the hilltop to seem as a self-contained little village. To one side of the "big house" stood a very fine mast, some 100 feet in height, that pointed as a white finger at the blueness of the great expanse overhead. At its top was a cross-arm, from whence a most efficient antenna sloped to a lesser spar, on one corner of the house. Thence the wires led, in braided form, to a huge insulator in the wall.

And by these things be it known of Robert Briggs, the Senator's only child, a youth of sixteen, utterly spoiled by an adoring mother, and suffered in silence by his father, that his latest "craze," as the Senator dubbed his various enterprises, was radio. But he was far too lazy to study with any degree of seri-

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ousness. He had mastered the code, after a fashion, and absorbed just enough knowledge, by dint of hard, professional coaching, to sneak through the Government examination—that was mandatory for his being granted a license to operate.

At the time of the examination, the radio inspector, after having read young Briggs' papers, snorted in disgust—"What a wicked waste!" he ejaculated to his assistant. "I suppose that I've got to pass him—or the Senator will raise an awful row—or his wife will, which is *worse!* Lord! the boys in this great land of ours, with *his* opportunities—with that splendid station—the finest apparatus that money can buy, and an electrical engineer to help him run it—the boys, I say, in this land—half, yes one-quarter, of his age—would pass this examination 100%; and look at *that,*" tossing a sheet to the other, "can't even define an ohm! I don't know—" the grey-haired inspector walked to the window, looked pensively out over the endlessly-stretching roofs of the city—"I'm not criticizing, *but* God does seem—unfair—at times!"

ON the third floor of the Briggs' home was a huge room, devoted entirely to radio. Here were to be seen the latest types of receivers, amplifiers, loud speakers, elaborate phonographs, for music reproduction, motor-generators—all manner of expensive things were scattered here and there. And there was a large bookcase, filled with the most modern and expensive radio publications. In short, a station that, in so far as its cost and excellence were concerned, was unequalled in the country.

Moodily sitting on a table corner, one leg swinging idly, was Robert Briggs, Jr.—the owner and. . . . . "operator."

Busy at a long-wave receiver, whose performance did not please him, was Hugh Mathers, Robert's "radio tutor"—as Mrs. Senator Briggs was wont to tell her friends, adding: "Robert is making great strides in his radio studies. The Senator is very proud of him! He has heard Kalamazoo, or Kamchatka, or Berlin—I have forgotten just which—but it was a *very* long way off!"

"Look here, Rob! Why don't you get busy, and make an effort to really study the radio game? It's the coming thing—the greatest discovery ever made, and we are only the fringes of it! With the opportunities that you have, man alive! you could be, you *ought* to be, the top-notch amateur of the United States!" The young professional looked—imploringly—at the rich man's son. But Briggs, Jr., stared at him—dully—

"Too darn much trouble! I don't ever have to be a radio operator—for a living—and my station is pretty widely known, as it is! I'm satisfied!" He lumbered his overly-heavy figure from the table—"Think I'll go for a run in the new car. Have that thing working for tonight!"

Mathers watched him go, shrugged his shoulders—"I'm not going to quarrel with the easiest bread and butter a chap could make—BUT if that big lunk of ignorant conceit belonged to *me,* I'd . . . . . ."—he whistled his intents.

A ROISTERING wind lifted the dusty-dry snow—as powder—whirling it gleefully hither and yon over the broad landscape. There was an invigorating sting in the clean chill of the winter morning, and Mathers hummed gaily as he plodded along, returning to the Briggs' mansion from the village.

Save for the housekeeper and another servant, he was alone at "Viewdale," Congress being in session, Senator Briggs in Washington, while the boy and his mother, "avoided the rigors of a New England winter"—at Palm Beach.

But Mathers did not at all object to being alone. Amply supplied with every facility to further himself in his chosen profession of radio, he studied and experimented, hour after hour, and during the long night watches.

Rounding a sharp turn in the road, he came suddenly upon a strange little figure, sitting a'top a rail fence—in an old coat made of quilted patchings, a pair of rubber boots—much too large for him—a frayed tam-o'-shanter pulled over his ears, and a pair of coarse mittens. The figure did not notice his approach, and Mathers followed the line of the other's gaze. It was focussed on "Viewdale," whose buildings, a quarter of a mile away, shone vividly clear in the brilliant winter sun, and where the radio spar seemed taller than ever, against the deep blue of the skies.

"Hello sonny!"

Walter Ellison turned, in a startled way—" 'Mornin'—pretty cold!"

"Roosting on that fence is no *warm* proposition! What are you looking at so hard?"

"Me? Oh—I was just—just playin' wish—*kind* o'!" the boy answered in a forlorn little way.

" 'Playing wish'? What for?"

"That I—that I could have the chances *he's* got!" ducking his head toward "Viewdale." "I'd be *some* operator—in less'n no time—I bettcha!"

" 'Operator'?" repeated Mathers, incredulously, but taking instant interest in the country lad, with his earnest, intelligent face, and honest gray eyes.

"Oh yes! Dunno why, but I'm set on learnin' to be an—an operator! An' goin' to see the wide world on—on ships. Don't seem *right* to stick 'round a farm, tendin' pigs and cows—if a feller has got any brains—and I—I got

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a few, I think! I wish I had—*his* chances!" he reiterated, slowly.

The longing in the boy's voice touched chords in Mathers, that vibrated strongly.

"Want to come up and see the station? I'm all alone. Senator in Washington, and the family in Florida. Come on—if you want to!"

A gleam of passionate desire came in the gray eyes. Then it flickered out.

"I—daren't! Pop'ld murder me! He's licked me till I couldn't stand—when he found me studyin' the—the signals, an' some other scraps of things—I—I picked up."

"Whose boy are you?"

"Zeb' Ellison's—down in the bottom—yonder."

"*Hmmm!*" the information conveyed a full understanding—for even Mathers had had a row with the farmer, who insisted upon being paid $5 for a scraggly hen that he had accidentally run over while driving a little runabout car that he was permitted to use.

"Suppose that I slip you a couple o' dollars—and if your father says anything—tell him I hired you to come up and help me!"

The boy was off the fence in an instant—

"Come on!" he said, simply.

"Well—there's the outfit. What do you think of it?"

The lad stood just inside the door of the big room, where the sunlight glinted and sparkled on the metal work of the radio apparata. A little fire burned cosily, and there were comfortable chairs about.

The big gray eyes travelled slowly round, then Walter looked at Mathers:

"Guess I've got into Heaven—by mistake!" he said, gravely.

Then, in simple language that—to his great pleasure—the boy easily grasped, Mathers gave him his first "lesson" in radio, defining the more simple terms, explaining carefully. And the boy listened — *how* he listened! — keenly, avidly, sometimes asking a pertinent question.

"There!" said the professional, "think that you can remember all that? Here . . . . . ." he went to one of the bookcases, took therefrom a small volume—"study this first chapter, and come up again day after tomorrow—same time."

Eagerly did the boy's thin hands accept the book. But then his face clouded over, and the light of rapt happiness went from the gray eyes—leaving them dull—and tired.

"It's no—no good—my takin' this book—Mister Mathers—'cause even if I sit up all night, studyin' it—and that's the only time I get—I dunno's I can get up here—*ever* again!" There was

Continued on page 62

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a quiver in the voice—but it was sternly repressed.

"Why not?"

"Got to *work!* Pop keeps after me—pretty much all the time." Then he told of the loft, over the wagon barn, and of the candle stubs, that he got in one way and another.

There flashed through Mather's mind the pathos of it! This overworked, under-fed little body—far too insufficient a vehicle for a mind, active beyond the body's years—a mind that craved knowledge, and one that was willing the vehicle should suffer discomforts, punishments—if through these led the way to—progress. And in Mather's mind was the comparative picture, between this boy—and another, who had everything!

And an idea came—

"Look here, Walter! Tell you how we'll fix the old skinf——I mean your father—" he corrected, hastily.

"Don't mind me. Everybody calls pop a skinflint—and worse. I'm used to hearin' it—and they're right—I guess." The words were unemotionally spoken—merely in acknowledgement of a fact.

"Well—er—we'll fix it in this way: I'll give you two dollars for two hours' of your—'helping' me—three times each week. You slip the money to him—and he'll be satisfied—won't he?"

"You *bet* he will! But—that don't seem right—for me to come up here, pesterin' you, and get paid for doin' it!"

"Leave that to me, son!" laughed Mathers.

"I—I don't know how to—to thank you, b-b-but I'll make good—*somehow!*" the lad blurted and ran from the room, clutching a $2 bill and his precious book.

Mathers went to the window, saw the little figure scurrying down the snow-clad road, and a mistiness rose in his eyes—that blurred the peaceful landscape.

"Most of my life has been chiefly occupied in looking after my own interests—but now—" passing his hand hurriedly across his eyes, he watched the lad as far as he could see him.

For Mathers had neither kith nor kin, and, because of his voyagings up and down the seas of the world, as radio operator on all manner of vessels, he was almost—as he admitted to himself—a man without a country.

When Walter reached the farmyard gate he was greeted with a bellow of rage—

"Whar in tarnation' ye bin? Here's nigh on two hours o' the best part o' the day gone!" Ellison shook the boy, roughly.

There was no book visible—as *that* the boy had, with cunning foresight,

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hidden in an old log. But he held out the $2 bill—

"The feller up at the big house gave me this, for—for helping him—wants me to come three afternoons a week—for a couple o' hours."

"Well!"—the farmer's voice changed; he made a grab for the money—that's not so bad, bub! Not *so* bad! Sure—ye can go up—but, hol' on—what's he payin' ye?"—suspiciously.

"S-s-six dollars a week."

"Lot o'money, for a shrimp like you! What ye a'helpin' him of?

"O—kinda readyin' up the place—cleanin' closets—an'—an' such. Folks all away."

"Mind ye be there on time—or I'll whale ye!" and Ellison walked off, muttering—"I'm jiggered! More money'n brains! Six dollars a week is $24 a month—or $188 a year—just to clean out closets an' tidy up papers, I s'pose! Well—it's time he was earnin' his keep—so it's none o' my funeral—if they wants to *throw* money away!"

WEEKS slipped up from the far ahead, passed under the feet of the present—and vanished in the never-to-be-again. They boy studied hard, made the most of his rare-found opportunities, and excited in Mathers an unbounded admiration for his grit and perseverance.

"You'll go much farther than I can ever hope to, laddie!" he said, earnestly, during one of the afternoon sessions. "You've got a much better memory and a natural radio mind! It took me months to grind in my skull the things that you drink up—as a sponge absorbs water—in no time!"

"Think so—*honest?*" There was an avid pleasure in the gray eyes. "But it's all thanks to you! Where would I have been, if . . . . . ."

"Well, well! Who is our young friend—eh?"

Mathers and the lad swung round; Senator Briggs stood in the doorway—a cheery smile lightening the strong, somewhat stern, face. Mathers thought him in Washington!

The two looked at one another; then the boy stepped forward—and told the whole story—of his determination to become a radio operator—of his father's antagonism to the idea—of his chance meeting with Mathers—of the latter's assistance—and, finally, of Mather's paying him to come, in order that he might get away from his father.

Silence in the room—when the young voice had finished its somewhat halting recital.

"Fine work!" said the Senator, abruptly, passing his hand over his face. "And I am back of both of you! Want to keep on—studying radio—son?"

Continued on page 60

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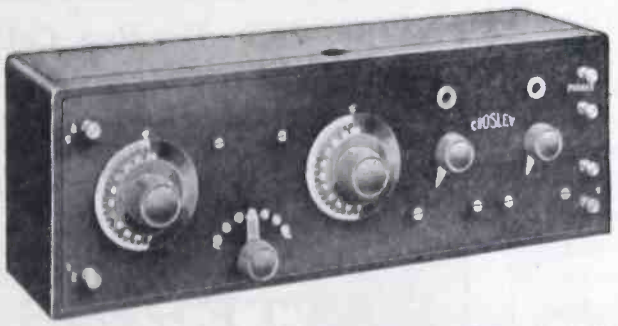

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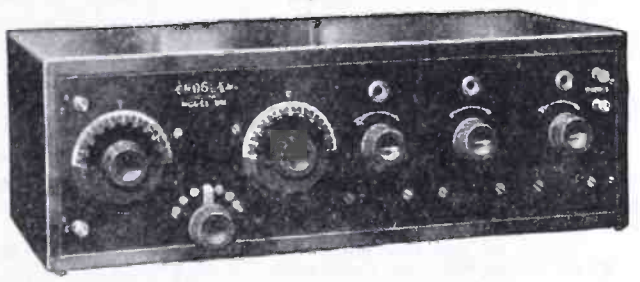

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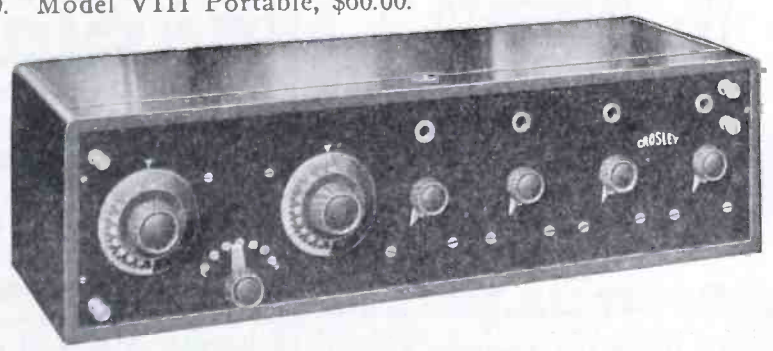

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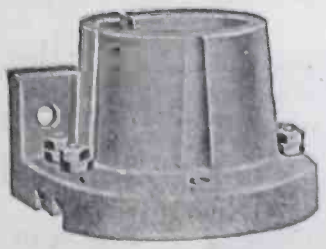

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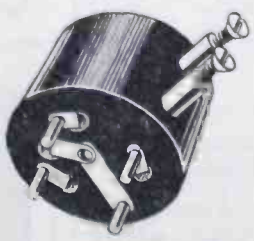

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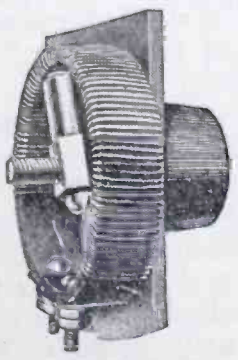

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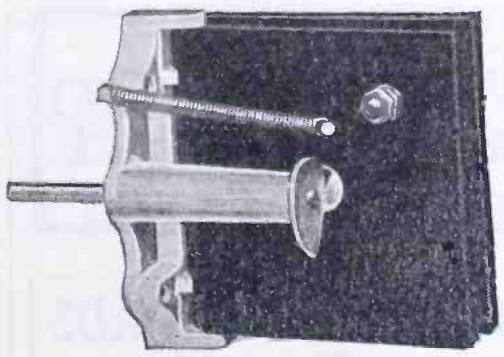

CROSLEY CONDENSER—MODEL B.

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"Oh *yes,* Sir—Senator, I mean!"—the words burst from his lips

"So you shall!"

"But my father—he won't hear of . . . . . "

"We'll see about that! Come along—I'll walk home with you, now. I need some air after that train."

And again Mathers looked from the window, watching the Senator striding along, the lad almost running to keep up—while an Indian summer afternoon waned softly.

"What do you say, Ellison?" the Senator asked, after he had made a proposition to the farmer.

"Don't like it, Senator. 'Fact—won't hear of it—*nohow!* He's a farmer's son—same's I was—and he'll stay one, s'long as I'm on top o' the earth!"

Briggs heard the quivering little sigh that escaped the boy's lips.

"No chance of your changing your mind—Ellison?" he asked, slowly.

"Nope! Last word's . . . . said! God knows how long it'll take me to whale this damn nonsense that he's l'arned—outen his head, as 'tis!"—vindictively.

"Just one moment, Ellison!"—as the angry farmer jerked the boy from Briggs' side—"I suppose that you have heard of the R.R. branch line that is coming up the Drift Bottom—soon?"

"Sure I have! I'm aimin' to get a good price for the six acres o' mine they got to cross—you bettche!" And he started off again with the lad in tow.

"That 'one moment' was too short, Ellison!—Just *one* more!"

The farmer stopped at the compelling note in the Senator's voice—

"Well . . . ?" he snapped.

"It so happens, Ellison, that I can have that six acres *condemned*—by the county assessors—and appraised by a board! You will take what *they* think it worth! It's absolutely of no value—all swamp ground—better consider again—had you not—Ellison?"

The farmer's face became distorted with rage—"Take the damned brat—an' good riddance! But lemme tell ye one thing, Mister Senator Briggs—if he goes along with you—now— he needn't never expect to cross my door sill again—and that's . . . . *final!*"

"Well—lad—what is it to be? You heard your father," said the big man, quietly.

It was a strange, tense moment—while the gentle breeze of gloaming time rustled through the aspen leaves.

Then the boy spoke—"Pop—ever since mother—died, you've never given me a chance! You wouldn't let me go to school—nor you wouldn't let me read, or study, nothin'! That is, if you knew about it! You've fed me, an' given me

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clothes—o' one kind and another—but I've worked, an' worked *hard*, for everythin' I've had. Mother—she said that a feller ought to honor his father'n mother—'cause God said so; but I don't reckon—somehow—that God had any idee o' *you* as bein' anybody's father—when He said it! An' so—an' so—" he stopped, looked up at the Senator's towering height—"seein's as the Senator's willin' to give me an education—a *chance* to learn—I'm goin' with him. It's only fair to me—an' to you, too, if you'd only look at it that-a-way."

A volley of epithets poured from the farmer's lips—to which the man and boy listened in silence.

"You are *sure*, Walter?" the Senator asked.

"Yes, sir!"

"Let's go—home, then."

The strange pair walked slowly from the farmyard. At the gate the boy turned—

"Goodbye, Pop!" he called—wistfully.

But the farmer did not even turn his head.

THE *Ariadne* steamed along at a comfortable 15 knots over a moon-swept sea, and the big steam yacht's every detail of rigging was brought out in sharp relief by the brilliant light. On the after deck, sat former Senator Briggs—owner—with some business associates and his private secretary.

Just visible—as little sparklings—the lights of some vessel a few miles away to port, glinted and vanished as she rolled.

"Big freighter?" some one suggested.

"More than likely. She is not wasting coal—for speed!" laughed Briggs.

"If I had to choose, over again, I believe that I should be tempted to be a sailor! Glorious, roving life—none of the nuisances of existence ashore—plenty of fresh air—out of touch with everything, most of the time—if one so desires." Thus spoke Conrad Morton—one of the eminent Wall Street men of the day. And he sighed.

"Not out of touch—these days of radio"—corrected the owner. "I've had the most powerful plant, for its size, that I could get, installed, and you know that we've been in touch with both British and American stations, either direct, or through rapid relay with other vessels."

The conversation drifted to other matters—chiefly things financial—as the former Senator was notoriously on the bull side of the market, carrying huge numbers of stocks—commercials and R.R.'s chiefly. He liked the excitement of the game, and the need of quick thinking—he was wont to say.

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WALLOWING easily along, the *Perseus,* cargo carrier, pushed her fat forefoot through the moonlight at her unvarying 9 knots, and the smoke of her passing rolled evenly and blackly away from her stack—blotting out the stars for a long, straight space of the scintillating overhead.

Skipper Jim Lewis, his daughter, Marion, and Radio Operator Walter Ellison were confortably ensconced on the little bridge deck—outside the skipper's quarters.

"Hard boiled"—was the term generally applied to Cap'n Jim Lewis, along the more important water fronts of the ports of the world—for he knew them all. A seaman of the old, nearly-vanished school, he held not at all with the more polite ways in which the ships' crews of modern days insist upon being treated—on board. He had gone to sea—in the dim, gone-by-the-board years—on whalers, and on full-rigged vessels—'round the Horn. As a result he was a "two-fisted" man. Not hard-hearted—by nature—but "two fisted"—nevertheless. Did one desire to make him "see red"—the merest mention of the La Follette Seaman's Bill accomplished the purpose—instantly! He detested steam, and commanded a vessel that was so driven for the simple reason that there were no captains' berths open a'board the scattered sailing ships—that eked a precarious living for their owners—principally by 'long shore hauling—and Jim Lewis detested that—also.

"So you and Marion have 'framed' the Old Man—eh?" he chuckled in his thick beard. "Want the Old Man's OK to sign articles together—do you? Well—I hold a lot by you, Walter, lad. Watched you ever since you got the berth of operator on the *Perseus*—and haven't a fault to find!"

The tall, graceful girl rose—crossed the deck and knelt beside the old sea dog. He touched the masses of dark hair with strange tenderness—for these two were inseparable, since the wife and mother had gone on the Long Cruise—and the big, rough hand was so light that it scarcely distured the tresses.

"How about the dollars, boy? Love has a nasty trick o' deserting the ship—when the cargo o' dollars runs low!"

Efficiently neat in his summer whites—for Skipper Lewis kept up his big ship in yacht fashion, and his officers always made a smart appearance—Walter Ellison stood very straightly against the rail, his strong figure looming in the moon brilliance—

"Well, sir—the farm is mine, as father died so suddenly that he had no time to make a will—or so the lawyers say. If he had—I shouldn't own the farm today! Owing to the railroad crossing it I ought to be—fairly well fixed. Father and I couldn't get on—

so I got out, thanks to the generous kindness and help of . . . . . hello!" —he broke off, crisply—"what's that ship using her Morse blinker light for?"

All three looked across the slow-heaving, moon-laved expanse that separated the two vessels by a scant four miles.

"MESSAGE for you, sir!" the radio operator of the *Ariadne* saluted the owner smartly and gave him a folded form.

"Thanks"—turning to the others—"what's the betting that it is about the A.I.&L. deal, gentlemen?"

There was a note of hardly-suppressed excitement in the former Senator's voice, as he felt for a nearby switch, turned it and flooded the after deck in the soft glow of electric lights—cunningly stowed at the awnings' edges.

"*If* you make a go of this, Briggs—you will benefit some several millions' worth—eh!" pleasantly remarked one of the group, as Briggs scanned the sheet.

"Pshaw! Code again! I do not see *why* the offices coded a message of this kind to me! A simple 'yes' or 'no' would have sufficed. Decipher this, please!"—to the secretary—who took it and hurried below.

"Just what would it mean, Briggs—merely for the sake of supposition—if the deal—er—went against you? Supposing someone—'split'?"—asked the Wall Street man—gravely.

The Senator did not answer at once. And the sounds of disturbed waters liquidly broke the silence. Beneath them the rythmic, thudding vibrations of the propeller came as from far away.

Then spoke Briggs, with careful precision: "It would mean a far heavier loss than I can afford, at this stage. Indeed it would be almost disastrous! And for the reason that I am out here—away from personal contact with matters—some 1200 miles out of contact, to be exact, by the noon reading, today."

"Transposed message, sir."

Briggs read it—passed one hand over his eyes—read it again.

"Bring me a blank—*quickly!*" was all that he said, but the way in which he said it told a story that belied his apparent calmness—for the Senator was noted as being "nerve-less."

"Odd — Ryerson — that you should have made that—'supposition'—by way of conversation—as to that which would happen, if things went wrong!" Briggs re-lighted his cigar, but his hand shook—a little. "Odd—*very!* For that is exactly what has happened! Man I trusted—completely—has double-crossed me—been bought off, I think. Fortunately I still have a card to play—that will take the trick—but I admit that it is far too close for any great amount of comfort!"

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THE VACUUM TUBE

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properly tuned in the antenna and secondary circuits, impresses a radio frequency potential on the terminals of the secondary variable condenser. When that side of the stopping condenser which is connected to the grid is positively charged by this radio potential, which is also impressed across the grid and filament since they are shunted or connected in parallel across the secondary condenser, a current passes from the grid to the filament. When it is negatively charged, however, the rectifying property of the tube does not permit a current to flow from the filament to the grid. Consequently, for each radio cycle or wave in an incoming train, a negative charge is given to the stopping condenser and grid. For each *train* of waves, there is accumulated on the stopping condenser the summation of these negative charges, exactly as in the case of crystal detector rectification.

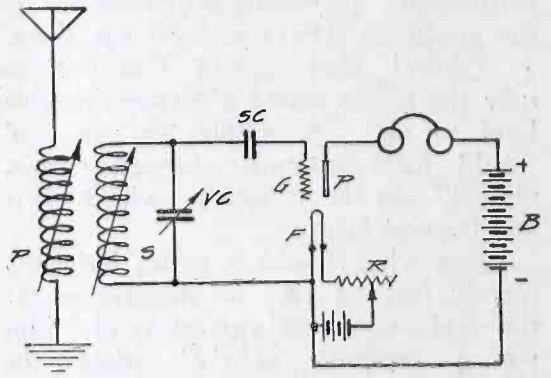

Fig. 63. Hook-up for Vacuum Tube Detector

This large negative charge causes a reduction in the plate current, as we should expect from Fig. 63.

The nature and the relation of these various currents and potentials are shown in Fig 64. The upper curve *(a)* shows the radio frequency potential of a wave train such as might be received from a damped wave telegraph transmitter or a radiophone. Due to tube rectification, this potential impresses the potential shown in curve *(b)* on the grid and stopping condenser. The summation of these negative charges on the stopping condenser is shown in curve *(c)* and the resultant current through the telephone receivers, the plate current, is shown in the lowest curve.

Thus, as in crystal detector reception, one impulse per wave train is heard in the telephone receivers. There is this fundamental difference, however. With the crystal detector, the energy which flows through the telephone receivers, after rectification, is actually received energy. With the vacuum tube detector, however, the telephone current, while produced by the received energy, is actually supplied by the "B" battery and in energy content is very much greater than that received. In other words, as we have previously seen, the vacuum tube detector not only rectifies

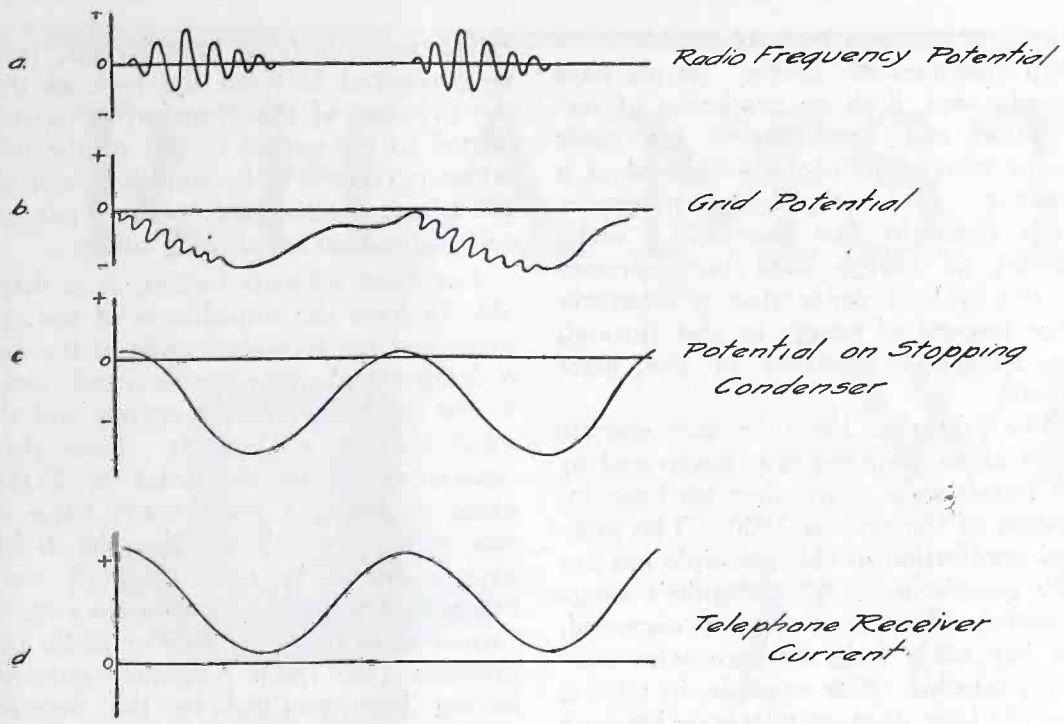

Fig. 64. Relations of Detector Currents and Potentials

the received energy, as does the crystal detector, but amplifies it. Consequently, the vacuum tube is very much more sensitive than the crystal, and much more desirable as a detector.

There are several types of vacuum detector tubes on the market differing from each other in various ways. The detector tubes manufactured by the Radio Corporation of America, see Fig. 65, are known as *Radiotrons*. Tungsten filaments, made in an inverted V shape and operating on about 5 volts for proper filament brilliancy, are employed. The filament in such a tube is surrounded by flat grid and plate. About 23 volts positive potential is required on the plate —this voltage being ordinarily supplied by small dry cells such as are used in flash lights. Such cells are supplied conveniently assembled in compact form. The plate current is relatively small and hence dry cells can be used. Their usual life is at least a year.

The filament consumes 1.1 amperes and hence requires a storage battery for its operation.

Since four leads must be brought out from the interior of the tube—two for the filament and one each for the grid and the plate—a four prong base is used which requires a special form of socket for its operation.

Other tubes are on the market which employ metallic filaments coated with compounds—usually oxides—of calcium, barium and other rare earths. These oxides, when heated, emit electrons copiously—hence their adoption. Tubes manufactured by the Western Electric Company commonly employ these coated filaments.

The Westinghouse Company supplies a small, oxide-coated filament tube designed to operate off a standard, six-inch, 1.5-volt dry cell. The filament current is only one quarter (.25) of an ampere so that such a dry cell will give about six months' life.

For best detector operation, it is desirable not to have the tube too highly exhausted. In fact, it is customary to interpose some inert gas, which will not assist combustion of the filament, in the tube. Argon, neon, and occasionally

Fig. 65. Radiotron UV-200

mercury vapor are used for this purpose. Gas-filled tubes, or tubes in which slight traces of air are deliberately left to enhance detector efficiency, are called "soft" tubes.

Amplifier tubes, which we shall study in the next assignment, are highly exhausted or "hard" tubes. To assist in their evacuation chemicals are used which leave the glass slightly discolored. The glass of detector tubes, however, is always clear—a characteristic which assists in their ready identification.

ASSIGNMENT No. 10

THE VACUUM TUBE AS AN AMPLIFIER

In the last assignment, we observed that a vacuum tube functions both as an amplifier and as a rectifier, due to its

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steep characteristic curve. As we have already seen, both its properties of rectification and amplification are made use of when the tube is employed as a detector. Its amplifying properties result from the fact that only a small amount of energy need be impressed on the grid in order that a relatively large amount of energy be sent through the telephone receivers in the plate circuit.

The fact that the tube may operate solely as an amplifier was discovered by De Forest some years after his basic invention of the grid in 1906. The practical application of this principle has not only greatly extended the tube's range of usefulness as far as radio is concerned, but has made long distance wire telephony possible. For example, in talking over the long distance telephone between San Francisco and New York, the speech currents are put through several banks of amplifier tubes at frequent intervals along the line. Such tubes are termed "repeaters" in telephone parlance, but they are of the same general type as the amplifier tubes used in radio receiving sets.

The grid circuit of a vacuum tube may be termed the *input* circuit, and the plate circuit the *output* circuit. By connecting the output or telephone receiver circuit of a detector tube to the input circuit of an amplifier tube and transferring the telephone receivers to the output circuit of the amplifier tube, we shall secure, for the average tube, about ten times the audibility or intensity obtained with the detector alone. Such a receiving set is said to employ a detector and one *stage,* or *step,* of amplification. We may increase this amplification by using an additional amplifier tube, the output circuit of the first amplifier being connected to the input circuit of the second amplifier tube. The telephone receivers, of course, are shifted from the output circuit of the first amplifier to the output circuit of the second. The amplification is now increased to about one hundred. This combination is called a detector and two stages of amplification. If a third amplifier tube is added, the intensity will be increased to about one thousand.

Theoretically, an indefinite number of amplifier tubes can be added so as to increase the intensity of received signals or music to any amount. There are certain practical limitations, however, which prevent this—i.e., the intensity of static, detector tube "noises," and interaction or "howling" between the tubes. Consequently, it is not customary or desirable to employ more than four steps of such amplification.

In connecting up tubes as amplifiers, the output circuit of one cannot be led directly into the input circuit of the next tube. Instead, a small transformer, called an amplifying transformer, must be connected between the two, so that the primary of the transformer is connected to the output circuit of the tube whose current is to be amplified, and the secondary is connected to the input circuit of the next amplifying tube.

For most efficient results, it is desirable to have the impedances of the primary and the secondary coils of the amplifying transformer approximately equal to the resistances of the output and the input circuits, respectively. Since these resistances are of the order of 25,000 ohms or more, a great many turns of fine wire, No. 38 or No. 40 B.&S. gauge, should be used on both coils. Since the frequencies which such a transformer must carry are low or audio frequencies (the radio frequency currents having been rectified by the detector tube), an iron core may be used with efficiency. Transformers, such as loose couplers, which are designed to carry currents of radio frequency cannot employ iron cores to increase the efficiency of transformation, since such high frequencies produce losses in the iron. In order that the magnetic field produced in an amplifying transformer shall not extend beyond the transformer itself, it should be shielded in a metal case. If this precaution is not observed, the extraneous magnetic field which may result is liable to affect another amplifying transformer mounted near the first if more than one stage of amplification is employed, with the result that tube interaction or "howling" may be set up.

Fig. 66 shows the diagram of a vacuum tube detector with two stages of amplification. *A* represents the "A" batteries used to light the filaments of the three tubes and *B* the "B" batteries required to supply the plate currents in the detector and amplifier tubes. In practise, it is customary to supply one "A" battery and one "B" battery for all three tubes but in order to simplify the diagam separate batteries are shown. *P* and *S* represent the primaries and the secondaries, respectively, of the two amplifying transformers required. It will be observed that the telephone receivers are connected in the output or plate circuit of the second amplifier tube. If an additional stage of amplification were to be employed, the telephone receivers would be removed, and the leads from the plate and "B" battery connected to them would be connected to the primary of a third amplifying transformer.

As we learned in the last assignment, the tubes used as amplifier tubes are pumped to a higher vacuum than those ordinarily used as detectors. Consequently, to pass a sufficient current through them, a higher "B" battery or plate potential must be supplied. Thus, while detector tubes commonly require approximately but 23 volts, amplifier

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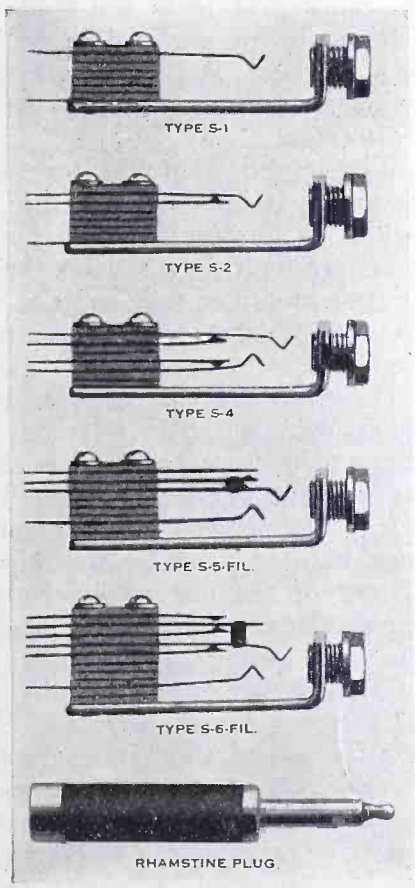

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Continued from page 74

tubes must be supplied with from 40 to 90 volts. The latter value should be used if a loud speaker is to be operated off the second stage.

The negative charge which accumulates on the grid of a vacuum tube, due to its property of rectification, is of use, of course, only to "trigger" a relatively large current through the plate circuit. If distortion is not to result, however, this charge must be dissipated or carried away after it has served its purpose. A high resistance, *R* (Fig. 66), must be supplied in the grid circuit of each tube, therefore, to carry off this charge to the filament. This resistance, for obvious reasons, is termed the *grid leak*. For a detector tube, such as the Radio Corporation UV-200 tube, it should have an approximate value of 2 megohms (2,000,000 ohms). The grid leak for an amplifier tube should have a value of from 0.3 to 0.5 megohms (300,000 to 500,000 ohms). Such high resistance grid leaks are made of graphite or lavite, enclosed in an insulator such as glass. A pencil mark on paper, or some insulator, also may be used as a grid leak.

The amplification which we have been discussing is known as *voltage* amplification, its purpose being to build up a relatively high potential on the grid of the last amplifier tube so as to secure a maximum current through the telephone receivers.

However, this current, even after amplification, is still relatively small. When a loud speaker, such as the Magnavox or the Western Electric Type 10-A is to be employed, *power* amplification must be used in order that the output current of the last amplifier tube may be quite large. Power amplification differs from voltage amplification only in the respect that means must be provided for carrying larger currents. This entails the use of amplifying transformers wound with heavier wire, special tubes (usually transmitting tubes) capable of delivering large output or plate currents, and high-potential "B" batteries. With power amplification, plate potentials of from 120 to 300 volts are common for the power amplifier tubes.

Both the voltage and the power amplification which we have been considering have been employed after the received radio currents have been rectified to *audio* currents. Such amplification, therefore, is known as *audio* frequency amplification.

The gas commonly left in detector tubes, to enhance rectification and thus to increase sensitiveness, gives rise to slight tube "noises"—hissing, etc. When more than three or four stages of audio frequency amplification are employed, these tube noises are amplified to such a degree that signals are distorted if not obliterated.

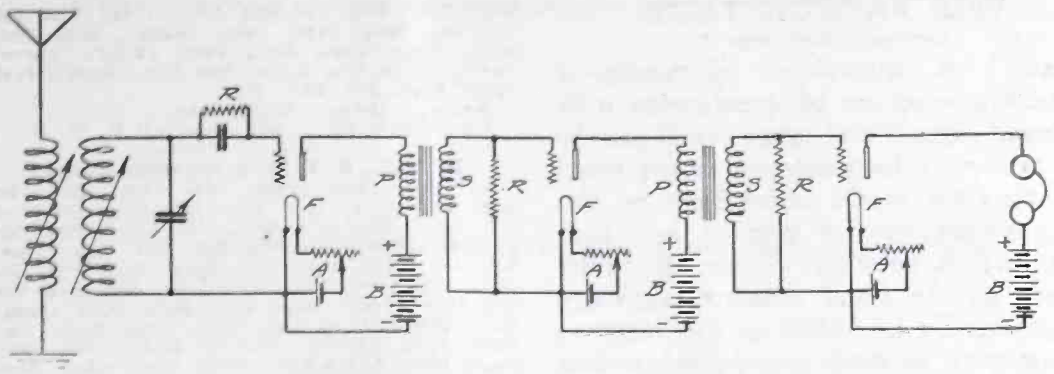

Fig. 66. Detector with Two Stages of Amplification

It becomes desirable, therefore, when additional stages of amplification are required, to interpose such stages *before* the detector tube. This means that such amplification will be at radio frequency, since the received radio-frequency current is not rectified to audio frequency until after it has passed through the detector tube. This amplification, therefore, is termed *radio*-frequency amplification.

Radio-frequency amplification is similar in a general way to audio-frequency amplification with the exception that the amplifying transformers should contain little or no iron in order that there may be no undue losses or distortion.

In Fig. 67, two stages of radio-frequency amplification, a detector, and one stage of audio-frequency amplification are shown. The received radio frequency current is first tuned to resonance, after which it is passed through the first two amplifier tubes, by means of the radio frequency amplifying transformers and thence to the detector tube where it is rectified into audio frequency current. The single stage of audio frequency amplification may be of the power type for the operation of a loud speaker.

In addition to the elimination of amplified detector tube noises, radio-frequency amplification assists in the elimination of static through the use of a loop antenna. This form of antenna consists of a square wire usually from 2 to 5 ft. in length and height, mounted in a vertical plane, and arranged so that it may be revolved. The number of turns used—from five to ten—depends upon the wavelength which is to be received. It receives from a transmitting station only when it is pointing in the direction of the transmitter. Such an antenna is not connected to the earth—the two leads from the coil being connected in series with the secondary of the loose coupler. No primary coil is employed. In fact, the loop itself—if wound with the proper number of turns—may be the only inductance used in the receiver, in which case it would be shunted by the "secondary" tuning condenser.

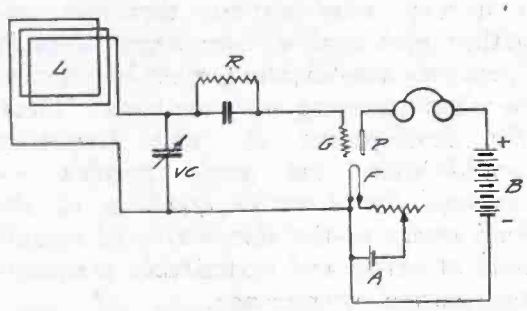

Fig. 68. Loop Antenna Connections

Fig. 68 shows a loop together with a detector tube. It should be understood, however, that for efficient results, several steps of both radio and audio-frequency amplification should be employed. The diagram is given only to show the connections of the loop antenna.

In the third assignment, we learned that radio wave propagation consists of a flow of electrons through the earth accompanied by electrostatic and electromagnetic strains in the non-conducting space above the earth. The usual type of grounded antenna makes use of all three factors of propagation, but the loop antenna is affected only by the space strains. Consequently, the energy which it can receive from a distant station is very much weaker than that which can be picked up by the usual type of antenna. Since it has marked directive qualities, however, as stated in the preceding paragraph, it follows that

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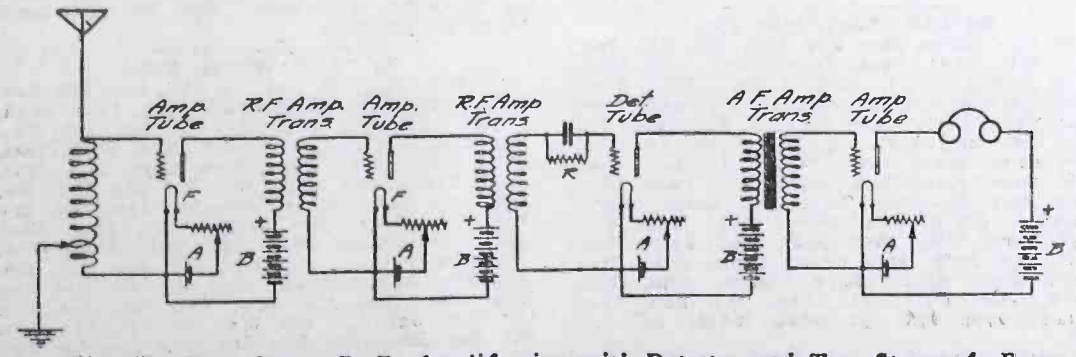

Fig. 67. Two Stages R. F. Amplification with Detector and Two Stages A. F.

Tell them that you saw it in RADIO

THE VACUUM TUBE

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"static" or atmospheric electricity—a troublesome source of interference with received signals and music—will not be received on a loop antenna except when it originates in the atmosphere on the approximate line of bearing in which the loop is pointing. Since the static heard on the usual antenna originates at practically all points of the compass, the amount of static interference picked up by the loop is greatly reduced.

Since the signals or music received on the loop, however, are very weak as compared with those picked up by the elevated antenna, five or six stages of amplification must be used to secure the customary intensity in the telephone receivers or loud speaker. But we have seen that it is impracticable to employ so many stages of audio frequency amplification. Three or four stages of radio frequency amplification, therefore, together with two or three stages of audio frequency amplification, must be resorted to when receiving with the loop. Thus, the development of radio frequency amplification has made possible — through the directive qualities of the loop antenna—the elimination of a great deal of static and undesirable transmitting station interference.

The General Electric Company has developed an amplifier cabinet, Type AA-1520, which contains three stages of radio frequency amplification. This radio frequency amplifier is enclosed in a metal case to eliminate any disturbing effects of the capacity-to-earth of the body or hand, in making adjustments. It may be used in conjunction with any type of receiver and is designed to match a companion cabinet, Type AA-1400, which contains a detector and two stages of audio frequency amplification. Both cabinets are designed to be used with a regenerative tuner, Type AR-1300. The phenomenon of regeneration will be described in the next assignment.

As with audio-frequency amplification, only "hard" or amplifier tubes should be used in radio-frequency amplifiers.

CALLS HEARD

Continued from page 48

7ex, 7ly, 7zu, 7pf, 7sc, 7jw, 7tq, 7zv, 7zu, 7zo, 8anb, 8aaf, 8bxx, 8ue, 8zy, 8bvt, 8zw, 9anq, 9afd, 9arz, 9asf, 9bka, 9bun, 9bdv, 9bji, 9bik, 9cfy, 9cow, 9pkd, 9dtm, 9ei, 9gk, 9pq, 9pw, 9wq, 9xaq.

By 7ZU, Polytechnic, Mont.

C. W.: 5anv, 5aw, 5cn, 5ek, 5nk, 5tj, 5xaj, 5xd, 5xt, (5za), 5zak, 5zav, 6aav, 6ajh, 6aqw, 6arb, (6avd), 6bip, (6bjq), 6boe, 6bqc, 6bvq, 6en, 6gr, (6lo), (6lv), 6pi, (6rm), 6xad, 6xwi, 6zac, 6zb, 6zh, 6zi, 6zo, 6zr, 6zv, 6zz, 7abh, 7ck, 7gs, 7jw, 7mf, 7ny, 7tq, 7wg, 7wm, 7xk, 7zo, 7zv, 8aim, 8asu, 8azd, 8vy, 8yd, 9aap, 9aeq, 9afd, 9afk, 9aiy, 9aja, 9ajz, 9ami, 9anf, 9anq, 9aog, 9aon, 9aou, 9ar, 9arz, 9avg, 9avm, (9avz), (9awm), (9ays), 9b, 9bey, 9bfb, 9bik, 9bii, 9bjt, 9bmm, 9bri, 9bsp, 9btt, 9bud, 9bxa, 9bxb, 9bzz, 9ccv, 9cfy, 9ciy, 9cmk, (9cns), 9cvv, 9cuc, 9ddh, 9def, 9dgq, (9djm), 9dsm, 9dta, 9dte, 9dwk, 9ew, 9iy, (9pi), 9pn, 9ps, 9uh, 9xac, (9xaq), 9yaj, 9yf, 9yu, 9zaa, (9zaf), 9zl, 9zn, 9zt.

Spark: 5uj, 5zh, 5zs, 6amk, (6ani), 6awh, 6biy, 6km, 6nq, 6ot, 6qr, 7abs, (7fq), 7ge, 7gk, 7tf, 7zo, 9aoj, 9aps, 9arz, (9auu), 9aza, 9bsa, 9btx, 9bxc, 9bxt, 9bzi, 9cca, (9cns), (9ctw), 9dwg, 9dwm, 9fx, 9gdw, 9gk, 9tr, (9xaq), 9yah, 9yak, 9yar, 9zc, 9zn, 9zx.

Voice: (9cns), 9zab, 9xac.

Canadian—(4bv), 4dk, 5cn; all C. W.

By 7QT., R. F. D. 2, Corvallis, Oregon

C. W.: (4dq) Can., 5ak, (5cn) Can., 5ct, 5nn, 5uj, 5vm, 5kc, 5px, 5rh, 5vc, 5xa, 5xb, 5za, 5biv, 6bh, 6bs, 6bp, (6cc), 6ch, 6cu, 6dn, 6ea, 6eb, 6fh, 6gy, 6gx, 6gf, 6ka, 6ku (fone), 6lu, 6lv, 6od, 6pe, 6pi, 6qm, 6qr, 6rm, 6sz, (6th), 6tc, 6ti, 6vm, 6xh, 6zh, 6zo, 6zn, 6zv, 6zt, (6zz), (6zr), 6aat, 6aar, 6abx, 6afn, (6agq), 6aiv, (6ajf), 6ajp, 6ajr, 6alu, 6ame, 6apw, 6aoi, 6atc, 6atq, (6avr), (6avv), 6beq, 6bcn, 6bcv, 6agq, 6bjq, 6bnv, 6bin, 6bip, 6boo, 6boe, 6bow, 6bqc, 6bqe, 6bqg, 6bqr, 6xad, 7bm, 7bj, (7bk), 7eq, 7ge, 7gp, 7hi, (7hm), 7ic, 7iy, 7jg, 7jw, 7ke, 7lk, (7ly), 7ny, (7ot), (7pf), 7qe, 7qn, 7rn, 7ud, 7ui, (7th), 7sc, (7tq), 7zb, 7zk, 7zu, 7zv, 7aby, (7acg), 7adf, 7aio, 8aaz, 8sp, 8zy, 8bpl, 9cf, 9lz, 9zu, 9afd, 9ami, 9awg, 9asf, 9aul, 9bld, 9bji, 9bxa.

Spark: 6tu, 6ark, (6aoa), 6qr, 6auu, (7bh), (7ne), (7ri). Anyone hearing my 20-watt C. W. pse qsl.

By 5SF, 1616 Worth St., Fort Worth, Texas

C. W.: Can.—3xn, (4bv). U. S.—1bet, 1cmk, 2el, 3aay, 3blf, 3bz, 3ca, 3fs, (3yo), 3ot, 3zo, 4bb, 4bk, 4by, 4cg, 4cy, 4eb, 4eh, 4ft, 4hw, 4kl, 4km, 4ya, 6ajh, 6arb, 6avd, (6awt), 6boe, 6brg, 6bvg, 6cp, 6eb, 6tf, 6qf, 6ka, 6zz, 6zac, 6xad, (7zo), 7zv, 8aaf, 8ab, 8aio, 8aim, (8alc,) (8ame), 8asl, 8asv, 8azf, 8axb, 8axc, 8bdv, 8bek, 8beo, 8bfx, 8bke, 8bnh, 8bow, 8btl, (8bvr), 8bwa, (8byn), 8bzy, 8cbc, 8cdz, 8cgb, 8cgv, (8cgx), (8cko), 8cqu, 8cur, 8cyt, 8cve, 8ft, 8hh, 8hj, 8ib, (8lt), 8oe, 8qk, (8sb), 8vq (iew), 8vy, 8xe, 8yu, (8zaf), 8zag, 8zd, (8zy).

By 9BJI, 3935 W. 30th Ave., Denver, Colo.

C. W.: 2awf, 2ayv, 2bgm, 2bqh, 2brb, 2el, 2fp, 2nz, 2xao, 3afb, 3aqr, 3auu, 3bgt, 3bvc, 3bsj, 3zh-qra?, 4eh, 5aam, 5aar (5aby), 5acf, 5ae, 5aer, 5afq, 5be, 5ci, 5di, 5ek, 5ft, 5fv, 5gj, 5hz, 5ia, 5ix, 5ik, 5jb, 5jl, 5kp, 5lb, 5lj, 5mt, 5mu, (5mx), 5my, 5nd, (5nn), (5nv), 5nz, 5ou, 5pv, 6px, 5qi, (5qs), 5rn, (5sf), 5sk, 5ta, 5tc, 5tj, 5tp, 5tx, (5uk), 5un, (5uo), 5va, 5vo, 5sm, 5xa, 5xad, 5zae, (6abx), (6ahq), (6akl), 6amz, (6anh), (6apw), (6atq), 6awt, 6bbh, (6bcr), 6bet, (6bf), 6bfp, 6biq, 6bko, (6bob), 6bqe, (6bof), 6bqr, 6brf, 6bum, (6bun), (6bvw), (6bwe), (6cbi), (6cc), 6cu, 6dd, 6eb, 6ek, 6gd, 6gx, (6if), 6om, (6rm), 6tc, 6uf, 6rk, (6zh), (6zn), (6zz), 7abb, (7aem), 7afw, (7bj), 7ge, 7hm, 7hj, 7lu, 7tq, 7zo, 7zv, 8ab, 8aea, 8ago, 8aim, 8anb, 8aqo, 8ard, (8asv), 8avt, 8axb, 8bcy, 8bef, 8bek, 8bfh, 8bfm, (8bgl), 8bog, 8brc, 8bss, 8bsy, (8bvr), 8bxa, 8bxh, 8bxx, 8byf, 8byo, 8bwa, 8bzy, 8cf, 8cgo, 8cgx, 8cp, 8cur, 8cva, 8czc, 8dat, 8fa, 8ib, 8iz, 8jv, 8nn, 8pd, 8qk, 8sp, 8ue, 8uk, (8sb), 8wr, 8yn, 8zaf, 8zd, 8zw, 8zy, 8zz, (9abv), (9afn), (9aig), (9aon), (9ap), (9ayl), (9bgh), (9bko), (9bqw), (9bsg), (9clw), (9cmk), (9cpy), (9cxv), (9dcr), (9dge), (9fm), (9lq), (9uh), (9yaj).

Can. C. W.: (4bv), 4hh, 9bx.

Worked on fone: (5aby), (6zh), (9aig).

BY 6BOS—D. NEBEKER, PIEDMONT, CAL.

Spark—6ak, 6bu, 6dd, 6ea, 6eb, 6en, 6ff, 6gf, 6gn, 6gt, 6hy, 6ir, 6is, 6iv, 6jc, 6jd, 6ke, 6kc, 6ks, 6lc, 6lv, 6mh, 6mx, 6od, 6ol, 6qr, 6re, 6rr, 6rz, 6sk, 6tf, 6to, 6uo, 6up, 6za, 6zb, 6zr, 6zu, 6aak, 6aan, 6abo, 6acr, 6acy, 6adl, 6aei, 6aeh, 6aew, 6afd, 6agp, 6ahp, 6ahq, 6aiv, 6aix, 6ajr, 6ajh, 6akl, 6ald, 6ali, 6aln, 6ano, 6apr, 6apy, 6ard, 6ark, 6ars, 6art, 6asc, 6atf, 6aum, 6avd, 6avm, 6awh, 6zaa, 6zal, 6ben, 6bbc, 6bzg, 7bk, 7bh, 7br, 7bj, 7ck, 7dp, 7ed, 7fi, 7ge, 7gf, 7gj, 7gk, 7gq, 7hf, 7hi, 7iw, 7jd, 7ke, 7mf, 7mj, 7mp, 7mu, 7mv, 7my, 7nd, 7nn, 7nw, 7nz, 7oh, 7om, 7ot, 7ow, 7tj, 7to, 7vo, 7ve, 7vx, 7wg, 7ya, 7yj, 7zm, 7zj, 7zp, 7zt, 7zu, 7aea, 7kj, 7ks, 9bd, 9hm, cl8.

C. W.—5za, 5zq, 6ak, 6bf, 6ea, 6eb, 6en, 6cu, 6ir, 6rg, 6rr, 6jd, 6ij, 6ka, 6kc, 6kh, 6ki, 6lv, 6ny, 6pe, 6pt, 6tw, 6za, 6zb, 6zf, 6zg, 6zn, 6zz, 6xad, 6xaq, 6zac Hawaii, 6aiv, 6alu, 6aoz, 6art, 6apw, 6aqw, 6asv, 6atq, 6awp, 6awx, 6bes, 6bjc, 6bjy, 6btb, 6xas, 7cn, 7ln, 7nf, 7nu, 7oz, 7sc, 7qt, 7tq, 7wm, 7yn, 7yt, 9zx, 9wu, 9amb, 9zaf. Anyone hearing 6BOS on spark pse QSL card. Best 73. All cards answered promptly.

By 9BXT, Giltner, Nebr.

C. W.: 1cn, 1fb, 1gv, 1ii, 1kc, 1un, 1xu, 1yk, 1ary, 1bas, 1bes, 1bka, 1bkq, 1bwj, 1ckp, 1cmk, 1cmp, 1cve, cy-1, 2bg, 2fc, 2fp, 2gi, 2gk, 2kp, 2nz, 2ot, 2su, 2ud, 2wr, 2xq, 2ayv, 2bbb, 2bea, 2bml, 2bmr, 2bqd, 2bqu, 2brb, 2bys, 2cjn, 2ckr, 2cpd, 2xao, 2xap, 2xaq, 3bz, 3fs, 3hg, 3hx, 3iw, 3lk, 3mb, 3oe, 3ot, 3rf, 3su, 3tj, 3xm, 3yo, 3zo, 3zw, 3zz, 3aqr, 3aro, 3atg, 3auu, 3bec, 3ber, 3bfm, 3bfu, 3bhm, 3bkc, 3blf, 3blz, 3bnu, 3bob, 3bof, 3bss, 3buv, 4bq, 4by, 4co, 4ea, 4eb, 4eh, 4hi, 4hw, 4kc, 4kf, 4kl, 4km, 4lj, 4lp, 4oi, 4ya, 5be, 5bw, 5cn, 5di, 5dw, 5el, 5ek, 5es, 5fv, 5ft, 5ga, 5gj, 5gr, 5ik, 5ir, 5ix, 5jb, 5kc, 5kn, 5lb, 5ml, 5mo, 5my, 5mz, 5nk, 5nn, 5ns, 5nv, 5pf,

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And he wrote rapidly on the form—"Code that. It must be in N.Y. before the opening of the Exchange! How will you send it?"—to the operator.

"I got it from the *Ardathia,* sir. She is about half way between us and Cape Race, Newfoundland. I did not ask him where he got it, but he can reach Cape Race Station; more than possible that he is in communication with Atlantic Coast stations."

"*Any* way—provided that it . . . . . *goes!*"

"Aye-aye, sir." The operator hurried forward.

"Allowing for difference in time, that will be in N.Y. within the margin of safety, but not much more!" His calm entirely restored, Briggs again lighted the cigar.

The flame of the match had just flickered to its end, when everything went dark on the yacht.

"What the devil. . . . .?" the owner jumped to his feet and hurried forward, his guests following.

Briggs looked down the engine room skylight—"What's the matter?"—he shouted.

There was no confusion below. Engines running smoothly, but the pale yellow glimmerings of hastily lighted lanterns waved eerily to and fro among the moving masses of glinting metal.

"Something gone wrong with the generators' turbine!" bellowed a voice from the gloom—and there drifted up the sounds of many voices—calling to one another.

Stewards broke out the kerosene swinging lights.

And Briggs remembered his vital message. He hastened to the radio room—where the operator was busily connecting up the emergency storage set.

"Can you get that message I just gave —off?"

"There is no ship within 150 miles, sir, and that is my limit, with this set. But I am hooking it up, as the chief has notified me that it will be morning—or later—before the turbine can be got going. They can't see to work at it—down there."

"But—but, my God, man! that message must go! It has GOT TO GO—don't you understand?"

"Sorry, sir, but no emergency set will do over 150 miles—at the very outside!"

Aghast at the tremendous possibilities, Briggs walked to the rail—to pull himself together under the stress of this crisis. And his eyes fell on the lights of the freighter, plainly visible—as she rolled easily along—but falling astern —fast.

"What about *that* vessel? You can reach him, with batteries—can't you?"

Continued on page 82

Peerless Radio Laboratories
Manufacturers of Peerless Radio Frequency, Receiving Sets
San Francisco

November 1, 1922.

RADIO DEVICES CO.,
693 Mission Stret,
San Francisco, Cal.

GENTLEMEN:

In compliance with your request, we wish to state that until we used the Aerovox we had no end of disappointments owing to the fact that there are so many Radio Frequency Amplifying devices of indifferent make and none seem to stand or give the satisfaction that we derive from the Aerovox in connection with the Variometer that you have been making. These two combined, we feel, are about the most important item of our set. We hope our pleasant business relationship may continue forever.

Yours truly,
PEERLESS RADIO LABORATORIES.
By ARTHUR ANNIS, President.
Arthur Annis/MR

EDW. M. JONES
Insurance Brokers
SAN FRANCISCO, CALIFORNIA

October 28, 1922.

AEROVOX CORPORATION,
47 Kearny Street,
San Francisco, Calif.

GENTLEMEN:

You will no doubt be interested in knowing the results obtained by me in the use of the Aerovox Inter-Tube Coupler which I installed about a month ago.

I have received the concerts from thirty-six stations in six States and Canada. These were brought in using one stage of radio frequency and one of audio frequency.

I have recommended the Aerovox to many of my friends, who are getting great results from it.

In conclusion I might add that the efficiency of my set has been increased 100% since installing the Aerovox.

Yours very truly,
EDW. M. JONES.

BOYLE & KENNA
General Insurance
234 BUSH STREET, SAN FRANCISCO

RADIO DEVICES CO., November 1, 1922.
693 Mission Street,
San Francisco, Cal.

GENTLEMEN:

I have been using your Aerovox for the last several months and have experimented with one and two stages of radio frequency amplification. I have used your published hookup with the exception of adding a variometer in the plate circuit.

I have been able to hear stations from San Diego, Cal., to Seattle, Wash., and in the interior, back to Detroit, Mich., taking in Kansas City, Mo.; Davenport, Iowa; Phoenix, Ariz.; Denver, Colo.; Salt Lake City, Utah; Great Falls, Mont., and Reno, Nevada. All of these stations, with the exception of Kansas City, Detroit and Davenport, have been received on the loud speaker.

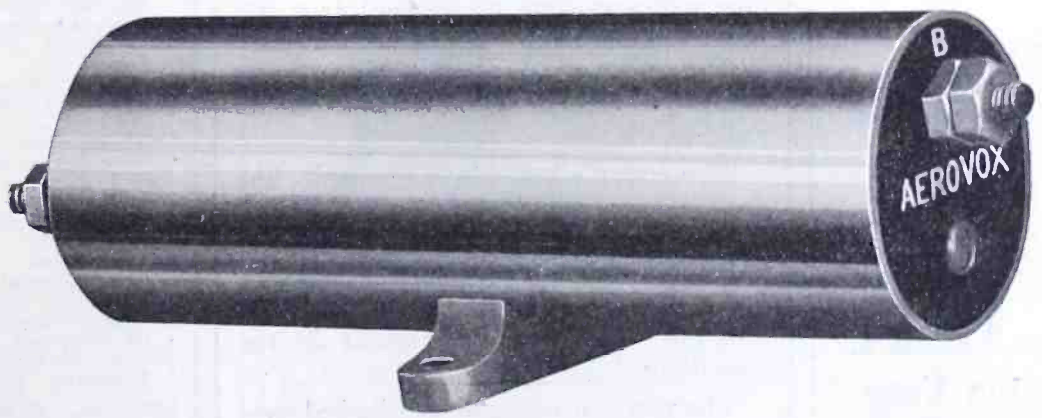
The results have been so amazingly wonderful that I take pleasure in writing you this letter to advise you of the result.

Very truly yours,
JRK:M JAMES R. KENNA.

AEROVOX

Radio Frequency Amplification

is simple enough for the novice, and efficient enough for the adept professional



The cut shows what the AEROVOX Inter-Tube Coupler looks like. The letters show what it has done in the hands of others.

Why not find out what it will do for you?

If you cannot get it from your dealer, send his name and the price, $4.50, to

RADIO DEVICES COMPANY, *Distributors*

693 MISSION STREET, SAN FRANCISCO

Tell them that you saw it in RADIO

Continued from page 80

"Yes sir. But he's only a cargo boat. They none of them have any half-way decent apparatus. I doubt very much if he carries a regular operator. The supercargo—or the chief officer—usually fills both positions.

"Well—try it, man—*try it!* Never get anywhere without *trying!*"

And he watched, with bitter impatience, while the operator finished making connections.

"I'll call him now, sir."

The crackle of the spark was but a feeble one—compared to that under normal conditions of full power. The operator tuned—listened for some moments—shook his head—

"Doesn't answer, sir! I'll have another shot at him!"

Again the spark—very blue-white in the kerosene light — ripped through space.

"No go, sir!"—after a period of listening.

"*Heavens!* what am I to do? What AM I to——do?" Briggs muttered—and his operator felt the poignant distress in the other.

"Maybe I can raise him with the Morse blinker, sir? He ought to see that, even in this bright moonlight. Just a minute!"

And — presently — there went forth from the signalling light on *Ariadne's* flying bridge—*dots* and *dashes* through the night.

"What does he want?" asked Skipper Jim Lewis, as Walter Ellison intently watched the winkings that came across the soft-rolling waters.

"Asks me to stand by for an important message—says his power plant has broken down—only got his emergency set to use — excuse me for a few minutes." He hurried forward to the radio shack.

"I wonder what ship it can be? She doesn't look very large!" said the girl.

"Haven't the faintest idea! He's in no serious trouble—and the weather is fine. Run along with Walter—and find out. I'll finish my smoke in the moonlight."

The girl ran forward and looked over her fiance's shoulder as he—phones over ears—began to copy the *Ariadne's* operator.

"To ship—de SY Ariadne—WPOI —glad you saw my sigs OM as our generator turbine has gone flooey—no juice for anything—I've got a rush message for NY—very important—are you in touch with anyone ahead? I took 1 msg from the Ardathia—WCE—an hour ago—he must be about 500 miles ahead of us—think can you reach him—hw? sig. Kruse—operator—SY Ardathia—WPOI—K"

Ellison snapped his switch to send—and shot back:

"To WPOI—de WSIE—R—Too bad about power I can try OM—have good set here—shoot the msg—glad to help if poss. sig. Ellison—OP"

Instantly the yacht replied:

"R—many tnx—here Nr 1—de SY Ardathia — To Martbrown—NY—ck 12—July 22—10PM — generic — fulsome—atropex—affected—quando nulval — plaore submo suavis notensem nariba—sig. Briggs."

When Ellison received the signature he ejaculated in surprise—but business came first! He repeated the message back to the yacht—to ensure correctness of code spelling.

From the yacht:—*"R—OK—OM—many tnx—hurry that—advise when you get rid of it—sig. Kruse."*

And Ellison dashed back with—*"R—what Briggs is that?"*

From the yacht:—*"R—x-Senator Briggs owner of yacht this is maiden cruise to England and back—sig. Kruse."*

With a whoop of delight—that startled the watching girl—Ellison hopped on the key—*"R—tell Senator Briggs I am Walter Ellison—he will know—answer—sig. Ellison."*

The other:—*"R——minute."*

To the wondering girl Walter explained, in hurried words—as he listened for the reply. In a moment it came—

"Senator's compliments—says now your chance to help him out of serious matters—cul—Kruse—K."

"Watch my smoke!" Ellison shot back at the yacht—and began to call WCE—the *Ardathia*—somewhere ahead.

And the girl wondered—a little—why, under the circumstances, he did not even look at her, but alternately called—and listened—and called again. Suddenly he stiffened—eyes staring—

"Got him!" He almost fell on the key — *WCE — de WSIE — have life death msg for NY can you take it? sig. Ellison—OP."*

The operator on watch on the big Liner chuckled to himself: "he's in a hell of a hurry," and answered—*"WSIE—de WCE—OK in 15 mins—sig Bartel*—OP" and then went on to finish up a batch of passengers' messages that lay before him.

From the yacht came—*"FB—OM—Senator says be sure come to his offices when you reach NY—cul—73—Sig. Kruse."*

And Ellison replied:

"Surest thing you know—73—Ellison."

Then he took off the head harness—seized the wondering girl's hands and danced her about the spacious operating room—

"Hoorah! And I haven't heard from him in so long! Wrote to him—several times—but I suppose that a man as busy

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as he hasn't time for a plain 'OP!' Maybe my letters never got by his secretaries? Oh Gollies—but I am tickled at being able to be of use to him!"

"What's all the excitement, Walter?" Skipper Lewis projected his big figure within—"What's broken loose? When I heard you whoop I thought—well, I didn't know what *to* think—so here I am, to find out!"

"Why, sir—that's a yacht, yonder—the *Ariadne*—bound for N.Y. Her generator turbine broke down and the emergency set is all that they have to operate with. Have a most *urgent* message for N.Y.—and wanted to know if I could take it and pass it along. By good luck I can just reach the *Ardathia* —about half way between us and Sandy Hook. Her OP says I'm weak, but he can read me, and will accept message in 15 minutes! Lord, but—but I'm pleased!"

"But why all the great *excitement?*" persisted Lewis.

"Oh!—you don't know, of course! The owner of that yacht is the greatest friend I have! I have not told you of some things in my life, Skipper, because they would not have interested you; but now—that—Marion and I wish to—er —'go shipmates' I started to tell you a bit ago. The owner of that yacht is the man who took me from a farm—paid for my electrical education—saw me started right, in the radio profession. Yes sir! there is nothing that I would not do for Senator Briggs! He . . . ."

"WHO did you say owned that yacht?"

Ellison looked at the Skipper in startled amazement, for a deep flush had surged over Lewis' face, and his hands clenched as he came forward a pace,

"Senator—or, rather, former-Senator Briggs, Sir."

"Let me have that message!" The Skipper held out his hand.

There was something about him that warned Ellison of impending trouble. He grabbed the paper on which he had written the coded message and thrust it in his pocket.

"Sorry, Skipper, but that is private property. I have no right to show it to anyone!"

"The yacht is in no danger?—No sickness on board?" Lewis asked with ominous calm.

"No sir!"

"Then, as commander of this vessel, I not only insist upon having that message, but I forbid your forwarding it!"

"But—but WHY?"

"Briggs was La Follette's right-hand man in putting the Seaman's Bill through—that has ruined the merchant marine of the United States—made a farce of it on the high seas of the world! And although it isn't much that

I can do—still, by Heaven, if I *can* break up any plans of this Briggs—*I'm* the man that's going to do it—if it costs me my job! There's enough in the bank for me to live on—while I'm afloat! *Hand over that message!* I'll give you a letter—clearing you!"

He came nearer—an ugly light in his eyes.

"Very sorry, Skipper, but I cannot! This is my *one* chance to do a small favor for the man who has meant everything to me! Be fair, sir, and see . . . ."

"Then I'll wreck the whole damned outfit—so that you can't send that message! *It shall not leave the ship!* Must be of great importance to that man—and so it is of more importance to me!" The now raging Lewis made a move toward the apparata.

It was but the continuation of one motion for Ellison to pull open a drawer, take out an automatic—

"I wouldn't—if I were you!"

"So-o-o! you pull a gun on your commander, eh? *Huh!* And I suppose that you expect to marry my girl—after this! *Ha!*"—he laughed unpleasantly—reached down with a quickness that threw Ellison off his guard, wrenched loose the fire axe that was in its clip at the side of the house, and dashed on deck.

"He means to cut the antenna halyards!"—the thought flashed in Ellison's mind and he darted after the other.

Of a certainty, the Skipper was already at the foot of the mainmast, fumbling about for the supporting halyards.

"Drop that axe! *Drop it!*—or I drop you!"

Lewis stared in the muzzle of the weapon—a few feet from his head. The axe clattered to the deck.

"Now get back to the radio room!"

Lewis sullenly obeyed.

"Sit in that corner!"

The Skipper did so, his great hands twitching, a stream of soft curses flowing from his beard.

Keeping his eyes on the dangerous man—Ellison slipped on the head harness and began calling the *Ardathia*—working the key with his left hand behind his back.

And he got the distant ship—gave the coded message, that was of such import—repeating it twice—receiving the other operator's "R" and "OK"—called the yacht—reported the message received by the *Ardathia*—and ended up with:

". . . . . *gudnight—OM—got a lot to do here—73's to you all—sig.—Ellison.*

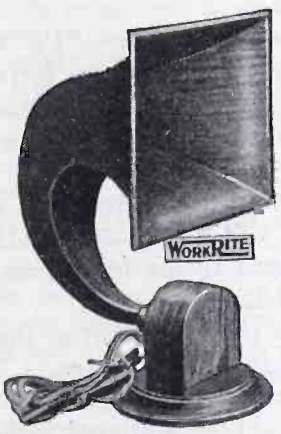
Then he opened the drawer again, tossed the automatic in—pulled off the phones—

"Now, Skipper, what are you going to do about it?"

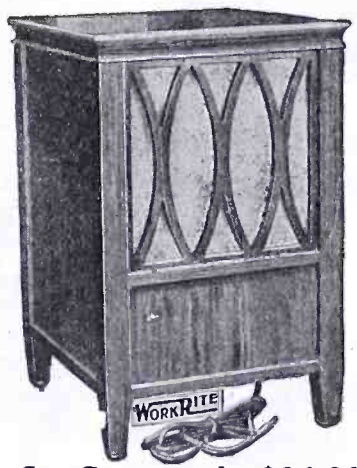
Continued on page 88

"WorkRite" CONCERTOLAS

THE BIG HIT IN LOUD SPEAKERS!



Let the whole family and friends enjoy the wonderful concerts, lectures, and other entertainment which is free for the taking. Attach a WorkRite Concertola to your set the same as a head phone. Requires no extra batteries. WORKS ONLY ON TUBE SETS WITH TWO STEP AMPLIFICATION. These loud speakers are different from others. There is no metal in them, which eliminates the tinny sounds of others. Reproduces voice or music in a clear, loud tone without distortion. Just right for home use. BOTH THE CONCERTOLA SR. AND JR. COME COMPLETE WITH OUR SPECIAL PHONE UNIT AND CORD. ORDER NOW AND DOUBLE THE PLEASURE OF RADIO IN YOUR HOME.



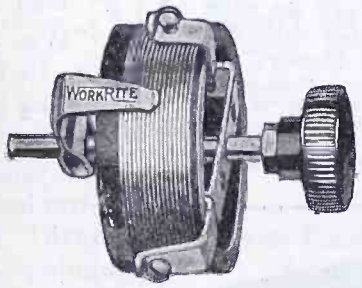
Jr. Concertola $12.00

Sr. Concertola $24.00

FREE TRIAL!

Upon receipt of the price, you will be furnished with either the Junior or Senior, charges prepaid. If not found satisfactory, you may return it and your money will be refunded.

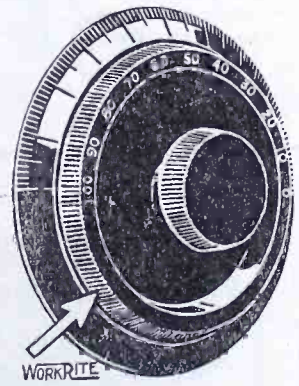
WORKRITE Super Vernier RHEOSTAT



Here is a Rheostat with unlimited adjustments. Pushing the knob in or out gives quick adjustment. Turning the knob around gives the most minute adjustment. Often turning the knob 1/32" will clear up a concert or separate two stations. You must use a WorkRite Rheostat to realize how much more efficient it will make ANY set. Indispensable for the detector tube. Equip your set with a "WorkRite" and note the difference!

PRICE $1.50

WORKRITE E-Z-TUNE DIAL



When you want to get very fine adjustment on your variometers, variocouplers, condensers, etc., you always grasp your dial on the outer edge for more leverage. Right there is where you will find a knurled flange that just fits your grasp on the WorkRite E-Z-Tune Dial. You can easily make a turn of a hair's breadth.

Made of the finest material, highly polished. Easily the "snappiest" dial on the market. 3½" diameter. Specify whether 3/16" or ¼" shaft.

PRICE 75c

"WorkRite Products WorkRite" Do not accept any substitute. If your dealer does not handle them, send check and we will see that you get them promptly by mail prepaid.

THE WORKRITE MFG. CO.

5549 Euclid Ave., Cleveland, O., U. S. A.

BRANCH OFFICE
2204 S. Michigan Ave.,
Chicago, Ill.

Tell them that you saw it in RADIO

Continued from page 85

The other's surface rage had burned itself out. He got up slowly—approached the young man—

"Nothing! But you will remember not to speak to Marion—*ever!*"

Then he went out.

The very fact of his life having been so devoid of affection, or of sentiment of any kind—caused his love for the girl to be a deep, abiding thing, with Ellison—a love that had grown in the months that she had been on board—in many journeyings—until his every thought was of her. And he felt that she would obey her father—to whom she was intensely devoted.

He sat down at the operating table and leaned his head on his arms—the weight of the price that he had paid, for his loyalty to the former Senator, crushing him.

"I'd do it again!" he said aloud—defiantly. And the quiet room echoed the sound of his voice above the *plash* of curling waters.

Minutes passed slowly—"I'd do it *again!*" he reiterated—thus fortifying himself against the Voices that mocked him—from within—jibbering in his ears.

"And I would not have you for a son-in-law—if you didn't—my lad!"

Ellison jumped to his feet as Skipper Lewis touched him.

There was a tense moment as the two looked in each other's eyes. Then Lewis held out his hand—

"Take it—lad! It's offered in honest apology! I'm getting on in years, and a man's apt to get . . . . 'crabby.' Your loyalty to your friend—and the *worth* of that loyalty—makes you doubly desirable for my girl! Let's forget!—Can you?"

SHE was waiting—along the after boat deck.

"We—we had o-sort of an argument—a little misunderstanding, Marion. But it's all settled now. I was wrong. And as for the 'Old Man's' consent to your sailing under the same house flag—you have it! *Loyalty* is of real . . . . worth! Don't ever be disloyal to one another—even in thought! I'm going to turn in—a bit tired." He turned to go—"*Sure* that that ship ahead got the message, Walter?"

"Very sure, Sir—he gave me his OK on it."

"That's good—that's *good!* Don't stay up too late—you two—dew is heavy—tonight."

And with a last look 'round the heaving, star-spangled, moon-beamed sea, the Skipper went for'ard to his quarters.

"What was it all about, Walter?" she asked—his arms about her.

"Oh—nothing much. Your Dad and I had a difference of opinion."

"Who got the best of—of the 'argument'?"

"We are both better off—*for* it!"

And the moon watched another pair of lovers kiss — while the *Perseus* thrubbed stolidly along over the shimmering waters.

AUSTRALIAN REGULATIONS

Continued from page 38

placed on applicants for licenses, but in cases where the applicant is under the age of 21 years, a responsible person will have to give a guarantee that the station will be operated in accordance with the terms of the license. Applicants for permission to use valve-receivers will be required to submit a certificate from a responsible officer of a wireless club or a postmaster showing that they are capable of receiving messages in the Morse code at the rate of 12 words a minute.

To check the erection of unlicensed stations, all dealers in wireless apparatus will be required to keep a record of their sales, and will only be permitted to sell apparatus to holders of licenses or those who are about to apply for licenses. Dealers will be required to produce their records of sales for examination by properly authorized radio inspectors.

One of the conditions upon which all licenses will be issued will be that the experimental station will at all reasonable times be open for inspection by a government radio inspector, and to check the surreptitious use of wireless apparatus all suspected stations will be regularly visited by inspectors.

Under the new regulations ship stations will be licensed at a fee of £1 a year, coast stations at £4 a year, aircraft stations (for the benefit of commercial aviation companies) at £1 a year, and portable stations at £1 a year. The portable stations have been licensed for the convenience of the troops of Boy Scouts and similar parties, who require, while travelling from one place to another, to keep in communication with headquarters. Time might evolve this class of license into a convenience for commercial travellers.

The regulations will also remove an anomaly at present existing in regard to the installation of experimental apparatus on yachts and similar vessels. Under existing regulations, these vessels are regarded as ship stations, and are compelled to carry an operator holding a commercial operating certificate, even though the apparatus may have been installed by an amateur for experimental purposes. Under the new regulations the operator of a yacht station will not be required to hold a commercial operator's certificate.

A license is provided for land stations erected in outlying districts and along air routes. In localities unprovided with ordinary telephonic communication, this type of station will be of great benefit to settlers, as it will enable them to make urgent calls for medical and other assistance.

BROADCASTING CONCERTS

Provision is made in the regulations for the control of "broadcasting" stations for the supplying of wireless concerts. Receiving stations for receiving the broadcasting only will also be licensed as a type of station. Broadcasting is an entirely new branch of wireless, and no reliable information of the experience in other countries was available when the regulations were drawn up. Thus the broadcasting regulations are in a very embryonic form, and it will be impossible to prepare satsifactory regulations for the control of broadcasting until it is known what is being done in other countries, and what plans the broadcasting companies are prepared to adopt in Australia. It has, however, been definitely decided to exclude rigorously from broadcasting programs all classes of advertisements.

In the preparation of the regulations the first consideration, of course, was to protect commercial and government traffic from interference from less important stations, but by the confining of amateurs' transmitters to certain bands of wavelengths and the restriction of the power of the transmitter, it is hoped to give the genuine experimenter full scope for his investigations without jeopardising other interests. For amateurs whose interest in wireless communication is stimulated by mere curiosity, the broadcasting licenses will suffice, and these same licenses will make it possible for the man on the land, hundreds of miles from large centers, to have concerts, weather forecasts, market reports, and perhaps press news brought into his home through the medium of the wireless telephone.

TRANS-ATLANTIC RESULTS

Continued from page 37

Free period: 1AJP, 1BEP, 1AKG, 1BES, 1ASF, 1BET, 1AWO, 1BRQ, 1AZL, 1BWJ, 1BCC, 1CN, 1BCF, 1CNF, 1BCG, 1CKP, 1BDT, 1CMK, 1DWP, 1EJA, 1GV, 1II, 1PG, 1RD, 1UN, 1XM, 1ZE, 2AWF, 2CBW, 2AWL, 2CJD, 2AYV, 2CJN, 2BDJ, 2CKR, 2BGL, 2CQZ, 2BLK, 2EL 2BLP, 2FP, 2BML, 2GC, 2BQD, 2GI, 2BQH, 2GK, 2BQU, 2GY, 2ZL, 2LO, 2LY, 2NZ, 2RP, 2UD, 2XAO, 2XAP, 2XAQ, 2ZE (error), 2ZK, 3AH, 3DLG, 3AQR, 3GN (Canuk?), 3AUU, 3HG, 3BCN, 3YU, 3BG, 3ZW, 3BGA, 3ZY, 3BGT, 3ZZ, 3BL, 3BLF, 3BLZ, 3BNU, 4BY, 4EA, 4GT, 5XK, 8ADD, 8BC, 8ADG, 8BSS, 8AGZ, 8BTV, 8AIO, 8BXH, 8QO, 8CJH, 8ATF, 8CVA, 8ATU, 8IB, 8AW, 8JB, 8AWP, 8MR, 8AZQ, 8UE, 8BR, 8YD, 8ZW, 9AUL, 9DFB.

Off-schedule: 1BCF, 1BDT, 1BES, 1BET, 1CDO, 1CDR, 1CDN, 1CK, 1CKP, 1DWO, 1II, 1IT, 1IW, 1XM, 1YK, 1ZE, 2BQH, 2CQZ, 2EL, 2RB, 2RLC (?), 2XAP, 2XAQ, 3AQR, 3AZQ, 3BES, 3BL, 3BLF, 3BM, 3CC, 3HG, 3IN, 3JRB (?), 3TJ, 3XN, 3WR, 4AU, 4EB, 6ADG, 6GZ, 6MLZ (?), 8ADG, 8AM, 8AK, 8AQO, 8AQZ, 8ATB, 8ATU, 8AWF, 8AX, 8AXC, 8BSS, 8BSL, 8BSY, 8BU, 8BXF, 8CKR, 8CYH, 8IB, 8ML, 8XE, 8WR, 9DWQ.

Dec. 21, 1922

Codes verified: 1XM, 1YK, 2LO, 2XAP, 2XAP on phone, 2ZK, 3ZW, 8AQO.

Free period: 1AGK, 1ASF, 1BDI, 1BDJ, 1BDT, 1BES, 1BRQ, 1BKQ, 1CKP, 1CMK, 1CNF, 1EMK (?), 1GK, 1HRX (?), 1OR, 1XM, 1XO, 1XRAY (?—hi! Who spelled out his call letters?), 1YK, 2AFB, 2AFP, 2AWF, 2AWL, 2BML, 2BQT, 2CBX, 2CKN, 2CPD, 2CQZ, 2EL, 2FP, 2GK, 2GLF, 2GR, 2LO, 2UD, 2XAP, 2ZK, 3AFB, 3BFU, 3BO, 3BSY, 3FA, 3HG, 3KXM (?), 3XM, 3ZW, 3ZY, 4BY, 5XK, 6ZA, 8AIO, 8ATU, 8AQO, 8AVO, 8BSS, 8BU, 8NF, 8UE, 8XE, 9OX.

Off-schedule: 1AJP, 1AWP, 1BCG, 1CDO, 1FB, 1II, 1OR, 1RDE (?), 1ZE, 2CQF, 2FP, 2FW, 2KA, 2ZK, WUBA, 3BLF, 8ADG, 8AQO, 8ATU, 8BRK, 8SP, 9CJC, 9OX.

Franco-Swiss Summary

From the above reports we obtain the following summary in the same manner as for the British reception:

District	*Stations Heard*	*Best Station*
First	62	1BDT
Second	63	2ZK
Third	41	3HG
Fourth	5	4BY
Fifth	2	
Sixth	7	
Seventh	0	
Eighth	51	8AQO
Ninth	9	
Total	240	

A total of 240 different stations, several from California, representing every district but the Seventh, with 8AQO easily the star.

Summary

A careful analysis of these reports, eliminating duplication of calls heard in both countries, gives the following total of individual stations crossing the Atlantic ocean in the tests.

First District	79
Second District	81
Third District	53
Fourth District	11
Fifth District	7
Sixth District	8
Seventh District	1
Eighth District	63
Ninth District	12
Canada	1
	316

Summary of American Reception

5WS, the London station of the Radio Society of Great Britain, heard by 1BFG, 1BQD, 1OR, 1XP, 1ANA, 3BEC, 2BBB, 1MO, 3ADP, and L. D. Warner of Schenectady. Total, 10.

2FZ, Wireless Society of Manchester, heard by 1ANA, 2CQO, 2GK, 2BSK, 2BML, 3HS, 8FQ, 8AMD, 9DRR. Total, 9.

8AB, Leon Deloy, Nice, France, heard by 8FQ and by C. A. Service, So. Manchester, Conn. Total, 2.

5SW, undoubtedly in error for 5WS, heard by 1RU.

2PO and 2JZ, somewhat questionable, heard by 8FQ.

Total British stations positively known to have been heard, 2. Total French, 1. Total Americans hearing European signals, 20.

HOW TO MAKE A VERNIER BLADE FOR YOUR CONDENSERS

By ARTHUR GORDON

A vernier condenser may easily be made from an ordinary standard variable condenser. All that is needed is a single blade, so fixed that it can be revolved by itself, independently of the other movable blades.

One amateur took his standard condenser apart, so that he had the stator (or fixed stack of blades) in one hand, the rotor (or movable blades) in the other, and the dial on the bench in front of him. He noticed that the uppermost rotor blade fitted against a shoulder on

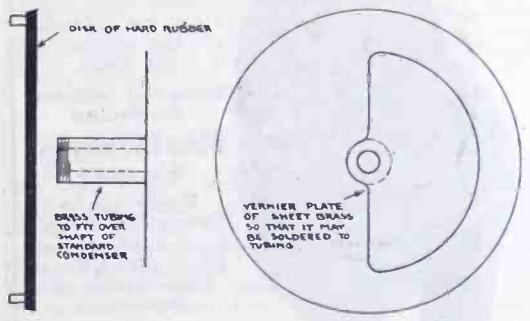


Fig. 1

the rotor shaft. Then the other blades were stacked on with a space washer between, while a nut held the whole of them tight and in place.

He then conceived the idea of using this shoulder as a space washer, adding another blade on a separate shaft, and operating it from the face of the panel by a large hard rubber disk, set with little knobs or pins for convenience in turning. A short piece of brass tubing furnished the vernier shaft. It just fit over the main shaft of the condenser. The extra blade was cut from sheet brass, not that brass is any better than aluminum, but because our crafty amateur foresaw somewhat of a soldering job in fastening the new blade to its new shaft.

When the blade was fixed on one end of the tubing, a die thread of small pitch was put on the other end. This thread was duplicated on the central hole of the hard rubber disk shown in Fig. 1, which disk, by the way, was cut out of an old phonograph record. In diameter, it was ½ in. larger than the largest diameter of the dial. The pins, which were of brass, were screwed into place, and then the vernier attachment was complete.

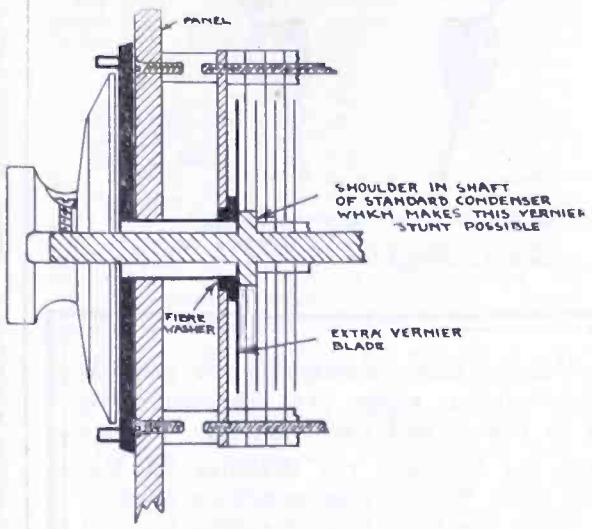


Fig. 2

In preparing the stator for the introduction of this new unit, it was necessary to add another blade. This was an easy matter and soon done. Not so easy, however, was the fitting of a fibre bushing, as shown in the assembly Fig. 2. Ordinarily, such a bushing is turned around the other way with its overlap outside; in this case, however, the overlap was put inside and used as a washer.

When the condenser was re-assembled, everything went well until the blades of the stator were tightened up. Then the ambitious amateur who was doing the job found that the vernier blade was packed in its space so tightly that it could not be moved. He had reasoned it out that the fibre washer should be just one-half the thickness of the space washers and had made it so. Theoretically this was correct, but practically the washer proved too thick. The amateur thinned it down a trifle and tried the assembly again. This time it worked perfectly. Mounting the reconstructed condenser on the panel was but the work of a moment. Of course, the shaft hole had to be enlarged to take the new diameter, but that is all. After the instrument was in place, the hard rubber disk was screwed on its shaft and the dial put on as before.

No dimensions are given with this article, for it is the idea which is important. Some amateurs may apply it as suggested while others may do something entirely different, according to the particular construction of the condensers that they now own. Whatever the method, however, the result is the same —a real home-made vernier, with all the advantages and ease of operation which distinguishes the commercial product.

CALLS HEARD

Continued from page 78

By Canadian 5EJ, Vancouver, B. C.

Spark: 6km, 6tu, 6bip, 7ix, 7oj, 7ne, 7ry, 7ve, 7agi, (7aio), 7aiy.

C. W.: 5ft, 5hk, 5px, 5sf, 5xb, 5xd, 5za, 5zag, 5zak, 5zay, 6ak, 6bx, 6eb, 6cc, 6cu, 6bu, 6en, 6ff, 6gx, 6gy, 6ka, 6lv, 6nx, 6pd, 6pi, 6qm, 6sz, 6ti, 6su, 6ur, 6uw, 6xk, 6zh, 6zn, 6zo, 6zx, 6zz, 6abx, 6ajf, 6ajr, 6alu, 6apw, 6arf, 6ark, 6amw, 6asx, 6avd, (6awt), 6bfb, 6biq, 6bmd, 6boe, 6bod, 6bqc, 6bqq, 6bqz, 6brf, 6bsq, 6bvq, 6cbi, 6xad, 7aw, 7ba, (7bj), 7bk, (7cu), 7dc, 7dp, 7ex, (7ey), 7fh, 7fr, 7hj, 7hm, 7ic, 7iy, 7jg, 7lr, 7lw, 7mc, 7mf, 7na, 7nf, (7nn), 7np, 7ny, 7om, (7pb), (7pf), (7qf), 7qt, 7ri, 7rm, 7rn, 7sc, (7sf), 7sy, (7th), (7to), (7tq), 7wk, 7wm, 7wx, 7zb, 7zo, 7abb, 7acg, (7acx), (7adf), 7adn, 7aea, 7aem, (7afh), 7afs, (fone), 7aft, 7afw, 7agf, (7aic), 7aiu, 8bk, 8ib, 8vy, 8yk, 8zw, 8adp, 8asy, 8axc, 8azy, 8azf, 8bvt, 8cfr, 9bk, 9bp, 9bm, 9dz, 9fh, 9fm, 9gk, 9ox, 9pn, 9qf, 9rc, 9uh, 9zn, 9aap, 9abu, 9agt, 9ajh, 9aou, 9aps, 9apw, 9asm, 9aua, 9aul, 9auz, 9awm, 9aws, 9aza, 9bbf, 9bly, 9bsz, 9cpu, 9dge, 9dky, 9dtm, 9dwk, 9ebt, 9xac, 9yaj.

Canadian Spark: 5dx. C. W.: 4br, 4bv, (4dq), 4hh, (5ct). Anyone hearing 5EJ 5-watt C. W. please qsl to 1451 Balfour Ave., Vancouver, B. C.

By 7TT, 7126 54 Ave. S. E., Portland, Ore.

5di, 5aem, 5ej, 5xd, 5za, 6ak, 6bq, 6cc, 6dd, 6bp, 6eb, 6en, 6fh, 6jd, 6ka, 6ku, 6km, 6lv, 6nx, 6qm, 6rd, 6rm, 6rr, 6sz, 6tc, 6uw, 6vm, 6aat, 6abx, 6adi, 6ahq, (6ajf), 6ajr, 6alu, 6amz, 6aor, 6arb, 6arf, (6ark), 6asj, 6atc, 6atq, (6awt), 6bcj, 6bet, 6bim, 6biq, 6bmd, 6bnt, 6bob, 6bqg, 6bug, (6bum), 6but, 6bvw, 6cbi, 6za, 6zb, 6zf, 6zg, 6zh, (6zi), 6zn, 6zs, 6zt, 6zw, 6zz, 6xk, 6xad, 6xar, 6xaw, (7bk), (7ny), (7ri), (7ke), 7rn, 7qn, 7ot, (7sc), 7hm, 7mf, 7tq, (7acg), 7ahi, 7abb, 7adp, 7zo, 7zu, 7zv, (7xc), 8ib, 8zy, 9bm, 9bx, 9dr, 9gk, 9pi, 9aul, 9ayu, 9bji, 9cfy, 9cns, 9xaq, 9yaj, 9zn, 9zaf, M (bt3), d53, Can.—4bv, 5cn, (5ct), 5cn, (5go).

Spark: 6tu, 6acr, 6ark, 6akt, 7kj, 7ne.

5pv, 5px, 5qi, 5qs, 5rh, 5rr, 5sf, 5ss, 5ta, 5tc, 5tj, 5tm, 5tp, 5tx, 5uj, 5un, 5uo, 5uu, 5vo, 5we, 5xa, 5xk, 5xt, 5xw, 5zb, 5zs, 5aah, 5aar, 5aat, 5aby, 5aec, 5aer, 5aqi, 5xaj, 5zag, 5zak, 5zas, 5zav, 6cc, 6ea, 6if, 6lu, 6lv, 6ka, 6jd, 6rm, 6vm, 6zh, 6zt, 6zz, 6abx, 6anh, 6arb, 6avd, 6avn, 6awt, 6bbh, 6boe, 6bun, 6bvy, 6xad, 7bh, 7lu, 7ly, 7hm, 7sc, 7zc, 7zo, 7zu, 7zv, 7abb, 7afw, ad-7, 8aa, 8ab, 8bo, 8cy, 8fq, 8ft, 8fu, 8hh, 8hn, 8ib, 8ij, 8ju, 8kg, 8ml, 8oi, 8pd, 8qk, 8rj, 8ry, 8sb, 8sl, 8sp, 8sh, 8tt, 8ue, 8up, 8vq, 8vy, 8xe, 8yn, 8zf, 8zw, 8zz, 8abe, 8adg, 8adu, 8adz, 8aea, 8aeb, 8aeg, 8aeh, 8ago, 8agz, 8aih, 8aim, 8ajx, 8alc, 8alf. 8alr, 8ame, 8anb, 8apt, 8apv, 8apw, 8aqo, 8ard, 8asc, 8asv, 8atx, 8avd, 8awr, 8awz, 8axb, 8axc, 8azd, 8azq, 8bcy, 8bdc, 8bde, 8bef, 8bek, 8bfb, 8bfh, 8bfm, 8bfr, 8bgl, 8bho, 8bic, 8bju, 8blc, 8blq, 8bnh, 8boq, 8bow, 8boz, 8bpe, 8bpj, 8brc, 8bry, 8btl, 8bur, 8but, 8bvr, 8bwa, 8bwy, 8bwz, 8bxa, 8bxe, 8bxx, 8byo, 8bzd, 8bzy, 8caa, 8cau, 8caz, 8cbo, 8cbx, 8cdz, 8cep, 8cfj, 8cfm, 8cgx, 8cia, 8cih, 8cim, 8cjh, 8cjy, 8cjz, 8cmy, 8coj, 8cpd, 8crb, 8cwc, 8cwp, 8cxf, 8csk, 8cyb, 8cyt, 8czk, 8czr, 8xae, 8zae, Nines too numerous. Canadians—2fc, 3bv, 3ds, 3fa, 3il, 3ji, 3ko, 4ab, 4br, 4bv, 4dk, 4hh, 9ac, 9bs.

By 5DI, 2209 Azle Ave., Ft. Worth, Texas

C. W.: 1gv, 1ii, 1mv, 1xu, (1xz), 1bes, 1brq, 1bwj, 1cmk, 2bg, 2el, 2gk, 2kf, 2ud, 2zk, 2anm, (2bbb), 2bof, 2bsc, 2bzq, 2bzv, 2cbg, 2ccd, 2cqz, 3cc, (3cm), 3iw, 3mb, (3ot), 3ro, 3sw, 3yo, 3xm, 3art, 3bhm, (3blf), 3brf, 4at, 4cg, 4co, 4dr, 4fg, 4fs, 4hh, 4hs, 4km, 4ne, 4oi, (4ya), 5ek, (5el), 5fv, 5hz, 5gy, (5nk), (5nn), (5nv), 5rh, (5ta), (5aah), (5aby), 5zas, (5zaz), 6bf, 6bh. 6ea, 6cc, 6if, 6lv, 6pi, 6xd, 6xk. 6zh. 6zn, 6zo. 6zx, 6zz, 6ajr, (6anh), 6arf, 6avn, (6awt), (6bbh), 6bep, (6bjb), (6bkx), (6bma), 6boe, 6brg, 6bun, 6cbd, 6xad, 6xaa, (6zac), (7bj), 7gd, 7jw, 7ot, (7sc), 7zu, 7bwj, 8ab, 8ck, 8cp. 8ft. (8iq), 8iv. 8qk. 8sb, 8xe, 8zn, (8aer), (8aih), 8ago, 8aio, (8alc), 8aly, (8ame), 8anb, 8asz, 8awe, (8awz), (8beo), 8bjv, (8bke), (8bsa), 8btl, 8but, 8bvr, (8bwa), 8bwl, 8bwy. 8byo, 8byt, 8bxx, (8caa), (8ccb), 8cfo, 8cgj, (8cgx), 8cjz, 8ckv, 8cmi, 8cpd, 8cpx, 8cur, 8dak, (9fm), 9nq, 9ox, 9wq, 9yu, (9zn), 9aap, 9abv, 9afa, 9akd, 9alw, 9amb, 9anf, 9ang, (9ans), (9aou), 9aqz, 9asn, 9aus, (9awm), (9bdo), 9bed, 9bfg, 9bgs, 9bhs, 9bij, 9bik, 9bjk, 9bkp, (9bly), 9bri, (9brt), 9bxt, (9byx), 9bzi, 9cba, 9ccs, 9ccv, (9ceh), 9cgd, 9cgk, 9chg, 9ciy, 9ccp, 9cvo, 9cte, (9ctg), 9dbb, 9djb, (9dkg), (9dmj), (9dqu), (9dsl), (9dsm), 9dta, (9dwg), 9dxn, 9xaq, 9yaj, (9ebt), (9ecz). Canadian—3bv, 3fa, 3gk, 3jh, 3jt, 3ox, (4bv).

By 6TI, 414 Fairmount Ave., Oakland, Calif.

C. W.: 5be, (5px), 5tc, 5xad, 5zak, 5zas, (6om), (6if), (6pi), 6bbh, (6bfl), (6bob), (6bod), (6bqq), (6bvq), 6bwe, (6zac), 7ey, 7nf, (7sc), 7wk, (7wm), 7acx, 8ky, 8qk, 8ang, 8anq, 8zaf, 9bp, 9ew, 9gk, 9ox, 9rk, 9aap, 9ans, 9baf, 9bly, 9bzi, 9cac, 9cjc, (9cjy), 9cpm, 9cpu, 9dcq, 9dkq, Can. 5cn.
Spark: Can. 5cn, (9bd).

By 7WX, 328 East Jay St., Tacoma, Wash.

C. W.: 1cy, 2ab, 4ex, 5fv, 5sf, 5px, 5fu, 5jt, Can. (5go), 6ang, 6awt, 6anh, 6ary, (6arb), 6aje, 6asj, 6aw, 6abu, 6ajr, 6aab, 6bo, 6bum, 6cu, 6cbd, 6dd, 6ea, 6ei, 6eb, 6een, 6ki, 6km, 6lj, 6xb, 7adp, 7abb, 7ajr, 7aea, 7fr, 7gb, 7jg, 7lu, 7ly, 7ot, 7qm, 7qn, (7ry), 7sg, 7sc, 7ud, 8azq, 8brm, 8bxx, 8sb, 9aly, 9aou, 9asw, 9ay, 9aya, 9bji, 9buy, 9cy, 9dpl, 9dt, 9dgo, 9dtm, 9ea, 9gk, 9ib.

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- ☐ New Gottschalk Loud Speaker
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This is the New Gottschalk Loud Speaker with Baldwin Phone Element in Base. It will Not Rattle.

FREE for securing only eight subscriptions to "RADIO." The price of this Loud Speaker is $22.00. You get it free for only $20.00 worth of subscriptions.

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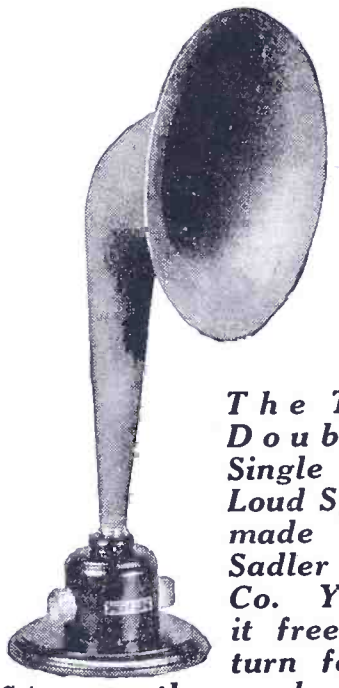
In return for a little of your spare time we will give you a Loud Speaker of Standard Manufacture.



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The Trutone Double or Single Phone Loud Speaker, made by the Sadler Mfg. Co. You get it free in return for only three subscriptions to "Radio." Please include 36c for mailing charges.

Pacific Radio Pub. Co., Pacific Building, San Francisco, Cal.

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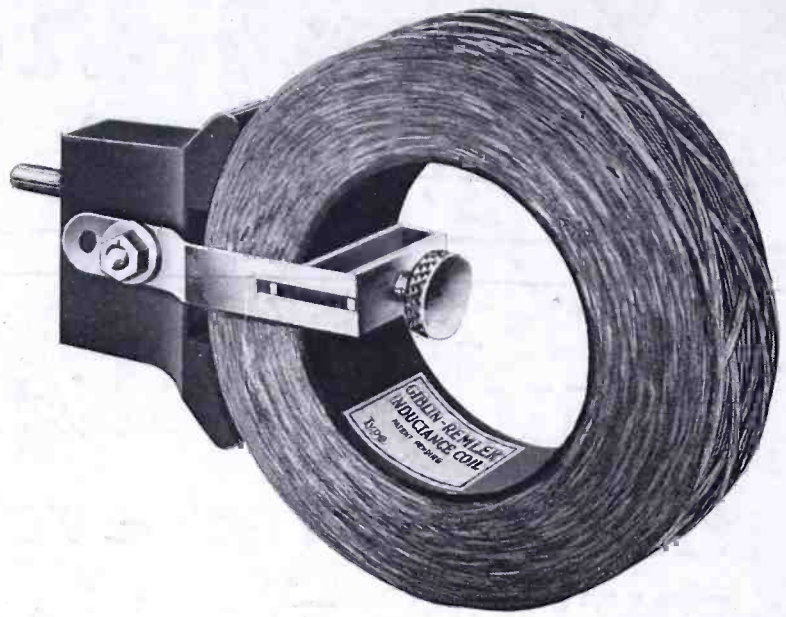
Built on the best Engineering Principles



Maximum Inductance. Minimum Distributed Capacity for a given number of turns.

The highly efficient form of winding used in the GIBLIN-REMLER INDUCTANCE COILS is responsible for their SUPERIOR OPERATION

The construction of the most efficient inductance coil ever developed

DUE to his untiring efforts to perfect compact inductances, Mr. Thomas P. Giblin has succeeded in developing the Giblin-Remler inductance coil. This coil is undoubtedly the greatest step forward in the radio art since the advent of the vacuum tube.

Built along sound engineering principles, this new coil embodies every feature necessary to obtain MAXIMUM INDUCTANCE, MINIMUM DISTRIBUTED CAPACITY and MINIMUM HIGH FREQUENCY RESISTANCE with a given length of wire and in a minimum of space.

Maximum inductance is obtained by winding the turns parallel and close together in each layer, a feature found only in the Giblin-Remler type of winding. Every turn is wound parallel to the circumference of the coil, thus having a shorter length of wire and less resistance than a turn of equal diameter than any other type of winding.

IN compact inductance coils the greatest distributed capacity occurs between layers. In this new coil Mr. Giblin utilized the fact that capacity is directly proportional to the distance between two conductors. By winding cotton yarn of high dielectric strength between layers he has reduced this undesirable internal capacity to a minimum. This is another important and exclusive feature of the Giblin-Remler type of coil winding.

The cotton yarn is wound back and forth diagonally across the layers and interwoven between turns in such a manner that there is maximum spacing, maximum insulation and minimum capacity at the point of greatest potential difference between layers. This minimum capacity at the point of maximum potential difference is a big factor in reducing the losses due to internal capacity. No other coil on the market embodies this important feature.

The results of these efficient and exclusive features of Mr. Giblin's latest form of winding is a new compact inductance coil which gives MAXIMUM SIGNAL STRENGTH, SHARPEST TUNING, and MINIMUM INTERFERENCE under any given condition.

Write for table of constants and complete information regarding these coils.

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

The Remler Technical Bureau is at your service. Address your problems to Dept. R.

REMLER RADIO MANUFACTURING COMPANY

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248 First Street, San Francisco, Cal.

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