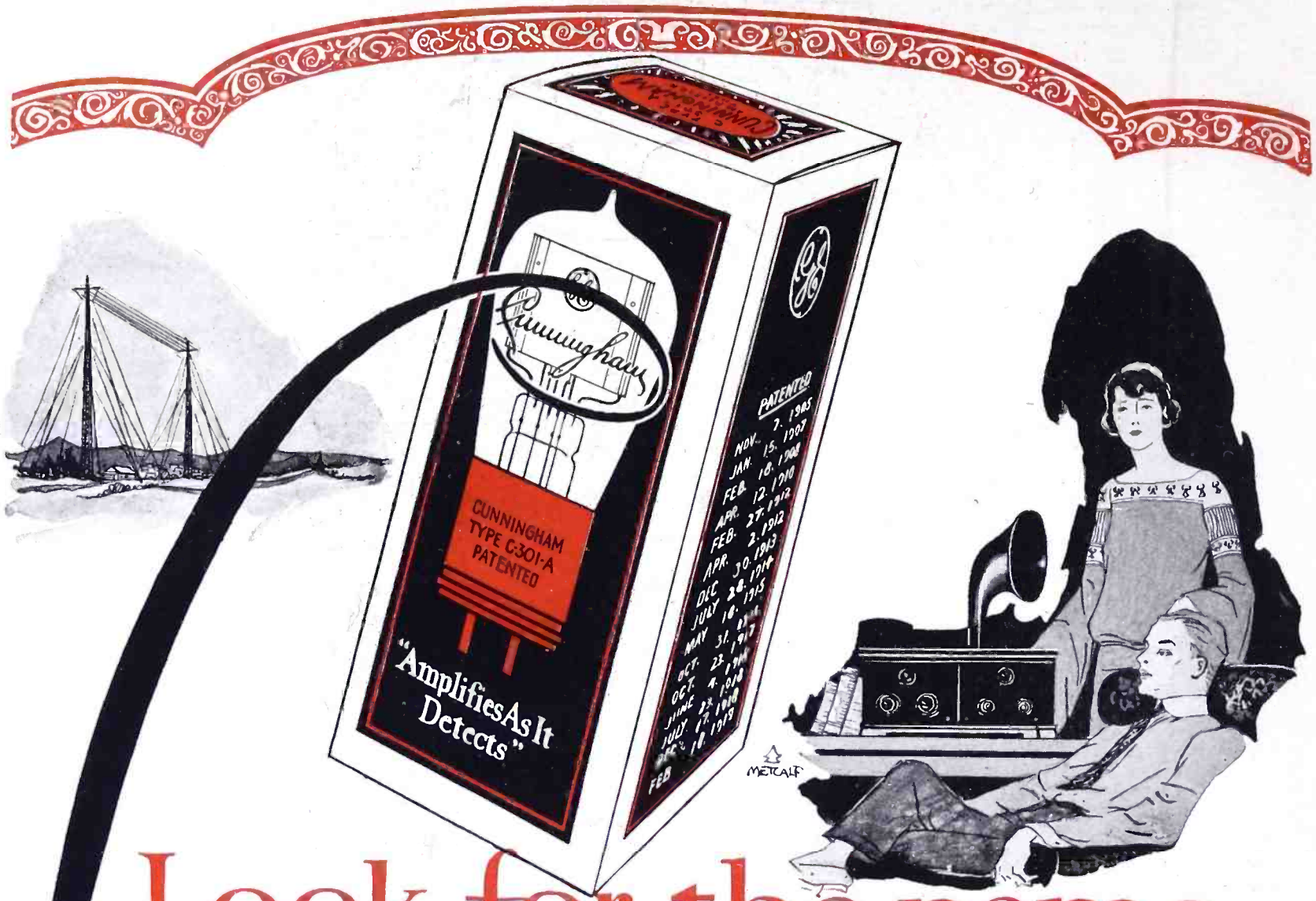
MARCH, 1924 25 CENTS

RADIO

(Reg. U. S. Pat. Off.)

W·H·ANDREWS

RECEIVER CONSTRUCTION NUMBER



Look for the name on the carton

Insist on Cunningham Radio Tubes—there is no higher Quality

THE primary purpose of a trade name is to identify a product or firm in the mind of the buyer. Ask the next Radio enthusiast you meet to state one of the best known names identified with Radio and he will say: "Cunningham."

The presence of the word "Cunningham" on Radio Tubes tells the character and quality of this product—the ideals, engineering skill and service given to the Radio field since the year 1915 by E. T. Cunningham, Inc.

It is the radio tube that has made possible the broad and far reaching application of radio telephony, and that plays the most important part in the operation of your Radio Receiving Set.

Cunningham Radio Tubes, standard for all makes of receiving sets, built by one of the world's largest manufacturers with unlimited resources, are the product of years of manufacturing experience and the creative genius of the engineers of the great scientific organization, the Research Laboratory of the General Electric Co.

Patent Notices Cunningham tubes are covered by patents dated 2-18-08 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

New Prices On Cunningham Tubes Now in Effect

C-301A—5 Volts 1-4 Ampere filament.....$5.00
C-299—3 Volts .06 amp. Dry Battery Det. and Amp..$5.00
C-300—5 Volts Gas Content Detector.....$5.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base.....$5.00
C-12—Similar to C-11 with standard base.....$5.00

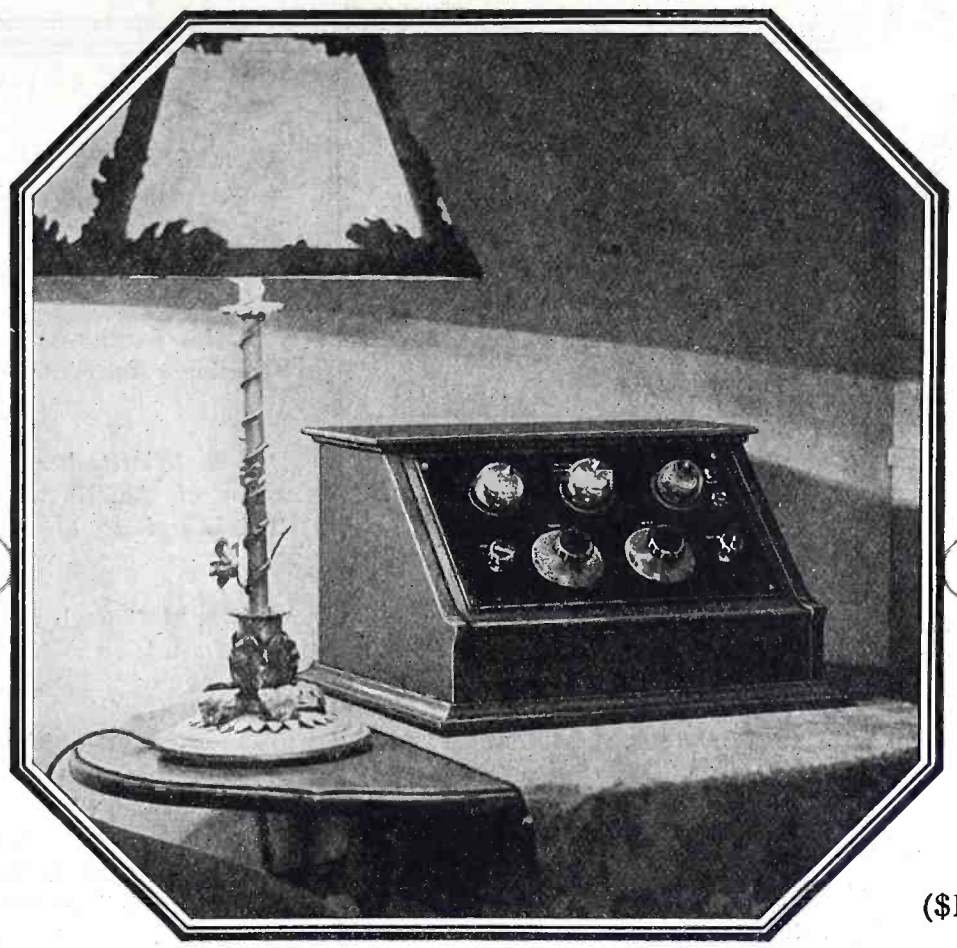
The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending ten cents to our San Francisco office.

E. T. Cunningham Inc.

HOME OFFICE
182 Second Street
SAN FRANCISCO

154 W. Lake Street
CHICAGO

30 Church Street
NEW YORK



$125
fully equipped
($127.50 west of Rockies)

New Kennedy Radio Receiver, Model V

Simple to Operate—Selective—Mechanically Excellent!

This new Model V Kennedy Radio Receiver has established a high standard of tuning simplicity—combined with the same precision and selectivity formerly associated only with the more complicated Kennedy models. Added to this are all the characteristics of mechanical perfection that have made Kennedy "The Royalty of Radio."

Anyone can operate this new product of the Kennedy Engineering Staff. After a preliminary setting has been made, tuning is controlled by a single dial. Dial settings are always the same for a given station, regardless of where the receiver may be operated or the kind of antenna that may be used.

Model V is particularly free from "re-radiation." It reproduces music and voice with unsurpassed purity and operates on any ordinary antenna—outside type preferred. Embraces the entire broadcast wave range.

Selectivity is one of the outstanding features of this new Kennedy model. It will clearly differentiate between distant and nearby stations only a few meters apart—local interference can in most cases be eliminated as satisfactorily as with older Kennedy models.

Mechanically, Model V bears the same high stamp of excellence that has characterized Kennedy Receivers during the past twelve years. In every detail of construction the highest standards of precision and accuracy are rigidly adhered to.

Model V is an exquisite piece of furniture. The cabinet is of mahogany, hand rubbed to a beautiful satin finish. Its proportions are pleasing. The highly polished black Formica panel lends an elegance of finish—its height and angle have been established, after much thought and study, to provide comfort and ease in tuning.

The price of Model V, completely equipped with all tubes, dry batteries and individual Kennedy 3,000-ohm phones, with plug, is only $125.00 ($127.50 west of Rockies)—marking it as a feature value in radio equipment. Other Kennedy models range from $285.00 to $825.00 (slightly higher west of Rockies), completely equipped, including built-in loud speaker.

See the new Kennedy Model V at your dealer or write us direct for fully illustrated literature on this and other Kennedy Radio Receivers.

All Kennedy receiving sets are regenerative.
Licensed under Armstrong U. S. Patent No. 1,113,149.

THE COLIN B. KENNEDY COMPANY
SAINT LOUIS SAN FRANCISCO

KENNEDY

The Royalty K *of Radio*

Tell them that you saw it in RADIO

RADIO

Established 1917 as Pacific Radio News

Volume VI for MARCH, 1924 *Number 3*

CONTENTS for MARCH, 1924

RADIO is Published Monthly by the Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, Calif.

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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 of Contributions for April Issue

E. M. Sargent presents the details for constructing a super-heterodyne receiver.

S. R. Winters has written an interesting account of the Naval Communication Service. This is profusely illustrated.

D. B. McGown has an eminently practical and useful article on soldering.

Constructional articles omitted from the March issue because of space limitations include "A Single Tube Reflex Receiver" by Paul Oard; "A Real Short Wave Receiver" by John F. Rider, and "Super-Autodyne Reception" by P. J. Townsend. They will appear in the April issue.

Part II of Chas. F. Filstead's description of "A Reflex Receiver for Beginners" takes up the one-stage a.f. amplifier unit.

Jacque Avon tells how to secure double rectification with a two-crystal receiver.

In his series of helpful explanatory articles L. R. Felder next takes up the how and why of the super-regenerative circuit.

R. F. Stares describes a quick change circuit board for the experimenter.

Carlos S. Mundt gives some sound advice on "Common Sense in Design".

Edward T. Jones tells "What You Should Know About Storage Batteries".

L. H. LaMontagne describes the construction of a super-selective receiving set; something much needed in these days of many good broadcast stations.

Jerome Snyder has an article on "A Study of The Frequency Trap" which will help those trying to obtain selectivity.

The fiction feature will be a screamingly funny story by Earl Ennis entitled "The Enchanted Jackass". Of course it's radio.

The GREBE "13"

A Real Receiver for Radio Men

"Let the instructed lead the way by example."
—KANG HSI

In relay work the wise DX man uses a dependable GREBE "13"

Doctor Mu

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RADIO-CLUB DE LA CÔTE D'AZUR
NICE

Mr. E. K. JAMES
c/o A.H. GREBE & Co. Inc.,
Richmond Hill, N.Y.
U.S.A.

Nov. 1st. 1923.

Dear Mr. James,

Back home since four days only I have reinstalled my station for 100 meter work.

I am glad to say the GREBE CR-13 which I brought back has already done splendid work. I tuned down to 100 meters for the first time this morning at 0010 G.M.T. and immediately heard KDKA. I followed him until 0200 and all the time his carrier wave was good, he could have been easily read in telegraphy. At times excellent orchestral music and some words were plainly heard in spite of heavy static and arc interference.

The distance from Pittsburgh to Nice must be about 7,000 kilometers (roughly 4,400 miles); I have all reasons to think this is the world record distance transmission on 100 meter wave.

Please express my hearty congratulations to the GREBE Co. for their wonderful receiver.

Very sincerely yours.

Léon Deloy
F8AB

IT is significant that the Grebe "13" is the choice of those Amateurs who have established worth-while distance records. Each detail of Grebe craftsmanship is fitting testimony of its efficiency.

Combining Regeneration and Tuned R. F., it affords sharper tuning, greater range and quieter operation. Its wavelength range is:—80-300 Metres.

Ask your dealer or write us for complete information.

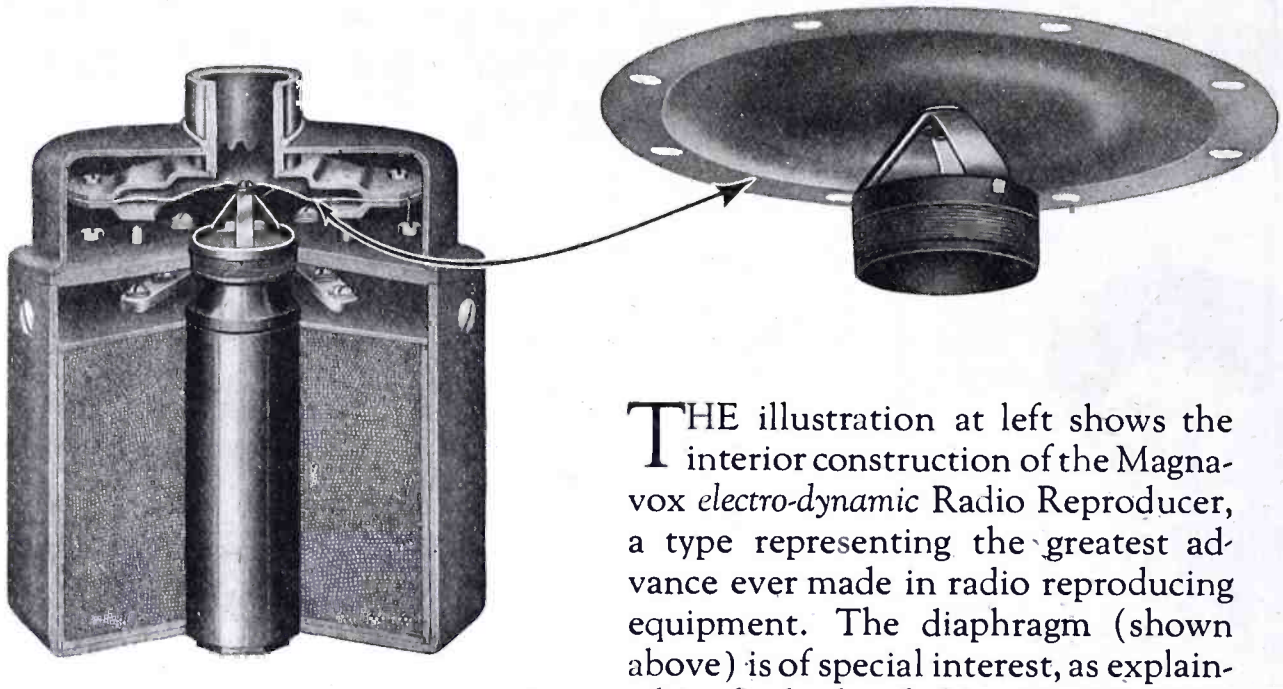
GREBE RADIO

Licensed under Armstrong U. S. Pat. No. 1,113,149

A. H. GREBE & CO., Inc.

79 Van Wyck Blvd., Richmond Hill, N. Y.

Western Branch: 451 East 3rd Street, Los Angeles, Cal.



THE illustration at left shows the interior construction of the Magnavox *electro-dynamic* Radio Reproducer, a type representing the greatest advance ever made in radio reproducing equipment. The diaphragm (shown above) is of special interest, as explained in the body of this advertisement.

A1-R—$59.00

This instrument (Magnavox Combination Set) consists of Magnavox Electro-dynamic Reproducer combined with a Magnavox Power Amplifier in one unit. It is an important addition to Radio in the home.

MAGNAVOX–True Radio Reproducer

THE basis of the operation of a Magnavox Reproducer is its diaphragm, the importance of which can be seen from the fact that it is required to render an almost human service in recreating every tone and quality of instrumental music as well as speech.

This diaphragm (as illustrated) has been designed and constructed in accordance with entirely new principles. Its shape, size and special character make it capable of responding to the widest range of tones.

But even this highly efficient diaphragm might be handicapped by operating restrictions—every diaphragm must have a vibrating force applied to it, and the inherent ability of any diaphragm will be injured if it is affected by mechanical operation or other foreign influences.

The use of the electro-dynamic principle of operation (found only in Magnavox Reproducers) removes all objectionable influences. This principle, utilizing the famous "movable coil" permits the Magnavox diaphragm to respond in perfect unison to the original tone.

These exclusive features, fundamental to radio reproduction, account for the superiority of Magnavox Radio equipment.

There is a Magnavox for every receiving set: Type R for storage battery sets, and M1 for dry battery sets.

THE MAGNAVOX CO., Oakland, Calif.

New York Office: 370 SEVENTH AVENUE

PERKINS ELECTRIC LIMITED, Canadian Distributors Toronto, Montreal, Winnipeg

3R

FADA "ONE SIXTY" NEUTRODYNE RADIO RECEIVER

Selectivity

The FADA "One Sixty" radio receiver is known to thousands as the greatest triumph in radio engineering down to this very moment. It meets all requirements for simplicity of control, selectivity, volume, clarity and ability to bring in distant stations.

Its selectivity appeals to everyone—and to the women folks in particular. You can tune out local stations, even when several are broadcasting, and bring in distant programs. Or, you can tune in any local station you wish and not be bothered with interference from the others.

After any station is picked up with maximum intensity, notations can be made of the dial settings, and if one desires to listen to the same station again it is only necessary to reset the dials in the same positions as recorded.

The FADA "One Sixty" is a four-tube Neutrodyne radio receiver. Our engineers have found by exhaustive experiments that the FADA "One Sixty" with four tubes will produce results at least equal to those of any five-tube set. This means economy in tube and battery costs.

In appearance the FADA "One Sixty" is an attractive piece of furniture. Installed in the home, its chaste, handsome cabinet harmonizes with any interior. It is a quality product throughout. Made with all the care and skilled workmanship that have made FADA products noted, the "One Sixty" is a radio receiver that anyone may be proud to own.

Price, exclusive of tubes, batteries and phones, $120—at all dealers.

F. A. D. ANDREA, INC., 1581 Jerome Avenue, New York City

Pacific Coast Representative: Globe Commercial Co., 709 Mission St., San Francisco, Calif.

FADA Radio

To get best results with low-voltage tubes

FOR perfect clearness you must use a storage battery with uniform current. This is particularly true if you are a fan for long distance. When signals are weak, the steadiness of a dependable A storage battery is indispensable to good receiving.

There are two tiny but sturdy Exide A Batteries designed specially for WD-11 and UV-199 vacuum tubes, and they give fine service with any low-voltage tubes.

You can carry one of these little batteries in the palm of your hand, yet they are powerful enough for long-distance receiving and have the true Exide ruggedness built into them.

A battery for 6-volt tubes

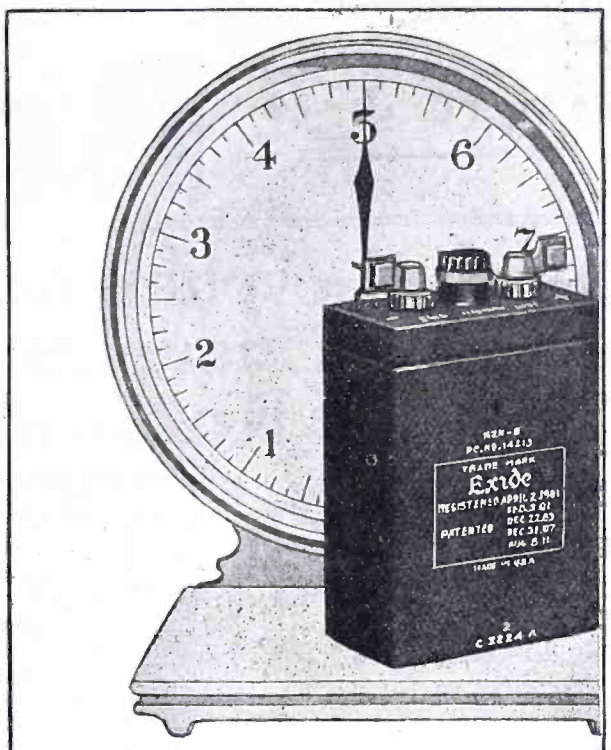
Three sizes of A batteries

The 2-volt battery has a single cell and weighs five pounds. It will heat the filament of a WD-11 or other quarter-ampere tube for approximately 96 hours. The 4-volt battery has two cells, weighs six pounds, and will light the filament of a UV-199 tube for 200 hours.

The Exide A Battery for 6-volt tubes is made in four sizes—of 25, 50, 100, and 150 ampere-hour capacities. These batteries have extra-heavy plates, assuring constant voltage and uniform current over a long period of discharge.

A battery with a pedigree

A good storage battery does not just happen. It is the result of long experience. The skill acquired



This 2-volt A Exide storage battery weighs only 5 pounds

and the resources developed in making batteries for every purpose since the beginning of the storage battery industry thirty-five years ago are built into the Exide Batteries made specially for your radio.

Wherever batteries *must* be reliable—such as on submarines, in the telephone system, in firing the guns of our battleships, in the central power stations of our great cities—there you will find Exides doing their unfailing duty. While the weight of the smallest Exide radio battery is only five pounds, the great Exides used in central power stations sometimes have as many as 150 cells, each cell weighing three tons—or nearly a million pounds for one battery.

A majority of all government and commercial radio plants are equipped with Exide Batteries.

Exide Radio Batteries are sold by radio dealers and Exide Service Stations everywhere.

Ask the dealer, or write direct to us, for booklets describing the complete line of Exide Radio Batteries.

Exide
RADIO BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

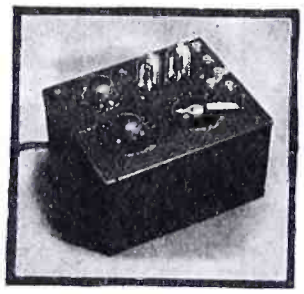
Manufactured in Canada by Exide Batteries of Canada, Limited, 133-157 Dufferin Street, Toronto

Tell them that you saw it in RADIO

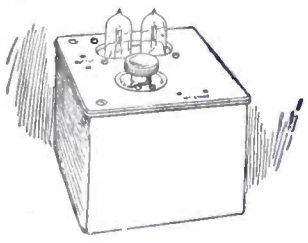
There's a Radiola for every purse

New and Revolutionary Radio Achievements in the new Radiolas

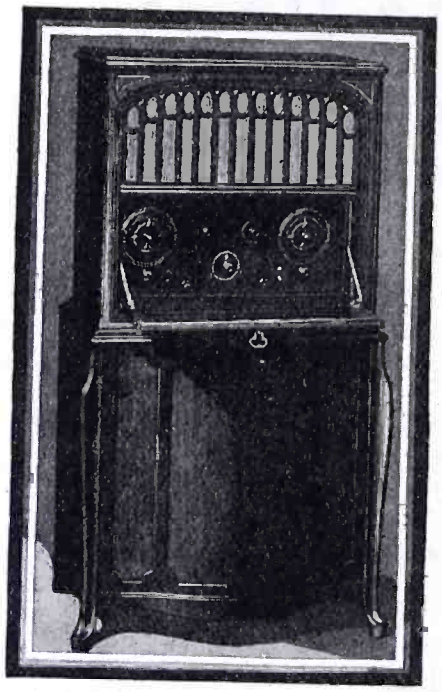
Radiola III, an improved two tube receiver of antenna type, sensitive and selective. *Complete* with two WD-11 Radiotrons and headphones (everything except batteries and antenna) . . . **$35.**



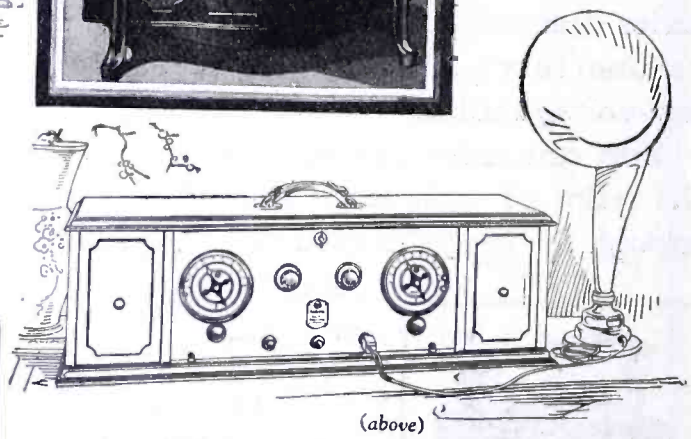
Radiola III Amplifier
Two tube balanced amplifier for Radiola III, including two Radiotrons WD-11 . $30.



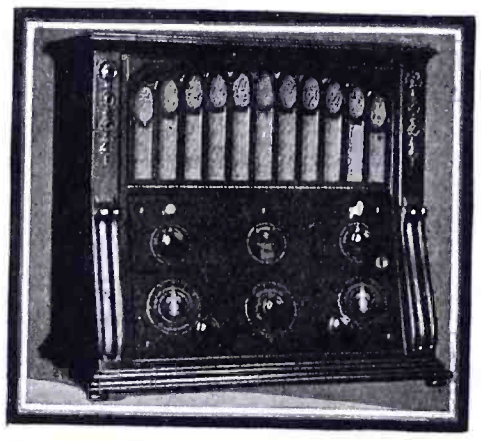
(above)
Radiola III-a, which is Radiola III and its balanced amplifier complete in one cabinet; including four WD-11 Radiotrons, headphones, and Radiola Loudspeaker (either type FH or UZ 1320.) Everything except antenna and batteries . . . **$100**



Radiola Super-VIII —an improved Super-Heterodyne. Selective and non-radiating. With *no antenna*, and no ground connection, it receives far distant stations, even while local ones are operating. Loudspeaker built in. *Complete* with six UV-199 Radiotrons — everything except batteries . . . . **$425.**



(above)
Radiola Super-Heterodyne (second harmonic) same as Super VIII but semi-portable in mahogany finished cabinet, with separate Radiola Loudspeaker of either type, FH or UZ 1320. With six UV 199 Radiotrons, but without batteries, **$286.**
Same as above, but without Radiotrons or Loudspeaker . . . . . **$220.**



(above)
Radiola X —ultra refined receiver of the antenna type, selective and non-radiating. Remarkable for distance reception and perfect reproduction. Built-in new type loudspeaker. Complete with four WD-11 Radiotrons—everything except batteries and antenna. **$245.**

(below)
Radiola Regenoflex, a modified Radiola X, in mahogany cabinet, with external loudspeaker. With four WD-11 Radiotrons and Radiola Loudspeaker (FH or UZ 1320) but less batteries and antenna . $206
Same as above, but without Radiotrons and Loudspeaker, batteries or antenna . . . **$150**

$35	$206
65	220
100	245
150	286

$425

This symbol of quality RCA *is your protection*

It is impossible to give here full description of these revolutionary new sets. Send this coupon for an illustrated booklet that tells the story completely, with detailed description of every set.

RADIO CORPORATION OF AMERICA
Dept. 53. (Address office nearest you.)
Please send me your new free Radio Booklet.
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Radiola

REG. U. S. PAT OFF

Tell them that you saw it in RADIO

March
1924

RADIO

Established 1917

Trademark Registered U. S. Patent Office

Volume 6
No. 3

Radiotorial Comment

THE distinguishing characteristic of this, as well as most other issues of RADIO, is the large number of "how-to-make-it" articles. During the past twelve months construction data have been given for almost every kind of radio apparatus. These articles usually have been written by amateur constructors as a result of their own successful experience and may be depended upon for guidance.

In its present stage of development radio is somewhat unique among the popular sports, in that it gives the combined pleasure of constructing and utilizing the equipment. In this respect it is not unlike amateur photography before the days of "you press the button and we do the rest". But radio has the added advantage that, if desired, every part may be made at home.

Radio, also, has reached the "you press the button" stage. To enjoy radio broadcasting it is unnecessary to know anything more about radio than the average man knows about telephone engineering when he uses a telephone. The newer sets are so simple in operation and so accurate in adjustment that the veriest tyro can get almost as good results as the expert.

These facts naturally raise in the mind of the beginner the question as to whether he should buy or build his radio receiver. And the answer, in large measure, depends upon the capabilities of the builder.

If he knows or can learn something about the electrical principles applied in radio, if he is mechanically inclined and handy with tools, and if he has great patience and perseverance, the answer is in the affirmative. For not only can a set be built at home more cheaply than it can be purchased but there is also the personal satisfaction and gain in individual accomplishment. This is one of the continual surprises in radio that so much can be done with so little.

But if the asker possesses none of the foregoing qualifications the answer is emphatically in the negative. He can buy a much better receiver than he can build, and at a smaller ultimate cost. Home radio construction is a waste of time and money for one whose handiness is limited to repairing an electric iron or taking the spark plugs out of a car.

Even for the mechanically unfit there is a certain amount of satisfaction in assembling a "knock-down" set or its equivalent in standard parts, a drilled panel and detailed directions. This will give a better knowledge of the how and why of radio than will merely twirling the knobs.

However, it is to be assumed that most of the readers of these pages are competent enough to wind coils, solder a joint and put together a fixed condenser. For them there is a great thrill in getting results from following constructional directions or in setting up a new hook-up. There is no manufactured set that cannot be duplicated or even improved —if. If—aye's there's the rub. So unless the "if" is no obstacle 'tis better to buy than to build.

This is not written to discourage home construction. Radio is doing more than any other one thing to satisfy the desire to explore the hidden lands of science. It is fascinating in its rapid developments. But to understand and apply its principles requires patience and skill.

RADIO is rapidly extending the university's sphere of influence. Especially is it enlarging the extension division's work in giving home instruction. More than fifty schools and colleges have broadcast stations and the professors from others are regularly speaking from the larger commercial stations.

Many of the university radio clubs are also carrying on telegraphic correspondence on the 1290-meter wavelength allocated for this purpose. This rapid interchange of information cannot but help each university.

But little imagination is required to see how the person in the home can thus gain many of the advantages of a university education at a minimum expense of time and money. Particularly valuable is this service to the farmer, as much attention is to be paid to the broadcasting of agricultural as well as general cultural subjects. Radio is destined to even a greater influence than the printing press.

THOUGH 'tis trite to say that radio is still in its infancy, yet the fact is emphasized by the rapid development of this lusty infant. The latest stunt that may soon become a regular service is the simultaneous broadcasting throughout the country of a program given at one place. Through transcontinental telephone lines Chicago was connected to the east and west coasts, Havana, and the south, so that a number of selected stations were able to broadcast all that transpired. This test has proven the practicability of wire interconnection for the forty-eight Western Electric Class B stations so that there is no section of the country which cannot listen-in to the broadcast from the nearest station.

The other method of simultaneous service, that of picking up the program from a distant station and re-broadcasting it from a local station, has been given satisfactory demonstration by the Westinghouse Company in its service from Pittsburgh, Pennsylvania, to Hastings, Nebraska. Similar experiments by the General Electric Company will soon come to fruition.

Either of these methods will greatly simplify the problem of local stations in putting on good programs. The entire nation can thus simultaneously hear the greatest speakers and the best music, no matter where located. Furthermore, it will tend to popularize the more selective but less sensitive receivers, for there is no object in getting d.x. when the same program is being broadcast locally. Surely, the world does move.

Pacific Coast Station KGO

By R. C. Koernig, Engineer KGO.

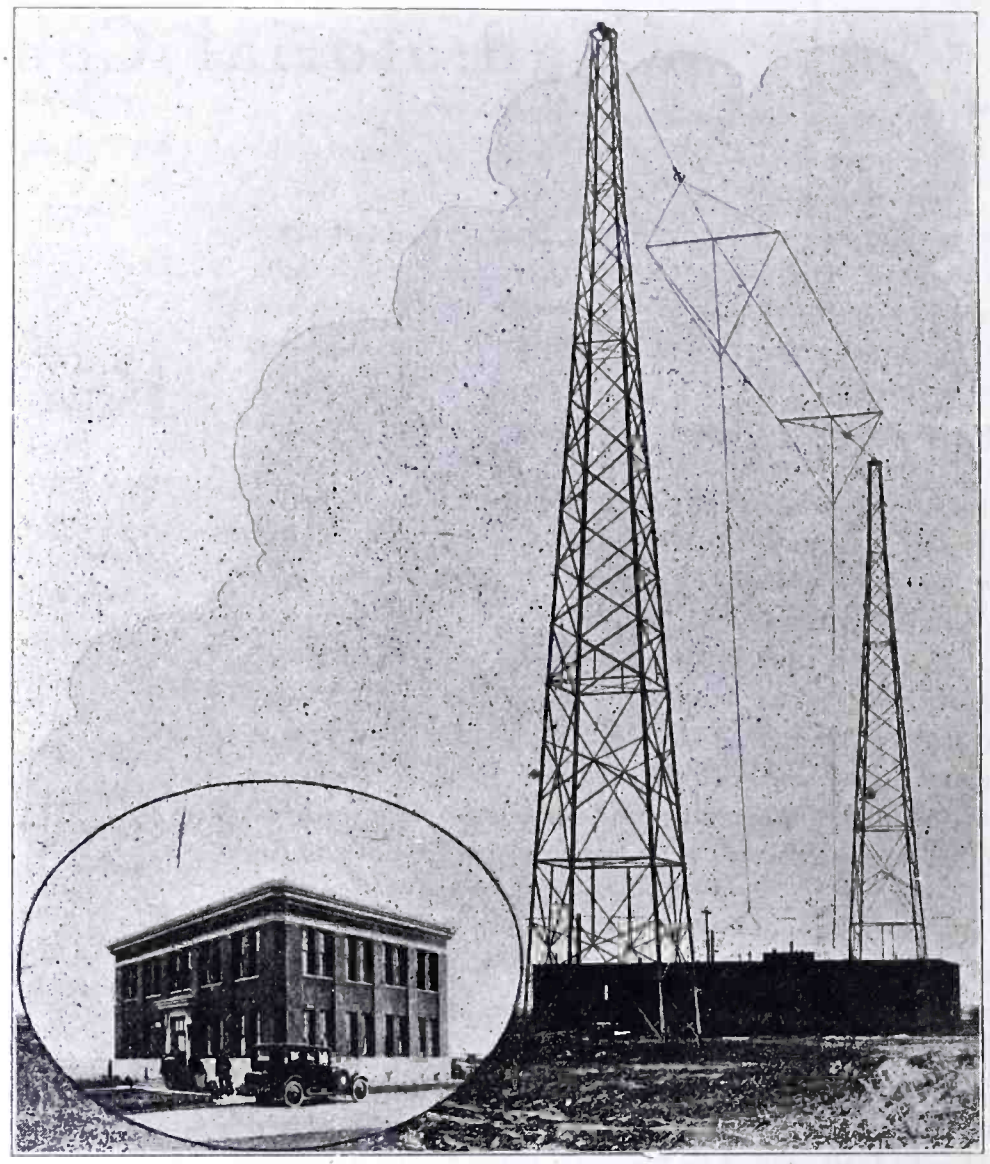
This is a complete description of the most modern and most powerful broadcast station yet on the air. Full details are given of the apparatus and methods employed.

KGO, the second of three super-broadcasting stations planned by the General Electric Company, came on the air January 8th on a wavelength of 312 meters. This new station is at Oakland, California, and is intended to serve the entire Pacific Coast. WGY, the first station, at Schenectady, N. Y., has now completed two years of broadcasting, and the third one, yet to be constructed, will be at Denver, Colorado.

The buildings at KGO have been especially constructed to house equipment that is used exclusively for popular broadcasting.

The studio building is a two-story brick structure. On the first floor, near the entrance, is the office of the program manager, and the correspondence room. Opposite these is the reception room where visitors are welcomed. In the rear is a room containing the storage batteries as well as one containing the battery charging generators and plate supply generators for the amplifiers in the control room. A switchboard in this room distributes the power and meters read the voltages and currents at which the various batteries are charging or discharging. A filter system for the amplifier plate generators is also located on this board. The storage batteries and plate supply generators are in duplicate, thus assuring uninterrupted service.

On the second floor are two studios very attractively decorated, the larger being for orchestras, bands, and choruses, while the smaller one is for addresses and solos. The use of these two studios makes continuous broadcasting possible, as artists can be arranged in one studio while the other one is in use.



Antenna at KGO Showing Studio and Power House Exterior

The walls and ceilings of both studios are covered with a sound-proofing material. Heavy draperies on the walls and thick rugs on the floor also aid in preventing any echo from being received by the microphone. By means of a ventilating system the air in each studio is kept pure and fresh as the noise of the street outside will not allow the windows to be opened during a program.

Interior of Main Studio

On this floor there is also a room where artists may await their turn on the program. A loud-speaking reproducer allows the artists in waiting to listen to the program.

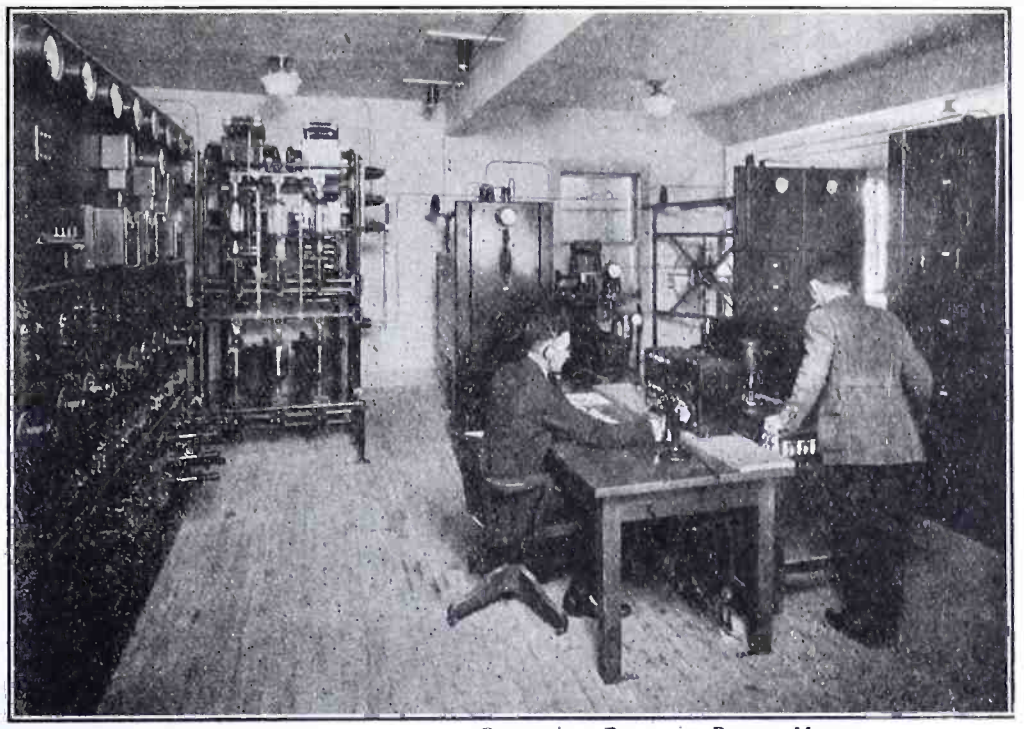
Between the studios is the control room in which the control apparatus and amplifiers are located.

KGO's pick-up devices consist of double-button carbon microphones, condenser microphones, and a magnetic type of pick-up. The carbon microphone has been in use for a long time and is the most common type. The condenser microphone requires from one to two additional stages of amplification and operates with a potential of 500 volts between plates. These amplifiers are placed in the base of the microphone pedestal. By means of the magnetic type of pick-up individual control of instruments is accomplished. This is particularly true of the piano. The vibra-

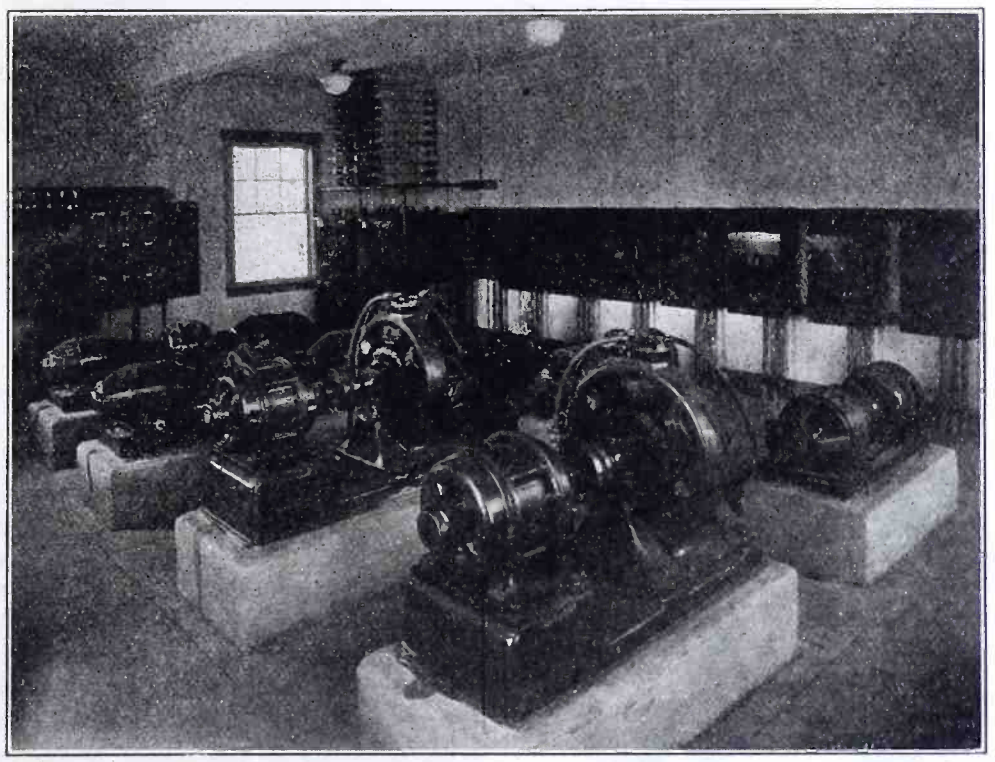
tions of the sounding board are transmitted to a rotatable coil which is placed in a strong magnetic field. The voltage thus induced in the coil is placed on the grid of a special first stage amplifier. When this pick-up is used the piano is controlled separately from the vocal selection, which is taken care of by a condenser or double-button carbon microphone.

Microphone outlet boxes and terminal boxes are placed at intervals around the studio behind the draperies. This allows the microphones to be placed in various sections of the room without a long length of wire being stretched across the floor and also connects the control box on the director's table with the control room.

The director's control box consists of a small key switch which is connected to



Operating Room in Power House



Generator Room in Power House

relays that control the first stage amplifiers. The announcer throws this switch into the "announce" position and the relays connect the announce microphone and its set of amplifiers. While the announcement is being made the senior control room operator prepares the amplifiers for the pick-ups that are to be used in the next selection. After the announcement has been made the announcer throws the switch to the "concert" position and the relays automatically disconnect the announce microphone and connect the proper concert amplifiers and pick-up devices.

By means of a signal light located in the director's control box the announcer in one studio can tell when the number in the other studio is completed and so can proceed with the next part of the program. An interlocking device in the control room prevents both studios from operating at one time.

The microphone circuits from both studios terminate in jacks in the control room. By means of plugs and cords the microphone is connected to the first stage amplifier. Three different types of first stage amplifiers are utilized and are selected according to the pick-up used.

All the first stage amplifiers are resistance coupled and use UV-202A or UV-210 tubes with a plate potential of 350 to 400 volts. The filaments of all the amplifiers are heated from batteries in the battery room. A bias potential of 5 volts is used on these tubes. Each amplifier has its own filament control, microphone current, and microphone volume controls.

The output of the first stage amplifiers is connected to either of the two intermediate amplifier banks. This intermediate amplifier bank consists of two stages of 50-watt tubes in cascade.

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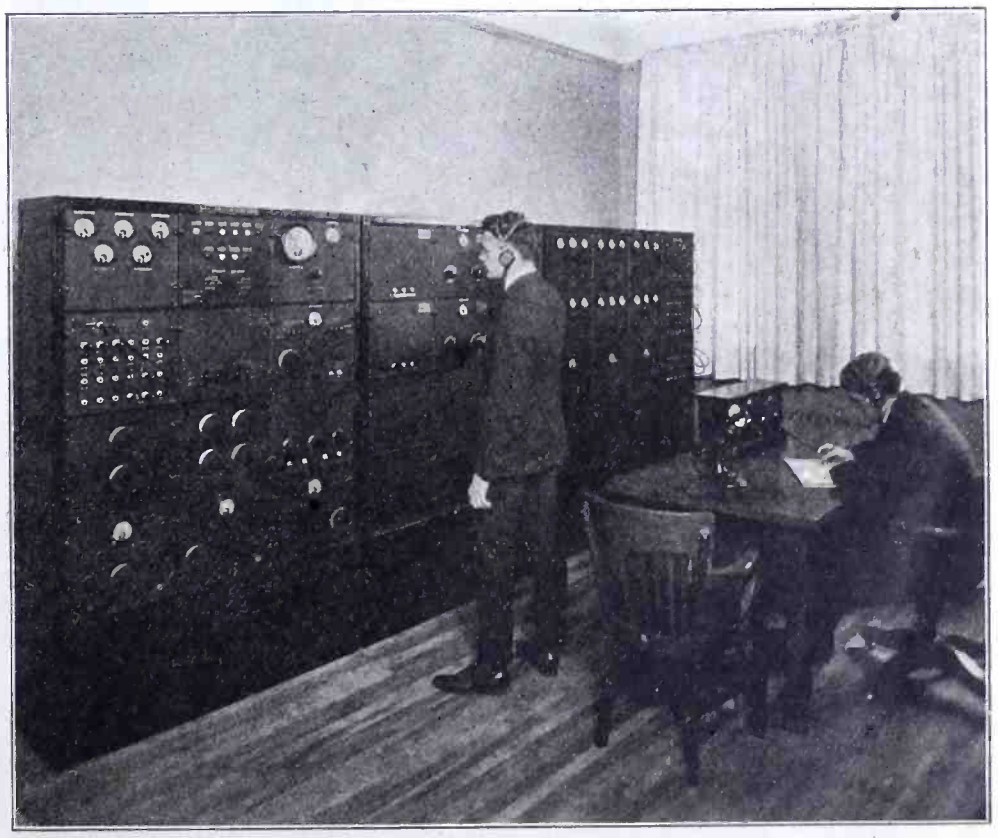


Control Room in Studio Building

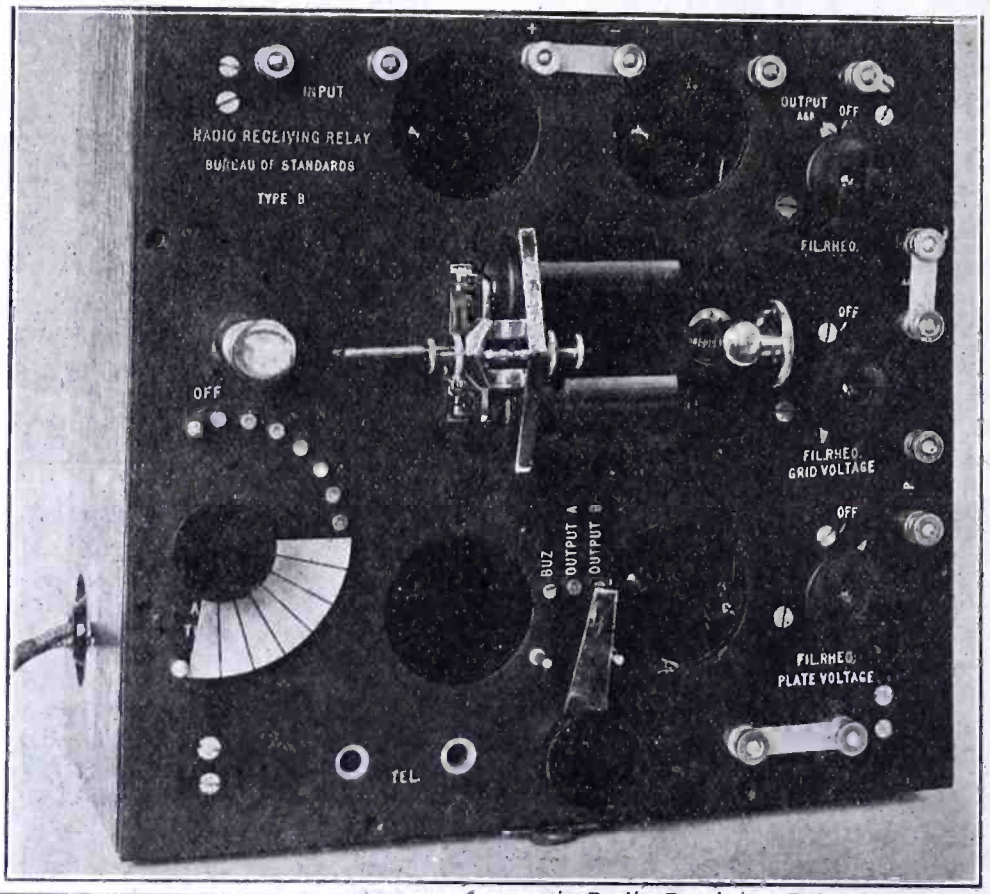
The Radio Printing Telegraph

By S. R. Winters

This article tells of successful experiments with a printing telegraph machine operated over the radio instead of land wires. This method insures secrecy of press dispatches to newspapers over a wide area. Brief description is also given of a new receiver designed by the Navy.

"BY Wireless", a credit-line appearing at the head of some foreign dispatches to leading American metropolitan newspapers, may in the near future appear in connection with stories written in this country and published in the smaller daily newspapers. The usual ways of sending these dispatches by telegraph or telephone, or both, may be partially replaced by a system of radio communication which is now in a process of development by a Chicago firm interested in the application of the "teletype", or land-line printer telegraph machine, to the transmission of news dispatches by radio. The first long-distance test of this nature was negotiated between Chicago and Milwaukee in co-operation with the Associated Press and the Milwaukee Journal. The traffic in dispatches from the "A.P." to this Milwaukee newspaper was conducted by radio, the items of news being received by the latter in typewritten form.

The use of a relay, invented by F. W. Dunmore of the radio laboratory of the Bureau of Standards, and the development of a radio receiving instrument by Alfred Crossley of the radio division of the Navy bureau of engineering, make possible the application of the land-line telegraph printer to the transmission of radio communications in privacy. The Dunmore relay is extremely selective with reference to particular wavelengths and equally discriminating in response to definite tones. This selectivity makes possible the transmission of news dispatches in virtual secrecy between two points in the absence of interference from other transmitting stations.



Automatic Radio Receiving Relay

Transmitting and Receiving Printer Apparatus in Newspaper Office

The novel radio receiving instrument designed by Alfred Crossley, a device not heretofore described, involves the use of three stages of radio-frequency amplification, two stages of audio-frequency amplification and a detector. The first two stages of radio-frequency amplification are impedance coupled, whereas the third stage of radio-frequency amplification is inductively coupled. This is said to be the first time in radio development that impedance and inductive coupling has been successfully used in an amplifier.

The signals received by the Crossley radio receiving outfit are passed to the Dunmore relay, and thence transmitted to the printing telegraph machine. The primary sending and the receiving equipment are not dissimilar to the apparatus employed in printer telegraphy over land wires.

Continued on page 78

An Ideal Short-Wave Regenerative Receiver

By D. B. McGown

This article describes the construction of a standard Armstrong regenerative tuner and detector in which every precaution is taken to insure the best results with the material employed. Especial attention is paid to shielding. Anyone carefully following the directions can be assured of an unusually efficient set.

IN THE design of an ideal regenerative receiver, we must take all the factors of operation into consideration. With the present tendency for low wavelengths, we must extend our wavelength band down to a point below the lowest in common use, so that the new low wavelengths will be well within the range of the set. The upper band will be determined by the class of service for which the set is to be used. In most cases the amateur, broadcasting and commercial ship-station bands of wavelengths are the ones that are of greatest interest. Simplicity of controls is desired, although these should not be reduced to the untunable, non-selective single circuit system. It is desired that the receiver be capable of loose coupling, in order to reduce interference, and facilitate adjustment of the system for C.W. telegraph reception. There should be a point of minimum coupling, where the strength of a received signal can be cut out entirely, due to the looseness of this coupling, which will reduce interference to zero. As we desire to receive continuous wave signals, as well as to take advantage of the increased amplification due to regeneration, there should be some means provided to allow the tube to oscillate, and at the same time to keep this oscillation well within control. Lastly, it must be possible to build this receiver from common parts available on the open market, and at the same time the constructional details should not be so complex that it is only possible for a skilled instrument man to build the set. In the set to be described the wavelength band is between 120 and 750 meters. There are six controls, excluding the vacuum tube filament control: primary inductance and capacity, secondary inductance and capacity, coupling between primary and secondary, and the feedback, or regeneration coupling circuit. The looseness of coupling is obtained by proper design of the primary and secondary coupling systems as explained later. Regeneration is accomplished by the "tuned plate" system, whereby a variable inductor is placed in the plate circuit, which, in effect, tunes this circuit to the frequency of the incoming signal, when regeneration takes place. This method allows the regeneration to be controlled within very close limits, or, if the tube is permitted to oscillate, the oscillation can be accurately controlled, and the optimum adjustment obtained without trouble.

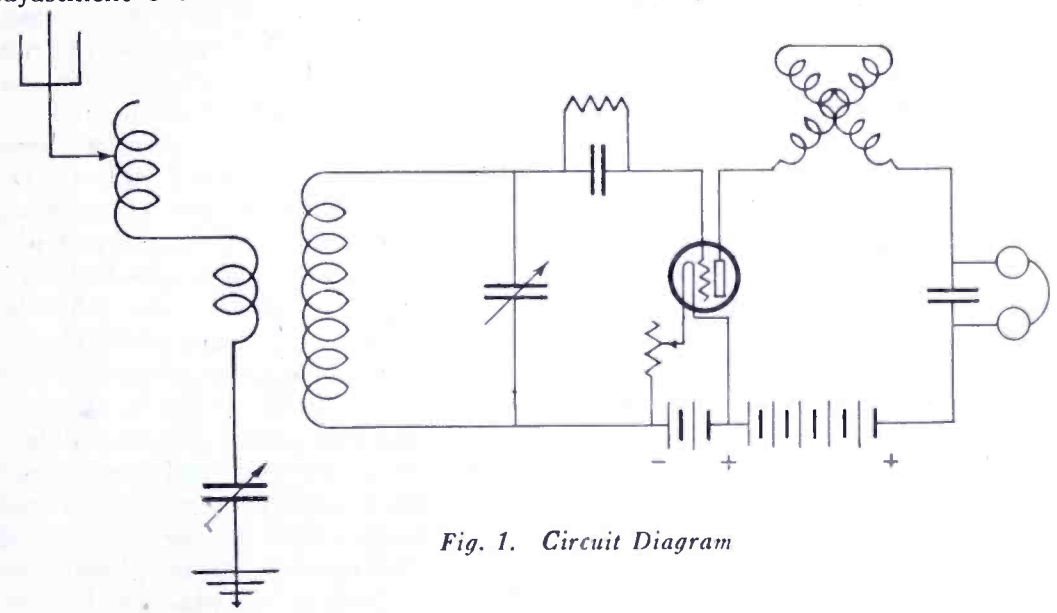
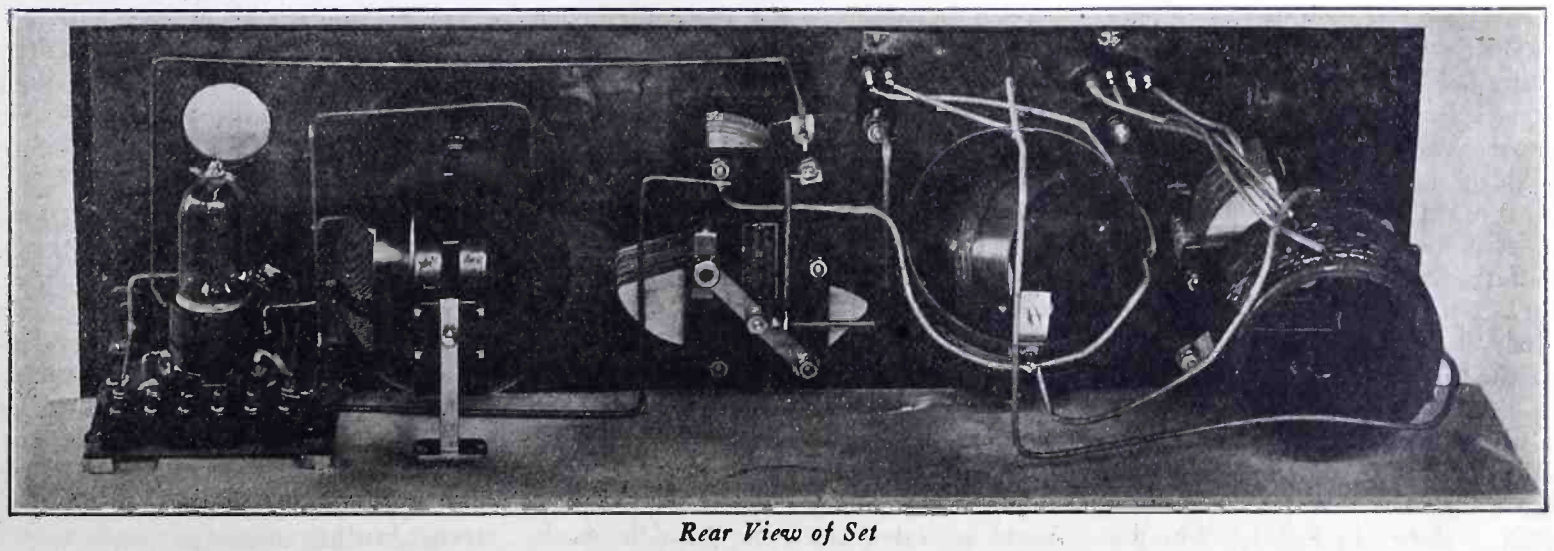


Fig. 1. Circuit Diagram

Fig. 1 shows the actual circuit. The antenna circuit is tuned roughly by the variation of the series load coil, which is tapped, and fine adjustment is provided by the series variable condenser. A coupling coil of a few turns, only, is included, being connected permanently in series with the primary circuit. (This is also tap *1*, on the set.) Those who object to using a series variable condenser can use a series variometer with equal satisfaction, although less inductance will be needed in the primary load coil. The secondary coil is arranged with taps, and a variable condenser in shunt to it. Again, a series variometer may be connected in this circuit, if an objection is raised to the use of a shunt condenser. The plate variometer is connected in series between the plate and head-receivers (or to the input of an audio-frequency amplifier), and permits regeneration.

The primary load coil is wound on a 3 in. bakelite tube with 58 turns of No. 20 DCC wire "double banked." The second tap is taken off at the 15th turn, the third at the 35th, and the last tap includes the whole coil. The first tap includes only the primary coupling coil. This primary coupling coil is mounted on the panel, as shown, in such a manner that it is at right angles to the rest of the inductance coils, i.e., with its axis perpendicular to the front of the panel.

The primary coupling coil and the secondary coil are mounted on a com-



Rear View of Set

mon 180 degree "varicoupler", from which the original windings have been removed, and the windings described below substituted. The primary coupling coil is composed of but six turns, which are wound in the middle of the inner coil of the variocoupler, as shown in Fig. 2, where the primary coupling coil shows at the point of minimum coupling to the secondary. The secondary wind-

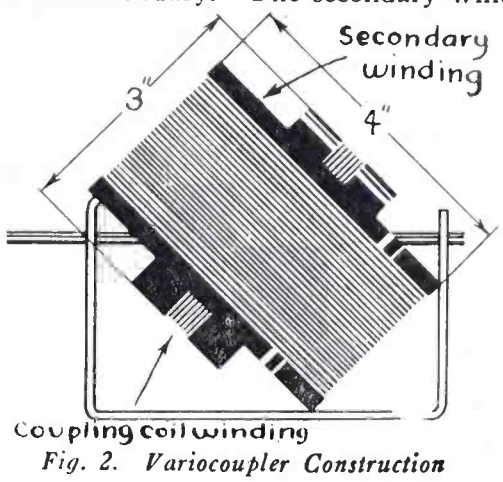


Fig. 2. Variocoupler Construction

ing is made up of 36 turns of No. 20 DCC wire, also wound double-banked. This is tapped at the 12th turn. The forms used were 3 in. in diameter for the coupling coil, and 4 in. in diameter for the outer, or secondary coil.

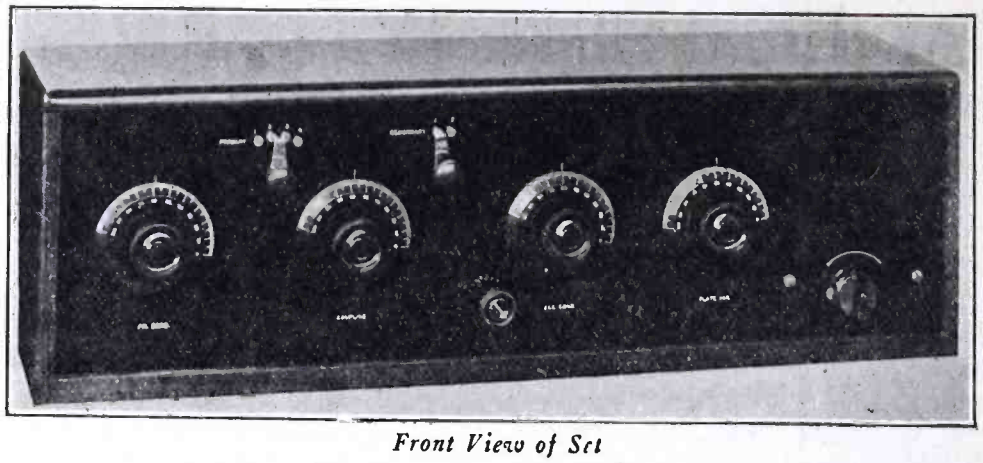
The primary series condenser has .001 mfd., maximum capacity, without vernier adjustment; the same type was used for the secondary shunt condenser, which is fitted with a vernier to facilitate critical tuning.

The grid condenser is of .00025 mfd. capacity, is shunted by a variable grid-leak, which can be adjusted to the proper value, whilst the set is in use. The bridging condenser is shunted across the telephones, and is of .0025 mfd. capacity. A larger capacity than this can be used with success, but one that is smaller should not be used, or the set may not oscillate over the entire wavelength range.

The plate circuit is tuned by the variometer inductor included in the plate filament circuit. This is separated from the rest of the circuit, and there is no inductive or capacitive feedback from any other source, in distinction to the more common type of set, where the variometer simply serves as a tickler.

The whole set is mounted on a bakelite panel shielded on the back by a sheet of copper, held in place by small brass escutcheon pins driven into small holes drilled part way through the panel. The copper shield is cut away to permit all live parts to go through the panel, such as the switchpoints, switches and the shafts of the condensers, and other rotary instruments. This shield is grounded, through a permanent connection to the ground binding post of the tuner.

The filament controls are mounted on the right hand side of the panel, and comprise a filament rheostat, and socket, connected as shown in Fig. 1. The fila-



Front View of Set

ment rheostat should be of appropriate value for the tubes to be used, 6 ohms for the 6 volt 1 ampere tubes and 30 ohms for the "A" tubes. If the low current tubes, such as the WD-12, or C-12 are used, a 6-ohm rheostat should be used. It is also possible to use the .06 ampere UV-199, or C-299 tubes with a high resistance rheostat. Western Electric type VT-1 tubes should be equipped with a 6-ohm rheostat, and a standard socket. In any case, the socket should be supported on rubber. A single piece of rubber is taken, and the socket mounted thereon, and two screws at the ends are fastened to brass strips, which are screwed fast to the panel. This prevents any vibration or shocks from reaching the tube, and prevents almost entirely the so-called "microphone noises", due to the tube elements vibrating as a result of the shocks.

All terminals are connected to blocks inside of the set. These can be seen just back of the tube socket. A single block is mounted in the primary compartment, which takes care of the antenna and ground leads. This system prevents the more or less messy leads from being visible at the front of the panel, and at the same time permits the easy disconnection of the set.

The entire set is housed in a wooden cabinet, lined inside with copper sheeting, which is connected to earth, through contact with the sheeting on the panel. The secondary circuit is entirely shielded from all outside influences, save for that which is properly led to the secondary through the coupling coil. The primary and secondary circuits are separated by a sheet copper partition, which is partly visible about a third of the way across the set from the left. This effectually shields the secondary from any influence by the primary, as both circuits are really encased in copper housings, as far as their electrical condition is concerned. The effective operation of the set depends largely on the effectiveness of the shielding, and it is almost impossible to get a complete minimum (no signal) at zero coupling, unless shielding is used. It may be simpler to make the entire panel and cabinet of metal, say No. 14 gage copper, and have the primary and secondary switches mounted inside the cabinet, and all live parts insulated from the panel by bushings. This metal cabinet might, then, be finished with an airbrush, or japanned. Brass or copper would probably be the best to use, being non-magnetic. Iron or steel should be avoided, as the metal of the cabinet is within the field of the inductance coils, and would tend to alter their inductance values and to lower their efficiency.

The operation of the set will be found to be simple. The primary inductance switch gives rough variations of the wavelength, and the condenser permits a close adjustment, so as to obtain exact resonance with the station transmitting. The coupling is variable, through rotation of the coil, and will be found to be quite broad, except for a few degrees on either side of the zero point, where it sharpens up the signals wonderfully, and permits the elimination of almost any interference signals, unless they are on the exact same wavelength as the station transmitting. The secondary circuit is adjusted by the variation of inductance and by the manipulation of the condenser in shunt thereto, aided by the vernier, for close adjustment, when necessary. The plate variometer will be found to be quite critical in its adjustment, and should be rotated slowly, until the tube either regenerates, or oscillates, as the desired case may be. On the extreme short waves it will be found that the plate variometer reads "reversed", i.e., it permits the tube to oscillate when its apparent value is just opposite from what would be expected in view of its operation on the longer waves. This does not seem to cause any trouble, and good strong signals can be obtained.

The set should operate on any ordinary sized antenna. The smaller the antenna the closer the coupling possible, and, if a very large antenna is used, it may be found almost impossible to cut out strong stations, owing to the comparatively high impressed voltage which is present in that circuit. On the other hand, too small an antenna should not be used, as this will cut down the signal strength too much, and may even have such a low natural period that the primary inductance coil will not suffice to bring the wavelength of that circuit up to the maximum range of the receiver, and will necessitate the addition of external loading coils.

The Four-Tube Grimes Receiver

By M. B. Sleeper

This, the concluding article in a series of three on the Grimes inverse duplex circuit, gives complete details for the construction and wiring of the four-tube set.

ALTHOUGH 4-tube inverse duplex receivers have been in use for several months, it is only within a short time that a production model has been available. The reason has been that, while four tubes could be used, the adjustment was so critical that it was hard to control the set. Moreover, except on those critical adjustments, the set howled in a most objectionable manner. Tests showed that the howling was caused by radio frequency currents in the audio frequency amplifier. A similar difficulty is frequently encountered in Reinartz reflex receivers to which audio frequency amplification is added. You will probably recall that, when the Reinartz circuit was first brought out, many experimenters claimed that an audio frequency amplifier could not be used with it. Later, a radio frequency choke coil was recommended to prevent squealing. On the inverse duplex, however, it was not such a simple matter.

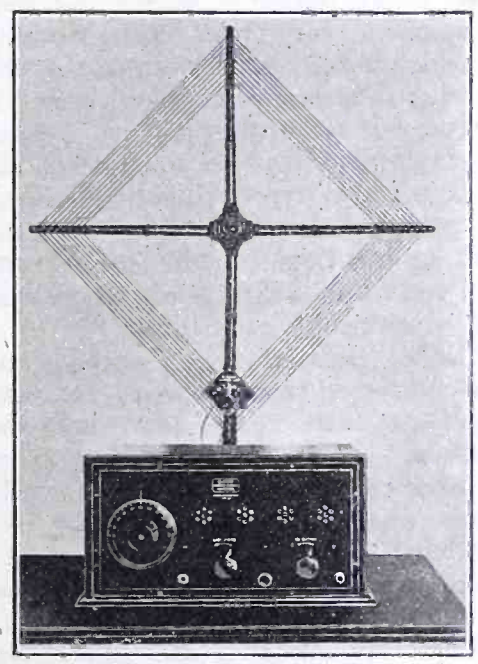


Fig. 1. Front View of Set

The front view, Fig. 1, shows the set ready for operation. The large dial controls the tuning condenser. Two rheostats are provided, one for the three amplifier tubes and one for the detector. Two of the amplifier tubes give both radio and audio frequency amplification while the third is straight audio frequency, as shown in Fig. 3. Jacks are provided so that the last amplifier may or may not be used, depending upon the signal strength required. The filament control circuit is not shown. It is arranged so that, with the plug in the first jack, only three tubes light, or four tubes when the second jack is in use. In addition, a switch opens the entire filament circuit to cut off the tubes when the set is not being used.

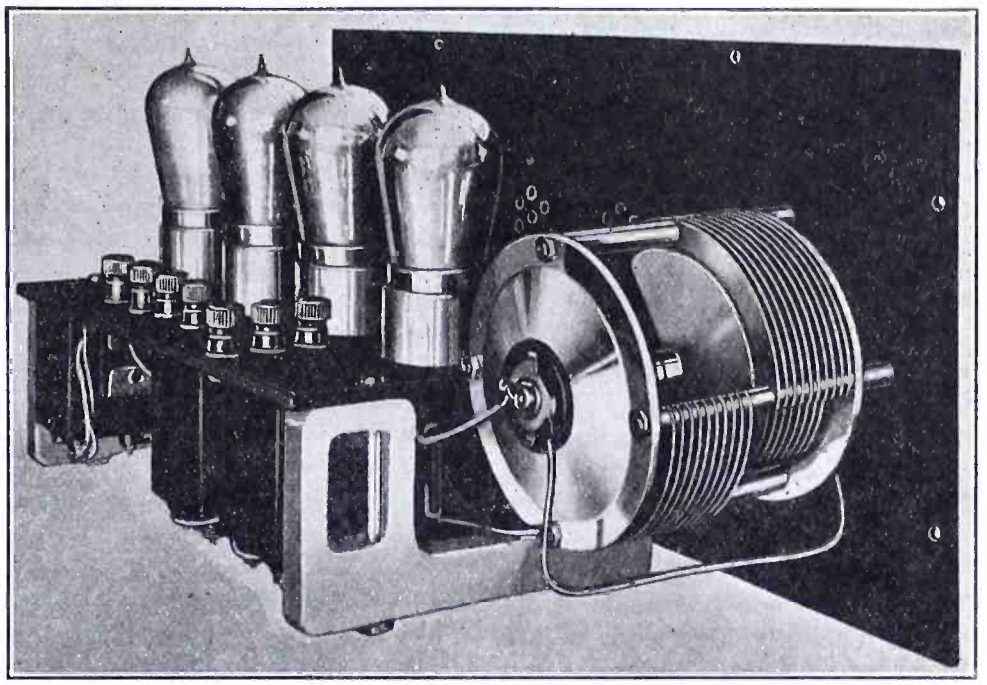


Fig. 2. Inside View of Set

The single straight audio frequency amplifier was responsible for the difficulty encountered. At first, it seemed impossible to prevent the disagreeable howling. Then, when it was stopped, the circuit and instruments required were too elaborate. Finally, however, the arrangement shown in Fig. 3 was worked out, with the result that no further difficulty from howling was experienced. The key to the whole situation lies in connecting the primary of the last audio frequency transformer between the plate and the primary of the first radio frequency transformer. Then, with the fixed condensers around the primary and secondary windings, the problem was solved.

Of the various ways in which the set might have been made up the method shown in Fig. 3 proved to be the most attractive in appearance and at the same time greatly reduced the length of the leads. You will see that three audio frequency transformers are mounted at the rear under the base

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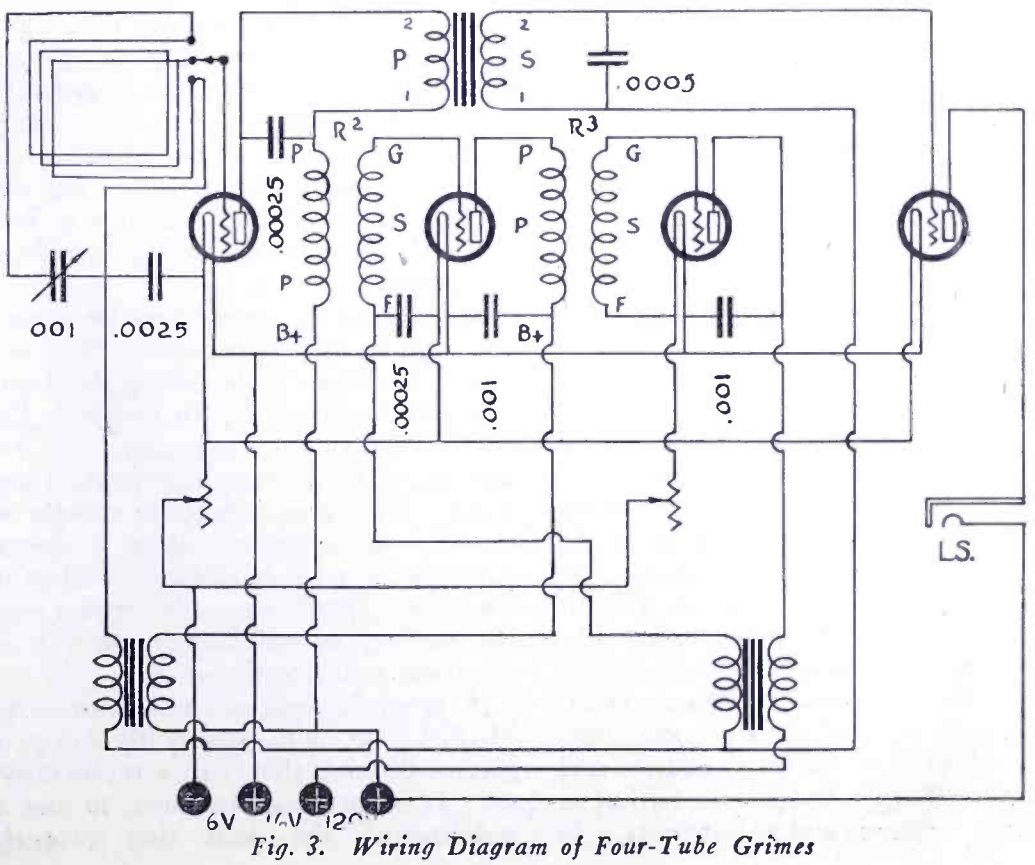

Fig. 3. Wiring Diagram of Four-Tube Grimes

Sensitive Receivers

By Don Lippincott

A brief comparison and clarification of nomenclature of the fifty-seven varieties of receivers is here given. It should be of especial value to the prospective purchaser or constructor. It is completely unbiased in its statements.

THE best radio set is the one which is most sensitive, most selective, gives the best volume of signals with least distortion, does not interfere with other receivers, is easiest to tune, is not critical in adjustment and is reasonable in price. It does not exist.

Any radio receiver is a compromise designed to include as many of these desirable features as possible. These features are to a certain extent incompatible. Hence any set has certain advantages and certain limitations. It is for you to decide from your own situation and natural preferences which is the best set for you.

All modern sensitive sets amplify the incoming signals *before* they are detected—i.e., at "radio frequency". It is the method by which this is accomplished that determines the type of set.

Of all the types in use the most numerous are the "single circuit regenerative". They are easy to tune, low in cost, sensitive, and give good volume. On the other hand, they are not very selective, if improperly operated they distort the voice or music and because they differ only in size—not in principle—from a transmitting set, they may cause a tremendous amount of disturbance in the neighborhood. The squeals, howls and "bloops" which are familiar to every listener are almost all due to this type of set. For the dweller in the country it is ideal, but in a crowded neighborhood, near to a powerful broadcasting station, its disadvantages become much more noticeable.

There are three varieties of this type. They have in common the characteristic that the radio-frequency amplification is accomplished by the detector tube itself, a part of its output being fed back to the input to reinforce the incoming waves. The antenna forms a part of the input circuit of the tube. They differ in the manner in which the feedback is accomplished, and are designated as tickler feed-back, tuned plate circuit (or capacity feed-back), and direct feed-back. The first is least critical in adjustment, and broadest in tuning. Capacity feed-back is a bit more difficult to handle but tunes a trifle sharper. The direct feed-back circuit—known also as ultra-audion, Colpits, Gibbons, phantom, autodyne, and no one knows how many other titles—is very sensitive and tunes very sharply, but is very critical as to circuit constants and adjustments. As a radiator it is one of the worst offenders.

The chief drawback to all of these sets is their lack of selectivity. This defect may be remedied by connecting the aerial to the tube through a "variocoupler", making it a "three-circuit" set. This increases selectivity and decreases radiation *if properly handled,* but to gain these advantages we have sacrificed something in sensitivity, signal strength and ease of tuning.

Anyone familiar with a regenerative set is familiar with the sudden momentary increase in strength of signal at the instant the set "slops over" or starts to oscillate. The "super-regenerative" receivers manage to operate at this point constantly, by stopping the oscillation immediately and letting it start all over again. This is done about 10,000 times per second. This type of set, with one tube, will operate a loud speaker over a range of from 50 to 100 miles on a small loop. The advantages are a combination of power and portability. The disadvantages are extremely critical adjustment, a tendency to howl and to distort, a rather limited range of reception, and the generation of much interference. Flewelling and Autoplex circuits are of this type.

The next important group of receivers is that using radio-frequency amplification by one or more tubes before the detector tube. When long waves, such as are used for trans-oceanic telegraphy, are to be received, the construction and operation of such amplifiers is not difficult. For reception of broadcast waves, however, efficiency in the amplifier circuits involves regeneration in the amplifier tubes, and the problem is to keep these tubes from oscillating—"stabilizing" them.

Radio-frequency amplifiers are known as "tuned" and "untuned." The untuned circuits are more readily stabilized, less noisy, and simpler to handle. The tuned circuits are much more selective and given to greater amplification per stage. The Neutrodyne is a form of tuned radio-frequency using a special patented form of stabilization. Most of the other "dyne" sets on the market copy the method of stabilization as well as the name which describes it.

A properly designed and constructed "R.F.A." set will consistently bring in greater distance than will a regenerative set. It is very easy, however, to lose in stabilization the gain that properly should be obtained from the tubes, and the tendency to oscillate may also prevent full regeneration being used on the detector. All radio-frequency amplifiers are critical of adjustment and their cost is greater than the regenerative set. The fact that they are non-interfering is their chief advantage from the standpoint of the community at large. A properly operated R.F.A. endears you to your neighbors.

Mention has been made of the comparative ease and efficiency of amplification at the longer wavelengths. This is taken advantage of in the "Super-Heterodyne" receiver. Two tubes are used to change the short waves to long ones, two or three tubes to amplify the long waves, a detector to change the long waves to voice frequency and then the usual audio-frequency amplifiers. The difficulties with this type of receiver are almost wholly those of design and construction. Once built and working properly, it has capabilities possessed by no other receiver. Settings are critical, it is true, but stability is perfect, there is great selectivity, and the sensitiveness exceeds all other types. The high cost is the principal drawback, this being due both to the large amount of material used and to the difficulty of construction and adjustment.

"Reflex" sets are those in which one tube performs two functions, i.e., amplifies at both radio and audio-frequencies. Their advantage is a saving in tubes required to do a given work. Their disadvantage is that they are somewhat less selective than sets in which each tube has but the one function to fill, and they are apt to be noisy.

There are all kinds of combinations possible with the principles above enumerated. A "Super-Heterodyne" may be "neutrodyned", or "reflexed", or both. It may employ a regenerative detector. It might even employ super-regeneration in the detector circuit, though the advantage would be small as super-regeneration works best at short wavelengths and high frequencies.

It is to be hoped that no one does this, however. The names we have tacked on to our receivers are bad enough already, but if it should ever become common to have to reply to the question, "What kind of a receiver do you use?"—"I have a Neutrodyne-reflex-ultra-audion-super-regenerative-super-heterodyne", lockjaw would become more prevalent than cold in the head.

A Reflex Receiver for Beginners

By Charles F. Filstead, 6CU

These instructions are intended for the novice who wants to start with a simple crystal detector unit, then add one stage of audio-frequency, and finally add a second tube reflexed to give one stage of radio and one stage of audio-frequency amplification. This installment describes the construction of the crystal detector and tuner.

THOSE just starting in radio and knowing nothing about it are the hardest to suit. What the beginners want is a simple set, that is easy to operate, does not require batteries, and is economical in cost. Something that can be added to and built-up as the builder feels he can afford it. They usually consider a crystal set as being too small, and a tube set, because of the batteries, as being a trifle too expensive. In this series of articles is offered a solution to that problem, which has found much favor with beginners.

The solution of the problem, as presented here, is to build the receiving set in three parts: starting it with a crystal set, adding one tube for audio frequency amplification, and finishing with a two-tube reflex receiver. The reflex set has the advantage of using a crystal detector, which is practically a distortionless detector, and the wonderful clearness of the music and the absence from distortion is a constant source of delight to the listener.

The simple crystal set which is described here is very selective; while tuning is easy. The wavelength range is about 180 to 600 meters, which takes in the amateurs and all the broadcasting stations. A list of the parts necessary for the construction of the set are given below:

Panel of 1/8 in. bakelite, 6 in. high by 10 in. long.
Sub-base of 1/2 in. wood, 6 in. wide by 10 in. long.
Variable condenser, 43-plate, 0.001 microfarad.
Variable condenser, 23-plate, 0.0005 microfarad.
Inductance coil—which will be described later.
7 binding posts.
Navy-type crystal detector.
Piece of mounted galena for detector.
2 three-inch dials for the variable condensers.
Fixed mica condenser, 0.002 microfarad.

The best mineral that it is possible to get should be used in the crystal detector, as the results obtained with the set depend more on this than on anything else.

The inductance coil consists of two windings of No. 18 D. C. C. wire on a 3½ in. bakelite tube, 4 in. long. Two small holes are punched through the tube near one end, the end of the wire is put through these holes to hold it, and 50 turns wound on. Two more holes are punched in the tube where the winding ends, and the wire cut and threaded through them. A space of 1/8 in. is left, and 20 more turns of wire are put on in the same manner. Four small binding posts should be put through the tube, and the ends of the two windings fastened to them. The coil should not be shellacked or varnished; but if the builder wants to make the winding firmer, he can paint a little collodion along the end turns of the two windings to keep the wire from slipping. A drawing of the completed coil is shown in Fig. 1.

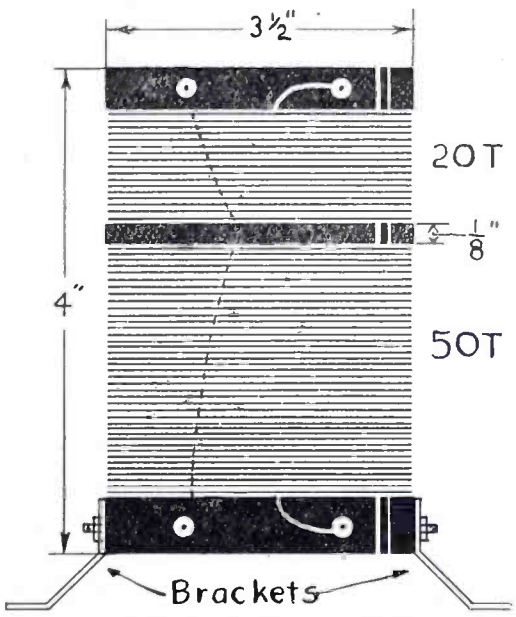

Fig. 1. Inductance Coil

The layout of the panel is given in Fig. 2. The position of the mounting screws of the variable condensers is not given, as it varies with the make used. The holes shown at each side of the panel are for the location of the condenser shafts. After the panel is drilled, the sub-base is attached to the rear of it by three ½-in. wood screws, put through the three holes drilled in the bottom of the panel. The inductance coil is held upright in the middle of the sub-base by three brass brackets, fastened to one end of the tube. The Navy-type crystal detector is mounted in the center of the panel with the cup at the bottom, and the set wired up with bus-bar wire as shown in Fig. 3, taking care that all leads are kept as short and direct as possible. Right-angle bends should be made throughout, and spaghetti tubing used over the wire wherever necessary. Before

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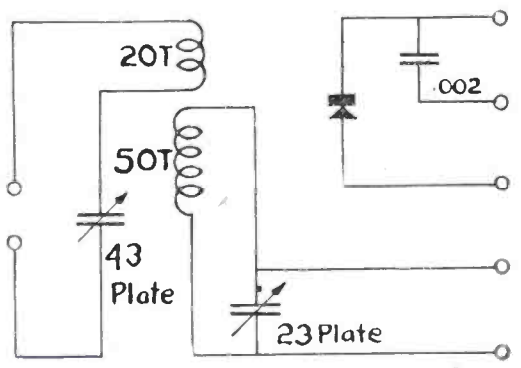


Fig. 3. Wiring Diagram

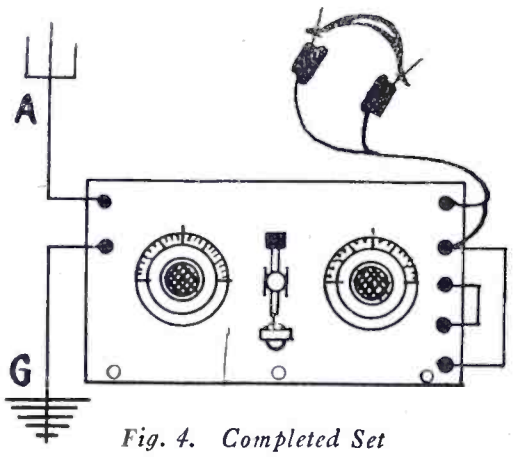


Fig. 4. Completed Set

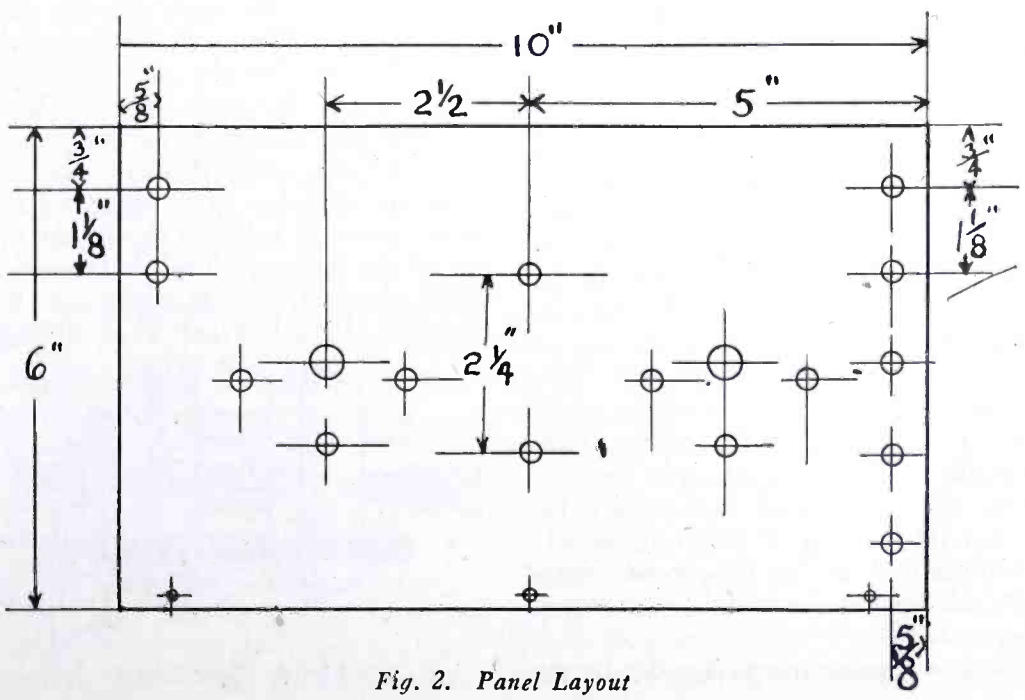


Fig. 2. Panel Layout

An Improvised Honeycomb Coil Winder

By Samuel G. McMeen

By means of the clever mechanism here described the amateur may wind his own honeycomb coils. The device is simple enough to be made in any home work shop.

FOR all the wavelengths, and particularly for the long ones, honeycomb coils are a valuable part of the receiving amateur's equipment. They have two outstanding virtues, one in that they are most convenient to manipulate, in changing from one value of inductance to another, and the other in their inherent quality of having low electrostatic capacity between turns.

It is this latter property that distinguishes honeycomb and duolateral coils from all other forms of inductance windings. The problem is to get the arrangement of turns that will have a given in-

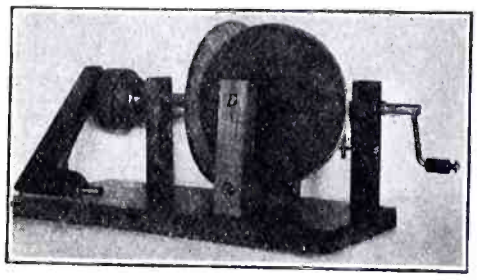


Fig. 1. Side View of Winder

ductance with the least obtainable short-circuiting of the energy through the mutual capacity of the turns. This can be approached in a measure by spacing out the turns while still giving the coil the form of a helix. But the desired result is most nearly approached by the expedient of laying up the turns so that they will cross each other at an angle, and this is the fundamental notion of both honeycomb and duolateral coils.

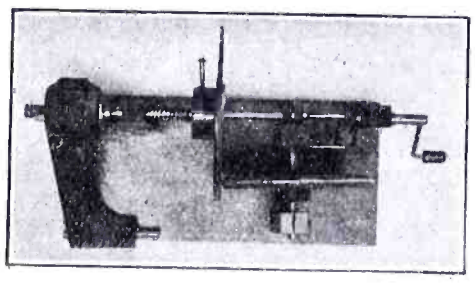


Fig. 2. Top View of Winder

On first consideration it may seem that there should be no need of being so particular about the presence of capacity between the turns of a winding, in view of the fact that the winding is to be used with a condenser in parallel with it, as this condenser itself puts a capacity in shunt with the turns of the coil. The reason for the harmfulness of the capacity within the coil is that there is no variability possible, as there is in the condenser. If a coil could be wound so as to have its capacity between turns adjustable at will, within the proper limits, it would need no externally connected condenser.

For many experimentalists the larger use of honeycomb coils is a little embarrassing on account of the need of a considerable assortment of them to cover the whole range of wavelengths, and that assortment runs into money. The way out of that dilemma is to wind the coils oneself. Doing such work by hand with pins or the like is tedious. By far the more satisfactory way is to wind them in a machine made for the purpose, and fortunately the machine can be built by the amateur in about the time it would take to wind one coil by hand.

The device here described is due to the designing ability of Mr. Howard Field of San Francisco. It is adapted to wind honeycomb coils of the standard dimensions of 2-in. core diameter by 1 in. thick, of any number of turns desired. The coil is wound on a piece of pasteboard tubing which oscillates left and right while the wire is fed to it through a hole in a stationary guide. That is, the guide is stationary except as it has to move outwardly as the wound coil increases in diameter.

On a wooden base about 5½ by 12 in. mount five posts, 1 by 1 by 4½ in. to serve as bearings for the two shafts. The main axis is a ⅜-in. steel shaft which rotates in bearings in the posts. Oil-holes are drilled in the tops of the posts to enable the contacts to be kept lubricated.

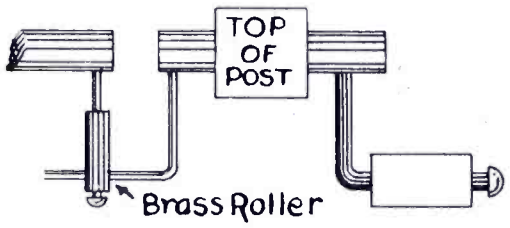


Fig. 3. Oscillating Link Detail

At its left end the shaft carries a chuck for the tube on which the coil is to be wound. We made it of two halves adapted to receive the core on a slight taper fitting the core, and with two wooden pins attached to one wooden half and threading through the other somewhat loosely. The object of these pins is solely to help get the finished coil out of the holder. The shaft carries a collar of metal, against which the chuck is drawn by a knurled screw engaging

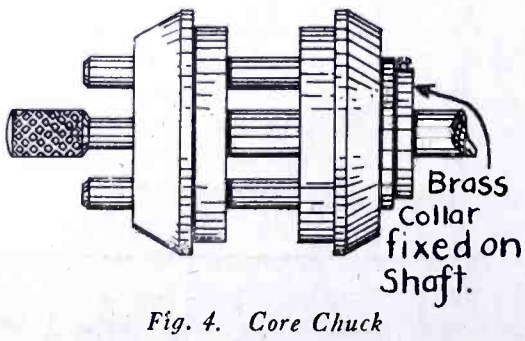


Fig. 4. Core Chuck

the end of the shaft. Fig. 4 shows the arrangement.

A 6-in. disk is attached firmly to the main shaft by means of a hub on the disk. Another 5-in. disk with a ⅛-in. rubber tire which bears against the face of the first disk turns freely on its own shaft and is eccentrically mounted. That is, its bearing hole is ½ in. off center. Therefore, in one revolution, it causes the main shaft to move endwise 1 in. and back again to its original position, which is the object of the whole arrangement. The tire is attached to the edge of the 5-in. disk, in a groove, by means of ferrule cement such as is used on fishing rods. A helical spring surrounding the main shaft keeps the 6-in. disk pressed against the eccentric disk. The contact between the two disks comes at a point ½ in. from the edge of the larger disk.

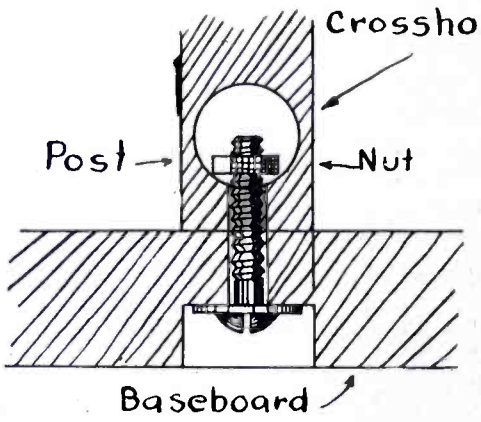


Fig. 5. Post Mounting

It is essential that all the oscillating power be applied by the rubber-tired disk and none by the driving crank direct to the main shaft. Therefore, the main shaft ends in a sort of link, through which it is driven and by the use of which the little portion of shaft that carries the driving crank may be non-oscillating. It merely amounts to a second crank engaging a radial pin carrying a roller. It is shown in Fig. 3.

The strip of wood shown at the left end of Figs. 1 and 2 is the guide through which the wire is threaded in winding. It is curved out on the edge toward the coil, and bears gently against the core at the beginning and against the wound coil after the first layer is on. The pull on the wire on the part of the guiding left hand is of the slightest also.

For the cores, get pasteboard tubing 2 in. outside diameter and saw off sections a shade under 1 in. wide. A small circular saw is a great advantage in doing this cutting. The reason for cutting the sections a little less than 1 in. wide is so that the wire of the first layer

Continued on page 61

Radio Construction Pointers

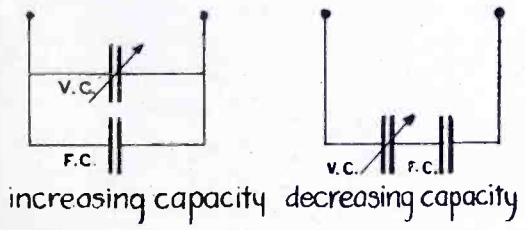
By Paul Oard

How to utilize the odds and ends in the radio drawer for making serviceable radio parts is the main purpose of this article. It also gives some especially good hints on soldering practice.

Increasing Condenser Capacity

THE experimenter ofttimes finds need for a wider range of capacities in the one or two variable condensers that he may possess, especially if they are of the 5, 7 or 23 plate types. As a limited purse ofttimes acts as a deterrent toward the acquiring of the wanted type, some other method than purchase of a larger capacity type must be evolved.

While the construction of a variable condenser from scrap material is not a satisfactory solution, most experimenters can scrape together the makings for fixed capacity condensers without a great amount of trouble. A fixed capacity condenser of the right size used in shunt



Methods of Varying Capacity with Small Condenser

with a small variable will enable one to secure the desired capacity. Most experimenters can secure a blown out telephone condenser, or the condensers used in Ford spark coils. The material from such will allow the making up of a number of small condensers of varying capacities. By means of various switching arrangements, as shown, in connection with a small variable, a wide range of capacities may be secured. Likewise, by means of series connections, as shown, minor capacities are available.

A Temporary Variable Condenser

A SMALL variable capacity that may be put together in a hurry, and which will do for odd testing, may be made up of any two sheets of metal, laid on the table, with a sheet of mica or paper between them. Capacity is varied by sliding the top plate over the bottom one. Not a pretty job, but one that is entirely practical for trying out some new kink, where the situation may not warrant the purchase of a regulation type, or the tearing out of one from a finished instrument. In place of mica or paper as a dielectric, the plates may be coated with shellac or lacquer. Quite high capacities may be obtained in this instance with comparatively small surfaces; suitable of course only for minor voltages.

Fixed Grid Condensers

A PRACTICAL grid condenser may be made from two twisted lengths of insulated wire—enamel, silk or cotton. Capacity is determined by the gauge and size. Such a type takes up very little space. I have heard that such condensers were used by the Germans in the war, being found in captured instruments.

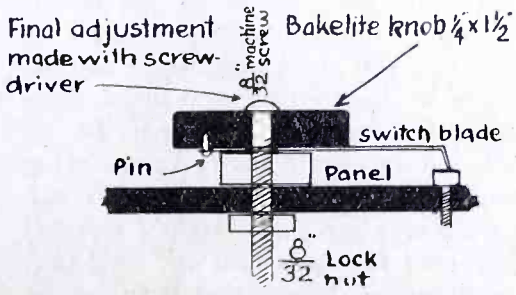
A neater type, and likewise easy of construction, may be made of a short length of quarter-inch brass rod, forming one plate, around which a single layer of insulated wire is wound. Such a condenser, using nickel-plated rod, with enamel or green silk wire, makes a neat enough appearance to be used on precision apparatus. A battery test should be made for possible short circuit. Either of these types takes up very little space. Flat metal strip may be used in place of the rod, in which case a fine file should be used to round the edges a trifle, to prevent cutting the insulation on the wire.

Still another method would be to use a small flat piece of bakelite or even dry wood. A piece of tinfoil is wound around this, forming one plate. The insulated wire is wound over this, forming the other.

A Different Style of Switch Knob

THIS type of knob costs little, looks well, is easy to construct, and properly adjusted, runs with a smoothness found on but few other types. Most knobs depend upon a spring to hold their tension, and few have the smooth, firm running that is so desirable. This particular knob operates with the precision that is to be found in that type which makes use of a blade that has bearing surfaces at each end, without its complication.

A bakelite disk, ¼ by 1½ in., is centered and drilled to clear an 8/32 machine screw. The blade, of phosphor bronze or spring brass, laminated or single, as desired, is cut ½ in. longer than the radius needed to cover the switch points. This is drilled to just take the

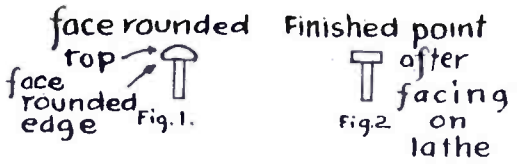


A Different Style of Switch Knob

8/32 machine screw, ½ in. from the broad end. A brass bushing ½ in diameter by ½ in. length is drilled and tapped for an 8/32 thread. An 8/32 machine screw, or suitable length to clear, is put through the bakelite disk. The blade is next slipped on the screw. A small hole is drilled through the broad end of the blade into the bakelite knob, about ⅛ in. A small brass pin is driven into this to make a driving fit. The brass bushing is next screwed up against the blade, just tight enough to press the blade firmly against the knob. The assembly is now inserted into the panel, through which an 8/32 clearance hole is drilled. Next screw an 8/32 hex machine nut on the 8/32 bolt, locking it firmly against the panel. Make the final adjustment with a screw driver, holding the nut with pliers if necessary. As only the blade and knob turn on this form of assembly, and as the bushing furnishes the necessary pressure, the knob will not wobble. The head of the machine screw may of course be countersunk into the knob, and many of the knobs now on the market can be adapted to this form of assembly.

Something New in Switch Points

OF the many forms of switch contacts that the enterprising experimenter can dig up, screw heads are common, .22 calibre cartridge shells are by no means new, and paper fasteners have found vogue in some radio circles. There is no necessity for these extreme steps, as first-class switch points may be obtained at very reasonable prices.



Something New in Switch Points

The point here described resembles very closely that type of contact used on many of the Marconi instruments. It is made from a brass rivet that is an elaboration of the brass escutcheon pin, but is minus the point, and is much larger. The head is rounded. These rivets are placed in the panel by securing a machine drill of the same size as the shank, and making a driving fit.

If one possesses a small lathe, the head of the rivet may be surfaced to a flat finish, as well as the edge. Where the smaller gauges of wire are used in the coils which are tapped off from these points, they are particularly suitable, and

Continued on page 66

Misconceptions of Reception

By Edward T. Jones

For the benefit of the novice the author here explains why daylight reception of distant stations is not possible, why one receiver may be more sensitive than another, why signals fade, and why amplification is used.

HOW many times a day is this question asked: "Why is it that I cannot receive anything in the daytime?" This from people situated some few hundred miles away from a powerful broadcasting station. The other day a lady asked if she could get in touch with someone with a radio receiving set in New Orleans who would permit her to listen to her daughter singing at a broadcast studio in New York City. The selection was to be put on the air at 3:00 p.m. New York time, which is 1:00 P.M. at New Orleans. While I do not know exactly what "freak" day reception has been recorded from the New York broadcasting stations, I believe I am safe in saying that they do not generally reach out much further than their written guarantee, which I understand to be 100 miles with a 500-watt transmitter.

Now for the shock—*All broadcast reception from* 300 *to* 1000 *miles or more is nothing more than freak reception.* In other words—it was not intended for you—way out there—and you are fortunate that the sun takes a rest for the night. Now with that jolt well under your belt—let me alleviate the situation for you . . . . . Very good results are obtained during the night over great distances throughout the year, except in some places where static predominates for several months.

If I stand 100 feet from you and whisper, you hear nothing of it. That's exactly the case of the powerful broadcasting station 300 or more miles from you in the day time. The energy is absorbed before it reaches you and you cannot pick up the signals during the day time, with the present receiver. They may be reaching you—but the present-day receiver, which is exceptionally sensitive, does not record it.

At sunset the waves spread out farther from the transmitter and 300 miles away you are beginning to hear the carrier wave (this is the whistle heard when tuning for the stations). The voice is too weak to be understood. As you listen from that time on—as it gets darker and darker—the carrier wave becomes louder and louder, until finally the voices and music can be understood and the program enjoyed. Probably by that time stations hundreds of miles beyond your range are listening to the same concert. As it gets later into the night the signals continue to increase until a loud speaker can be used very easily and in many cases less amplification will operate even a batteryless loud speaker.

A VERY efficient receiver is required to record a feeble carrier wave. You may own a receiving set manufactured by a concern having all the facilities for the proper construction, while your neighbor has thrown a few pieces of apparatus together in order to "get results quick". You hear the carrier wave at sunset, but he does not get reception from that particular station until later in the night. His receiver requires a much stronger signal to actuate it—while yours is exceptionally sensitive and records the very weak impulses. I do not want to convey the idea that it is not possible to construct a very efficient receiver in your own workshop, but want to bring home the truth about the matter—that there are too many sets being thrown together instead of being put together in accordance with the instructions and data given so freely and so cheaply in this and many other radio magazines. In other words—"Don't blame the tools—blame the builder".

If you are interested in building a set which you have not seen advertised or fully described in these magazines, get in touch with someone who can actually tell you something about it. Write to the editors; but by all means do not take advice from someone who has built one set and was fortunate enough to get it to work—you may not have such good luck, because of the possibility of receiving incorrect information regarding the same set. There are too many radio experts made overnight because of the fact that they succeeded in building a radio set that worked.

WHILE listening to the distant station which just barely reached you at sunset you may notice that the signals are barely audible for a time and gradually fade out—getting weaker and weaker until you cannot hear them. Then, after a short time, they began to build up again, until they finally reached their original value. This may also happen all through the period of reception. This is a condition which cannot be controlled at the receiving end. A re-adjustment of the dials will not increase the signal strength, and it will continue to fade out and come in. This may be due to changes in atmospheric conditions between you and the transmitting station, changes in cloud strata, and many other purely theoretical reasons may be offered, but no one actually knows what causes fading. *When a station is fading badly any particular night I strongly recommend that you "get off" and tune in some other station that is in an entirely different direction where this condition may not exist at that time.* You will find this to be the only solution to this problem, which confronts all of us at one time or another.

Retuning of the instruments only makes conditions worse—and the signal being very weak at about the time you are trying to "get it back in" causes you to lose the station entirely.

A ONE-TUBE receiving set will receive as far as a two or three-tube audio-frequency set. The one-tube (detector) picks up the signals—if they are to be heard at all. Therefore, no matter how many stages of audio-frequency amplification are added, you are not going to pick up stations from greater distances. Of course "picking them up" and "hearing them" are two different things. The added amplification builds up the signals to a point where they become audible in the telephone receivers and, furthermore, to the point where they will operate loud speaking horns, and, when desired for a specific purpose, operate recording relays.

The one-tube receiving set confines the listener to the earphones, which makes it impossible for the other members of the family to comfortably enjoy the exceptional programs which are being broadcasted every night. One stage of amplification will in some cases help to permit the addition of several pairs of headsets or even work a loud speaker, but in a great majority of cases it is absolutely necessary to make use of the two stages of audio-frequency amplification.

GENERALLY speaking, crystal receivers are only good for local reception. You will, however, be surprised to learn of many freak receptions with such apparatus. Aboard ships lying at their piers in the harbor we have been able to pick up many of the powerful stations in the country with a fair audibility. Of course the antenna employed aboard shipboard is very large and capable of delivering considerably more energy to the receiver than the average BCL's antenna.

For long-distance reception I would not think of using a crystal set under any conditions. In the first place it is a tedious task to keep the mineral in a high state of sensitivity—which is so necessary—and, furthermore, you have to practically remain in a state of coma while receiving in order that you might not "knock out" the detector adjustment. A crystal detector set is only recommended for use in the immediate vicinity of a broadcasting station.

"Splash! Something hit his up-turned face."

To Sea or Not to Sea

By Preston Decker Allen

This is a most vivid and truthful picture of the life of a sea-going "op." Skilfully woven into it is a human-interest tale of the sea's repulsion but greater attraction. And when the end is reached the reader concludes that there is more truth than fiction in the story.

JIMMY O'Brien, lightning jerker de luxe, sat with his feet on the edge of the desk, his chair braced against a bulkhead. His ship, the tanker *Crudol,* was plowing steadily westward, her nose pointed in the direction of Yokohama. No sound broke the stillness of the day except the slap of water against the vessel's sides.

O'Brien scowled darkly, slammed his magazine down upon the desk and sat up with a grunt.

"Rotten", he muttered viciously. "Gosh, what a rotten story! Bet that bird's never been out of Nebraska, yet he writes of the beauties of the sea, and the wonderful life of the sailor. Bah!" He fairly snorted as he adjusted his head phones and felt around six hundred meters with his secondary condenser.

Jimmy O'Brien was an old-timer. He had done everything from the *City of Eureka* to the *Finland.* He had washed his own clothes and bathed in a bucket on lumber schooners where the operating room was so small that the skipper had to hand his messages in through the window. He had sat at the head of his own table on passenger ships which carried three operators and did three thousand dollars' worth of paid business a trip. He had been on oil tankers, freighters and barges. In the radio company's office in San Francisco his name headed the seniority list. His fist was as clear as an electric sign, and he could copy with the best of them.

But Jimmy was not dwelling on the glories of the past just then. He was completely concerned with the present. The knob on the condenser stopped its to-and-fro motion while he reached over and adjusted the primary inductance. The whine of a five hundred-cycle quenched gap was making the call letters "WTT"—his ship.

"Nice tight gaskets on that one all right", he noted involuntarily as he observed the steadiness of the other ship's note.

"WTT de WMO", purred the five hundred cycle.

O'Brien pushed his antenna switch into send position and snapped the self-starter button. Nothing happened. Quickly he tested the main supply line. No current from below!

"D. . . .", he muttered. "Same old stuff! No power when you want it."

In another minute he was down in the engine room, only to find that the chief engineer had the cylinder-head off of the generator engine.

"Sorry", said the Chief, "but she needed a new gasket badly. Thought you wouldn't need any juice in the middle of the day way out here." (Their noon position had shown them some two thousand miles west of San Pedro.)

" 'Sall right, 'sall right, Chief. Some guy just called us and I was going to answer, that's all. Let me know when you have her going." He gulped down his annoyance and said no more. He was an old-timer and he knew the game.

But when he regained the radio room the author of the story came in for more attention.

"Beauties of sea life! Rot! Nice landlubbering sentimental bunk! Go to sea and be a goat! Same old stuff—radio man always gets it in the neck."

A full-sized, sea-going cockroach ventured into view around a pile of message blanks, his feelers waving a salutation to the operator.

"Great father of truck-horses!" snapped O'Brien as he let fly the work of the salt-water sentimentalist in the direction of the intruder. "I've asked the steward forty times to chloroform, drown or shoot 'em, but no action. It's only for the operator; take your time." His voice cracked under the weight of sarcasm.

Life on the sea, the wonderful life of the sailor, was getting on his nerves. He leaned back in his chair and closed his eyes. He needed a rest, a change of atmosphere, a change of work. A job in some inland town, far from the swish of sea water, inconsiderate engineers, elephant cockroaches and poor grub. He dozed, glad to forget for the moment the multitudinous cares of the commercial operator.

Splash! Something hit his upturned face and ran down his cheeks. He jumped clear of his chair and stared wildly at the ceiling. Drip! Drip! Drops continued to fall in the chair he had so hurriedly vacated. With murder in his heart he strode out onto the deck and looked up. Just above him on the bridge deck a sailor was massaging the white sides of the chart house while small streams of water trickled to the deck below. Fuming, O'Brien turned back to his room.

"My Gawd!" he railed. "Bet I've told 'em about that leak a hundred times if I've told 'em once. They're not satisfied with everything floatin' in here when it rains—they even pour it on in dry weather!"

He kicked the chair out of the line of fire and placed a paper under the drip. An oiler interrupted him at this point to say that the generator was again in commission.

Slightly pacified and hoping that the WMO was still on, O'Brien started his generator. As usual he glanced at the antenna ammeter. Only two amperes! And there should have been ten!

"Holy sufferin' catfish!" Rapidly he tested everything which might cause the low antenna current, but nothing was wanting. He scratched his head in exasperation.

"Don't that beat thunder? Everything apparently OK, but she just won't perk. Guess the old girl's getting tired of the life too."

Still grumbling to himself, he climbed the bridge ladder in order to have a good look at the lead-in. After satisfying himself that it was not grounded on a stay, he walked aft to where the lead-in insulator protruded through the deck above the radio room. A flash of red and a waving paint brush caught his eye. He rounded the corner of the chart-house. From the lead-in connection to the metal bulkhead, the insulator was a beautiful scarlet hue. It stood out against the white background like a port light in a fog! The admiring artist stood, brush in hand, looking for other worlds to conquer.

O'Brien's yell brought the mate from the bridge at double quick.

"Mother of sea pirates!" bawled the disillusioned operator. "Lead-in insulator painted from stem to stern with a coat of red lead that would choke a cow, and me tryin' to work a wireless set through a ground like that!"

Red lead is one of the commandments in sea religion and the mate, after a hearty laugh at what appeared to him to be a good joke, ordered the sailor to clean the insulator with gasoline.

O'Brien, once more in his quarters, was tempted to open up with the set while the sailor was at his manicuring job just to show him that it wasn't safe to monkey with the radio apparatus even though there was a surplus of red lead aboard.

Thirty minutes later, with ten amperes showing on the "hot-wire", O'Brien called the WMO. The other operator was still on watch and the five hundred cycle shot back at him.

"WTT de WMO, ge OM. Will u please give me ur position and weather?"

"Sure tng, if you'll QRX a few mins while these sea mathematicians figure it out."

"How do you like that chariot?" queried the operator on the WMO. "Always heard she was a home!"

O'Brien's key clicked with a wicked snap. "Someone's been filling you with sea water, OM. This bus is no home. She's a madhouse. There ain't enuff days in a year or I'd tell you what's the matter with her. Anyway I'm getting off next trip."

"That's hard luck, OM." The five hundred cycle was sympathetic. "Goin' to stick on the beach for awhile?"

"Beach nothing!" O'Brien snapped his denial. "When we hit Pedro I'm goin' to a place where they never heard of the ocean, and where they don't even use salt in their soup!"

"Hi, hi!" came from the WMO. "I said that once too, but look at me now."

"Yes, but you haven't bn hitting it up as long as I hv. Eight years is 2 mch. I tell u, OM, I'm gone for gud this time. Here's your position."

"Tnx, OM, and 73. Hope to see u agn when you're through workin' on that cockroach farm. Bet before many days you'll have someone squirtin' water against the side of the house so you can go to sleep." The quenched trailed off into a derisive splutter.

"73", spat O'Brien. "If you ever catch me on the bitin' end of a radio key again, I'll be workin' it with wings—or maybe a tail!"

AND he meant what he said—then. When the tanker made her lines fast to the oil dock at San Pedro, O'Brien was the first man ashore, duds packed and ready for the journey which would take him to a place where even the pork wasn't salty. He played in luck, too, for in his mail he found a letter

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It might as well be in Greek

Notes on Distortionless Amplification

By Walt. S. Thompson, Jr.

Herein are discussed the causes and remedies for distortion due to transformers and amplifier tubes. Included is a brief account of the functions of the "push-pull" amplifier. The discussion is concerned only with audio-frequency amplification.

ASSUMING that the readers are familiar with the characteristics of the thermonic vacuum tube and its application as an amplifier, it is the writer's purpose to discuss some of the causes of distortion in poorly designed multistage amplifiers and to suggest means by which such distortion can be avoided. This discussion will be confined to amplifiers as applied to audio frequency currents.

Audio frequency amplifiers may be divided into three classes according to the type of inter-tube coupling used. Of these three classes, i. e.—the resistance, the impedance and the transformer coupled amplifiers, the last is by far the most generally used today. This popularity of the transformer coupled amplifier is due to three distinct advantages which it possesses. First, high amplification per stage is made possible by the use of the step-up transformers, second, it is simple to construct, and third, excessively high voltage plate batteries are not necessary. A disadvantage of this type amplifier is that more care must be taken in designing the apparatus and the circuit in order to prevent distortion.

Distortion in a multistage amplifier is usually due to the unequal amplification of currents of various frequencies within the range which affects the human ear and to the fact that the amount of amplification may depend upon the potential of the grid with respect to the filament. These two causes of distortion will be taken up in the order above, the discussion applying to standard amplifier tubes.

It has been found that all currents having frequencies between 30 and 4,000 cycles per second must be equally amplified if reproduction is to be natural. As the amplification due to the tube itself is practically independent of the frequency up to several hundred thousand cycles per second, any distortion present will usually be due to improperly designed transformers. The effects of such transformers are shown by Fig. 1 which gives the amplification characteristics for a few of those that are on the market today. Only one of these transformers, "*A*," would be considered satisfactory, although the writer has found that there are several transformers being made which have characteristics similar to the best one plotted. From these curves it is evident that great care must be taken in selecting the transformers to be used in building an amplifier. As the average buyer is seldom able to distinguish between properly and improperly designed transformers, he must rely upon the manufacturer's reputation. In purchasing transformers, therefore, it is usually advisable to buy a make which is backed up by years of experience in designing such apparatus. It might be well to note that, in general, transformers with a turn ratio of 5 to 1 or less, cause less distortion than those with higher ratios.

If a high ratio transformer is already in use, distortion may be greatly lessened by connecting a resistance of 1 or 1.5 megohms across the secondary winding. This shunt resistance will decrease the amplification slightly, although this loss is well repaid in improved reproduction.

As mentioned above, distortion may also occur when the amount of amplification depends upon the grid potential. This type of distortion is due to the tube itself, and hence must be explained by referring to the characteristic curves of the tube.

If the plate current-grid potential characteristic curve is not a straight line over the operating range, the value of the current in the plate circuit will not vary in accordance with the varia

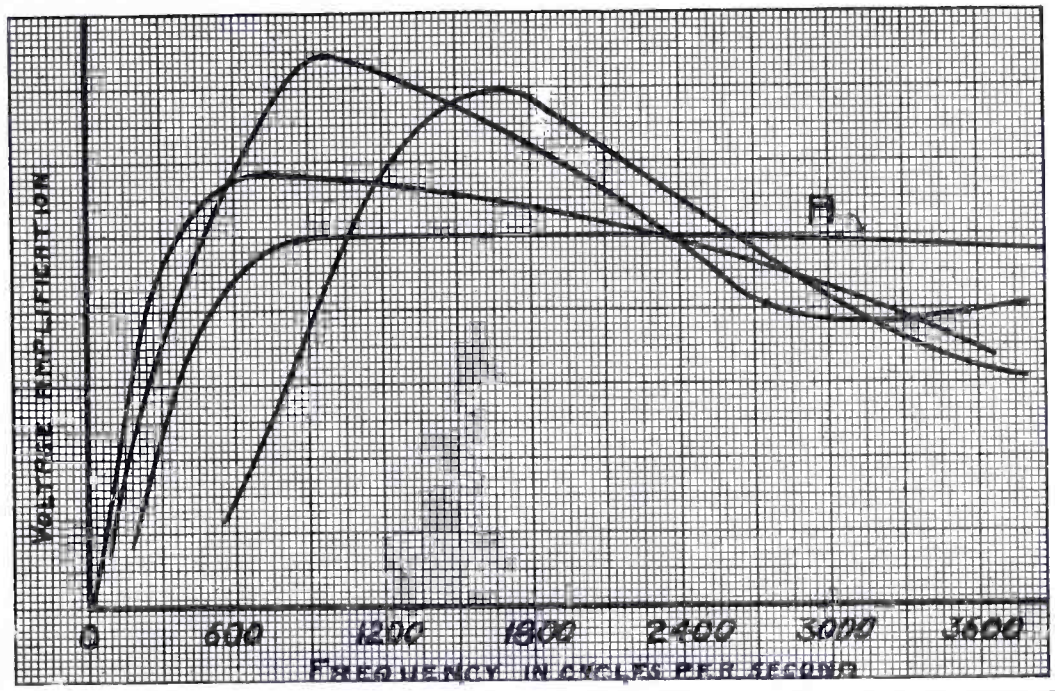

Fig. 1. Amplification Characteristics of Several Audio-Frequency Transformers, Only One of Which Is Satisfactory

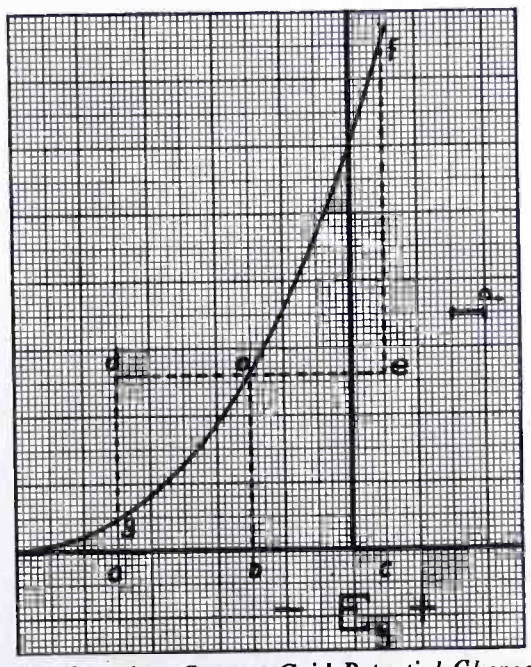

Fig. 2. Plate Current-Grid Potential Characteristic Curves of an Amplifier Tube Showing How the Plate Current Wave May be Distorted

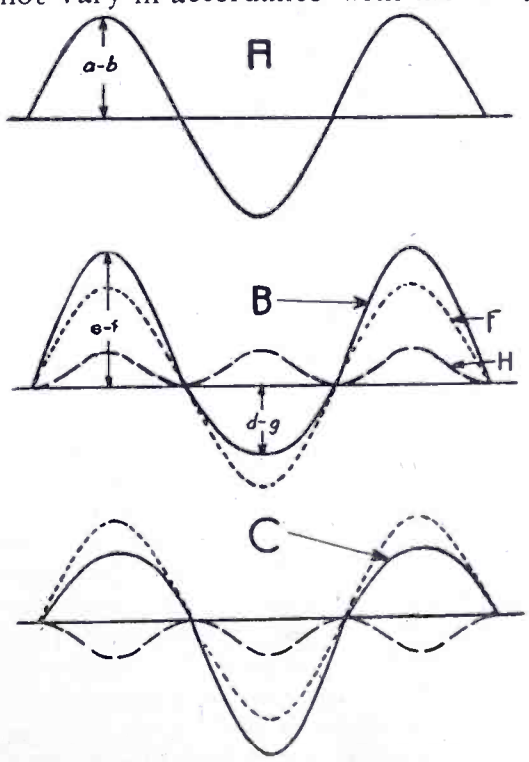

Fig. 3. Graphical Representation of the Plate Current Waves Showing How Detrimental Harmonics Are Balanced Out

tion of the grid potential. This can be understood by referring to Fig. 2 and 3. Assuming a plate current-grid potential characteristic as shown in Fig. 2 and assuming for the sake of clearness and simplicity, a sinusoidal voltage wave such as *A* in Fig. 3, to be impressed between the grid and the filament, the action is as follows. The normal grid potential being at *b* in Fig. 2, the variation of grid potential caused by the impressed voltage wave will be from *a* to *c*. During the positive half cycle, the grid potential will vary from *b* to *c* and cause the plate current to vary from *e* to *f*. During the negative half cycle, the grid potential will vary from *b* to *a* causing the plate current to vary from *d* to *g*. Thus the plate current plotted will be the full line wave, *B* in Fig. 3. It is very evident that this full line wave is not an exact reproduction of the voltage wave *A* and that distortion has occurred, due to the fact that the amplitude *d-g* is less than *e-f*.

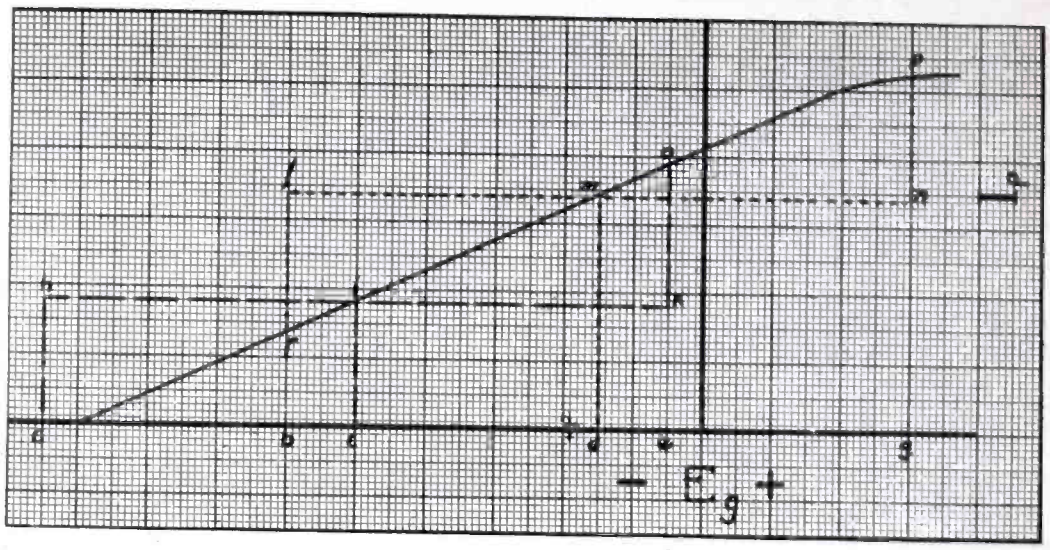

Fig. 5. Dynamic Characteristic Curve of an Amplifier Tube Showing How Improper Grid Bias Voltages May Cause Distortion

U. V.-201A is 13,000 ohms for a plate voltage of 80.

The value of the normal grid potential must be correctly adjusted if distortion is to be avoided. In Fig. 5 is shown a plate current-grid potential characteristic curve under operating conditions, the bend at *p* being caused by a grid circuit current flow, due to the positive grid potential. Assuming an impressed voltage wave as *A* in Fig. 6 and a normal grid potential at *d* in Fig. 5, it is evident that during a positive half cycle, the grid potential will vary from *d* to *g*, and during a negative half cycle, from *d* to *b*. The bend at *p* will cause the positive half cycle of the plate current *p-n*, to be less than the negative half cycle *l-r* as shown by *C* in Fig. 6. Thus it can be seen that if the normal grid potential is not sufficiently negative, there will be distortion.

This type of distortion can be avoided by giving the grid a negative bias, the value of which will depend upon the tube used and the plate battery voltage used. The proper grid bias voltages are usually given by the tube manufacturers and should be strictly adhered to if distortionless amplification is desired.

Again assuming the same impressed wave and characteristic curve, the normal grid potential will be taken at *c* in Fig. 5. The negative half cycles of the impressed wave will fall beyond the limit of the curve, causing the negative half cycles of the plate current wave to be cut off, that is, *a-h* is less than *o-k* as shown by wave *B* in Fig. 6.

Distortion of this type can be eliminated by increasing the plate battery voltage, by decreasing the negative grid bias, or by using a larger tube. This again brings out the importance of following the tube manufacturers' recommendation regarding grid bias voltages.

As the characteristic curve of a tube is seldom exactly straight over its entire operating range, considerable research has been done to develop an amplifier which will give distortionless amplification regardless of this fact. This research has led to the "push-pull" circuit, shown in Fig. 7. This circuit permits the tubes to be operated beyond the straight part of their char-

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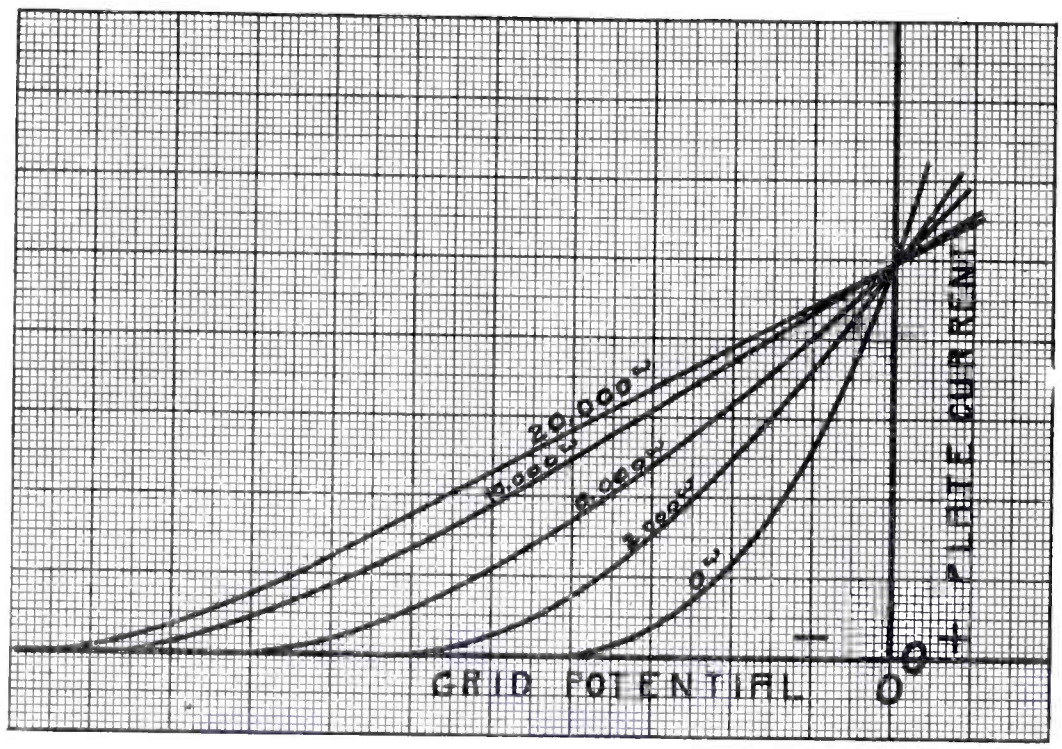

Fig. 4. Series of Characteristic Curves Showing the Effect of Increasing the Plate Circuit Resistance

Thus it is evident that the characteristic curve must approximate a straight line if distortionless amplification is to be obtained. In Fig. 4 is shown a series of characteristic curves plotted for different values of resistance in the plate circuit, the plate and filament battery voltages being kept constant. It is evident that the curves straighten out as the plate circuit resistance is increased, hence distortion is least for high values of this resistance. This factor is taken care of in practice by manufacturers, in making the impedance of transformers and head sets very high, usually equal to the plate impedance of the tube. To insure the best results, therefore, it is necessary to know the impedance of a transformer or head set so that it may approximate the plate impedance of the tube to be used. The plate impedance of the

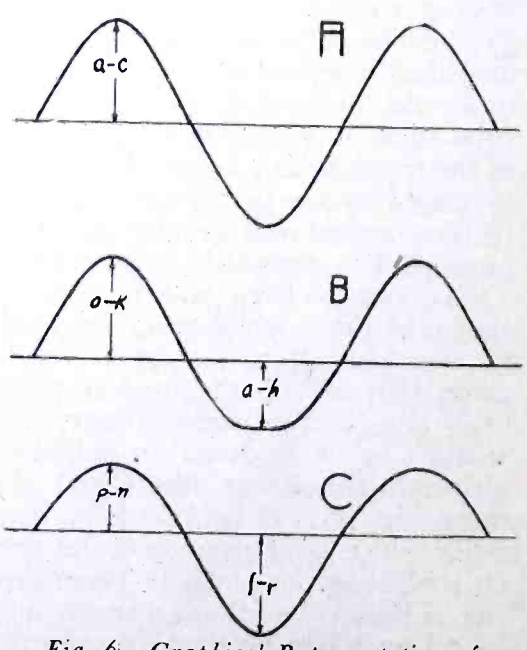

Fig. 6. Graphical Representation of Distorted Plate Current Waves Caused by Incorrect Grid Bias Voltages

Why a Circuit Regenerates

By L. R. Felder

Here is explained in simple terms the reasons why a circuit regenerates. The introductory remarks regarding the frequency of freak circuits are most apropos. It is hoped later to publish an equally simple article regarding the action of the reflex and neutrodyne circuits.

EVER since broadcasting roused everybody's enthusiasm for radio there has been a wave of experimenting which culminated in a host of these so-called "new circuits". All kinds of amusing names have been given these circuits—names which mean nothing, but which their inventors hope will have a magic influence on the radio public. Other circuit inventors have named their circuits after themselves, thus satisfying their conceit.

If all of these circuits really embodied exceptional features or revolutionary ideas then more progress would have been made in the last two years than in all previous years. But the fact is that most of them are freak circuits not supported by any rational theory and which work by mere luck, while the rest are standard circuits which have been so camouflaged by unnecessary apparatus and tricks in drawing up the circuit that the circuits appear to be new. A plex circuit in which one tube amplifies both radio-frequency and audio-frequency remains a standard reflex circuit as originally invented by Marius Latour of France; in spite of all the plex names added to it. Also 4-circuit and n-circuit tuners which control regeneration by means of the 4th circuit or nth circuit still remain the good original regenerative receiver as invented by Armstrong in spite of efforts to conceal the fact.

In all these years of radio development the number of circuits which represent real progress in the art of radio reception may be counted on the fingers of one hand. These circuits may be called the Big Five and are: the regenerative, the super-regenerative, and the super-heterodyne receivers invented by E. H. Armstrong, the reflex circuit as originally proposed by Marius Latour, and the neutrodyne invented by Prof. Hazeltine.

These circuits are the backbone of radio reception at present. Of these the first, third and fourth represent the greatest advance. They all involve new principles and a thorough understanding of modern radio progress in reception cannot be had without a thorough understanding of the principles on which these circuits operate.

The Regenerative Receiver

THE regenerative type of receiver was invented by Edwin H. Armstrong. Its action depends solely on the amplifying properties of the vacuum tube detector with which it is used. If the vacuum tube were not an amplifier this action of the regenerative receiver would not be possible. On the other hand, the regenerative receiver is a possibility with any type of detector, provided it amplifies at the same time.

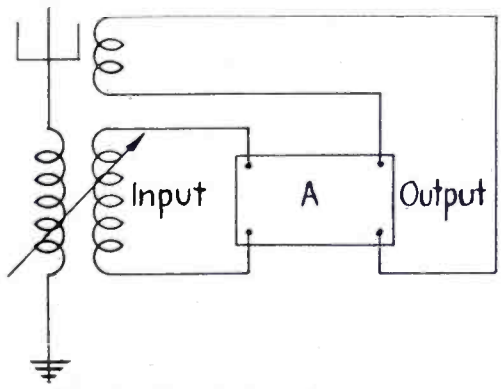

Fig. 1. Principle of Regeneration

Let us suppose that we have in Fig. 1 a device *A* which both detects and amplifies a radio-frequency signal, and suppose that a signal such as that due to a receiving antenna is impressed on the input terminals. Then in the output circuit we will have a magnified copy of the incoming signal. Since the output contains more energy than the input it is possible to extract a part of this magnified energy and still leave enough to operate any receiving instrument. Suppose then that by some means we extract a small part of this magnified energy and return it to the input of our detecting and amplifying device *A*, Fig. 1. Then we will have in the input of *A* both the incoming signal and a portion of the amplified signal. If matters are now so arranged that the incoming signal and the returned part of the amplified signal are in phase then the signal applied to the input of our device *A* will be greater actually than that received by the antenna. This increased signal applied to the input of *A* is now still further amplified by *A*, and as a result we have a greater signal in the output than we had formerly. Part of this output is again returned to the input, which part is again added to the incoming signal and reamplified, thus building up very large outputs.

To appreciate this great building up process of large signals let us consider a simple illustrative numerical example in round figures. Suppose our incoming signal applied to our amplifier is of strength represented by 1, and suppose our amplifier increases signals six times (the approximate amplification of most vacuum tubes). Then the output will be represented by 6. Suppose that of these 6 units output we return ½ unit (or about 8%) to the input. This still leaves 5½ units output. The returned ½ unit adds on to the incoming unit from the antenna, making now a total of 1½ units of signal applied to the input, which is again amplified 6 times by the tube, giving now a total output of 9 units. If about 8% of this enlarged output is again returned to the input, namely about ¾ unit, this will be added to the incoming unit from the antenna, making a total of 1¾ units applied to the input. This is again magnified 6 times, giving a total output of 10.5 units. This process is repeated until the limit of the amplifier is reached. In the case of vacuum tube amplifiers this continues until the output is magnified to 36 times the input, that is the process of feeding back gives an amount of amplification equal to that of a tube itself. It is thus apparent that enormous signals may be built up from little signals.

This process of feeding back a small part of the output into the input of a vacuum tube amplifier and reamplifying it is called regeneration. In order to see exactly how regeneration acts we will consider one of the best and simplest methods of regeneration, namely the use of a tickler coil as in Fig. 2. Suppose a

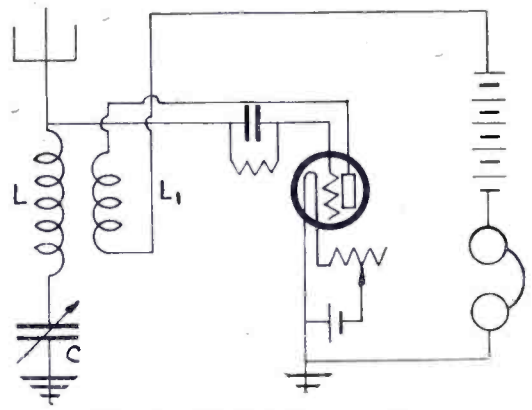

Fig. 2. Tickler Regeneration

signal voltage is applied to the input or grid circuit of the tube. Then we will have a certain output or signal, and this output is limited solely by the resistance of the circuits and by the amplifying power of the tube. Since the amplifying power of the tube is unalterable, we may say that our signal is limited solely by the resistance of the associated circuit *L C*, for a given signal voltage drives a current through it determined by its resistance. Suppose now that we couple the tickler coil L_1 closely to the coil *L*. Then since the output has the magnified signal current a voltage will be induced in the input coil *L*. This is the feed-back energy. This induced voltage is added on to the incoming signal voltage, thus giv-

ing a larger input voltage which, when applied to the resistance of the circuit, drives a larger current through it. This is again repeated and thus the resistance of the circuit, which limits the strength of signal, is overcome.

This action may be regarded from still another point of view, where voltage applied to the input is constant. But we saw above that the feeding back of energy into the input gave rise to increased input currents due to induction. If then the input voltage is constant and the current increases as a result of feed-back or regeneration, the only explanation for this can be that the resistance of the circuit decreases. In other words regeneration has the effect of overcoming the resistance of the circuit and thereby reducing the circuit resistance and thus increasing signals.

The closer the tickler coil L_1 is coupled to the input coil L the more energy is fed back and the lower does the apparent resistance of the coil circuit become, hence the greater the amplification. However, there is a limit to this process of regeneration. Obviously if the resistance of the circuit is apparently reduced to zero by this process of regenerative amplification, then, once a current starts flowing in it, it will never stop, for there is nothing to stop its flow. In other words, when the resistance of such a regenerative circuit is reduced to zero it begins to oscillate of its own accord and this oscillation destroys the amplifying properties of the receiver. Thus there is a definite limit to the extent to which regenerative amplification may be carried and this limit is the point where oscillations set in. The reader is probably well aware of this limit. For most owners of radio sets have observed that when they increase their tickler coupling the signals get louder and louder, until after a certain point is reached. At this point the set begins to squeal and distorts the incoming signal and reduces amplification of incoming signal. What has happened is that the limit of regenerative amplification has been reached, and the tube commenced to oscillate, with the result that distortion and reduced amplification of signal followed. There is a definite limit to which regeneration may be pushed. To go beyond this limit without distortion and loss of amplification requires super-regeneration.

Now that the reader has a good idea of the mechanism of regeneration, we may consider next the different practical methods by which regeneration may be secured. The first and most popular method is that of tickler coupling, which is represented in Fig. 2. Here the regeneration is accomplished by means of a coil L_1 in the plate circuit, called the "tickler" coil. By means of this coil energy from the plate circuit is fed back into the input side of the tube. Fig. 3 represents a two-circuit tuner employing

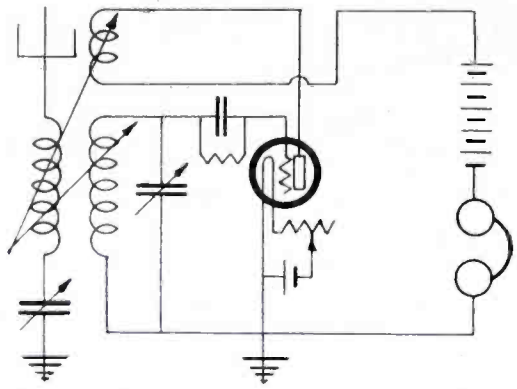

Fig. 3. Two-Circuit Tickler Regenerative Receiver

tickler coupling for regeneration. From a consideration of Figs. 2 and 3 it is seen that any type of tuner may be converted into a regenerative receiver by placing a coil in the plate circuit so that it is inductively coupled to the input coil. The size of this coil depends, of course, on the wavelength range, but for broadcast reception any kind of coil about 3 in. in diameter and having about 30 turns of No. 20 or smaller wire will do. What is important to note about this is the manner in which the tickler is connected to the plate circuit. It will be remembered that it was stated in the above explanation of regeneration that the voltage fed back into the input must be in phase with the incoming voltage. Whether it is in phase or not depends on the tickler coil connection. This can only be discovered by trial. Connect the tickler coil in place and vary coupling to the input coil. If, as the coupling is increased, there is an increase in signal strength, then regeneration is taking place. If not, there is no regeneration. Reverse the connections of the tickler coil and regeneration will follow. What happens is that with one method of connection the feed-back voltage is in phase and with the other it is not in phase with the incoming voltage due to the signal.

The second type of regenerative receiver is the tuned plate circuit receiver, sometimes called the Weagant X-circuit, and is shown in Fig. 4. Here the plate

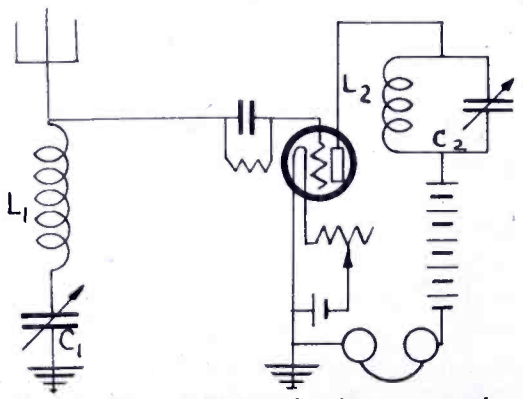

Fig. 4. Tuned Plate Circuit Regeneration

circuit is tuned to the incoming signal as well as the receiver unit. There need be no apparent or intentional coupling between L_1 and L_2. The feed-back of energy takes place by means of the capacity inherent in the tube, which is common to both plate and grid circuits. As the plate circuit is tuned to the incoming signal regeneration takes place. A modification of this is the plate variometer method shown in Fig. 5. Here an or-

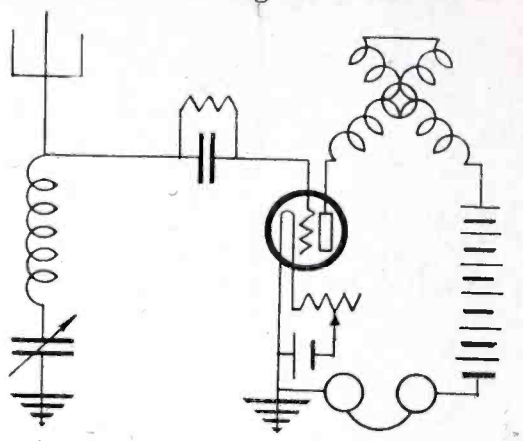

Fig. 5. Plate Variometer Regeneration

dinary variometer is placed in the plate circuit and as it is varied regeneration takes place. It is a modification of the above method because the distributed capacity of the coil takes the place of C_2 in Fig. 4. This method is also a very good one but has the disadvantage that best results require alternate adjustment of the plate circuit and the tuned circuit, for any variation of the plate circuit reacts on the tuned antenna circuit, thus altering its wavelength. In the case of the tickler once the wavelength of the antenna circuit is set it merely requires the tickler to be adjusted for maximum signal.

In conclusion, one word of warning should be given to broadcast listeners. The regenerative receiver is one of the best, if not the best, types of receivers to be had if properly used. If improperly used it will give the worst possible kind of distortion. The one thing to be avoided is too much regeneration. Too much regeneration, even though not yet in the oscillating state, results in distorting the quality of received signals. Hence regeneration should be brought up to the maximum possible point consistent with good quality of received speech.

HANDY HINTS

A twisted piece of lamp cord, with the ends open, makes a good low capacity condenser, for neutrodynes, etc.

Good wall insulators can be made out of short pieces of glass tubing, obtainable at any druggist's. Any convenient length can be cut off, and the wire run through.

A block of sal-ammoniac is very handy to tin a soldering iron. Just rub the hot iron onto the block, together with a small amount of hot solder, and the tin will adhere readily.

One of the most prolific causes of "funny noises" in receiving sets is poor, or carelessly-made connections. Solder 'em, and make a good job of it, it's not hard.

Common sheet celluloid, dissolved in acetone, makes a very good varnish for coating inductance coils.

How Modulation Is Accomplished

By Florian J. Fox

This, the last of a series on the theory and design of a C. W. transmitter, describes the different methods whereby the carrier wave is modulated by voice-frequency currents. The article so clearly explains the process that the layman can understand how broadcasting is transmitted.

MUCH can be written about the theory of modulation. A technical treatise would involve a good deal of mathematics. Let us be more general for the sake of simplicity.

The voice produces sound waves of audible frequencies which are very complex due to their richness in harmonics. Furthermore, the frequencies change rapidly as the pitch of the voice rises or falls. The average of these frequencies is about 800 cycles per second.

These voice frequencies, by means of special circuits to be described later, are impressed on the radio-frequencies generated by the oscillator. This causes the undamped waves to change both in frequency and amplitude. In other words, the voice frequencies mold the radio-frequency or "carrier" wave. Most readers have seen and are familiar with the pictures used for representing this phenomena.

There are several ways of modulating a carrier. One of the earliest methods is modulation by change of antenna resistance. A microphone is connected in series with either the antenna or ground lead. When sound waves cause the microphone diaphragm to vibrate, the effective resistance of the antenna system is varied. This causes the amplitude of the radio-frequency to change in a like manner, and modulation results. See Fig. 1.

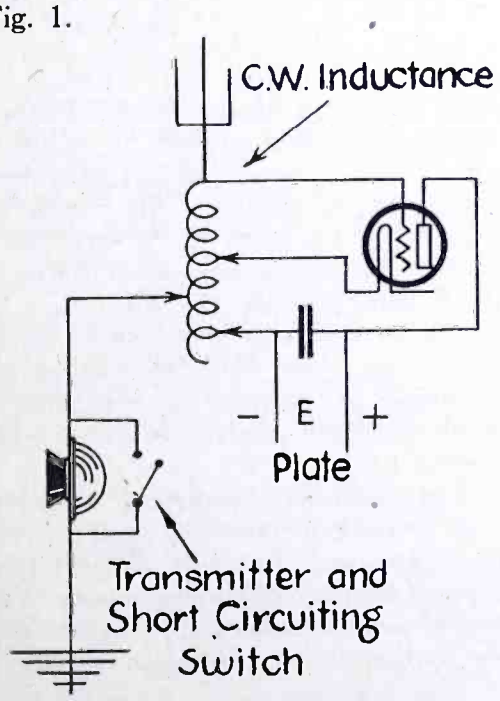

Fig. 1. Modulation by Change of Resistance

This system is simple and works fairly well on small sets. From a power standpoint it is inefficient because modulation is produced at the expense of energy lost in the resistance of the transmitter. On sets whose output is more than .5A this method should not be used. The transmitter will overheat and become worthless in a short time.

Using the above method of modulation an ordinary regenerative receiving set may be used for a radiophone. The range may often be as much as three miles. It is only necessary to place the transmitter in the antenna circuit, tune the set for about 200 meters, and throw the tickler or plate variometer into the oscillating position. It would help to short-circuit the phones during transmission. In most cases it is simpler to tune the set to the other transmitting station, and let him find your wavelength when the receiver is being used as a transmitter. The use of amplifier tubes with high plate voltages in place of the detector tube and its *B* battery will help to increase the range of such an outfit. It is not necessary to short-circuit the transmitter during reception but it might be advisable to do so.

Another simple and common system is the so-called modulation by absorption. A coil of one or two turns of wire is placed around the oscillation transformer (C. W. inductance). The circuit is completed through a microphone transmitter. When the resistance of the transmitter is changed by the impinging sound waves, the amount of energy absorbed by this microphone circuit varies approximately as this changing resistance.

Since the output of the tubes may be considered constant, the difference between the total energy and the absorbed energy represents the antenna energy. In brief, modulation is accomplished in this way. As in the previous system, modulation is produced at the expense of absorbed energy, and hence from an energy standpoint, this method is also inefficient. It has the advantage that the degree of modulation can be easily controlled by the coupling of the modulating coil with the C. W. inductance or oscillation transformer. Sometimes the modulating coil is coupled to an external coil placed in the antenna or ground lead. The result is the same of course. This method gives good results on low power sets and may be well worth a trial. See Fig. 2.

The magnetic modulator is an interesting piece of apparatus. It has a specially designed core with two windings. One winding is connected in series with

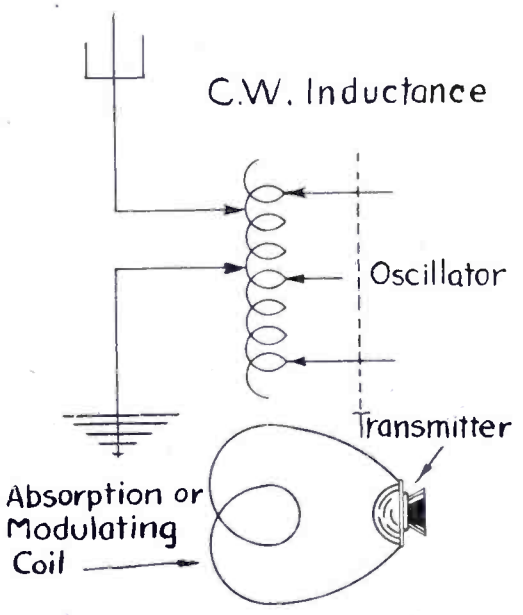

Fig. 2. Modulation by Absorption

the antenna or ground, while the other is connected to a microphone and battery. The design is such that the absorption of radio-frequency energy by the microphone circuit is cut down to a minimum. When the microphone is used, the current in the microphone winding varies. This causes the flux set up by the microphone battery to vary in a like manner. This varying flux causes the impedance of the antenna coil to change, thus producing modulation. The method is somewhat similar to the change of resistance method, the great difference and advantage being that very little antenna energy is lost. Modulation is produced mainly at the expense of the microphone battery. Here reactance rather than resistance plays a prominent part.

This is the first system described so far in which the microphone current is independent of the antenna current. It is evident that with proper design, magnetic modulators can be made to handle any output. Such modulators have been used successfully on large high frequency alternators. Fig. 3 shows the connections.

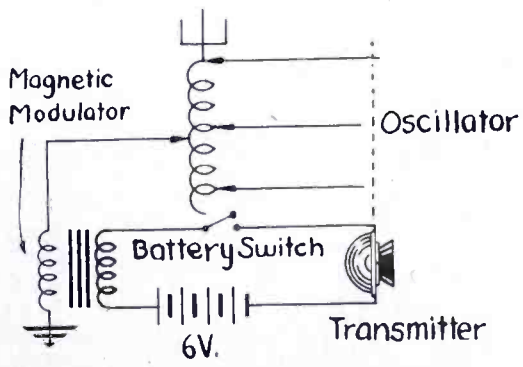

Fig. 3. The Magnetic Modulator

Grid modulation is now common and widely used among amateurs. The method is quite efficient and capable of giving quite satisfactory results. A modulation transformer is used. This consists of an iron core with two windings. The primary has relatively few turns of heavy wire, while the secondary has many turns of fine wire. There are many such transformers on the market. Ford spark coils have been used for this purpose with fair results.

The microphone, with a 6-volt battery, is connected to the primary, while the secondary is connected between the grid and filament of the oscillator tubes. See Fig. 4.

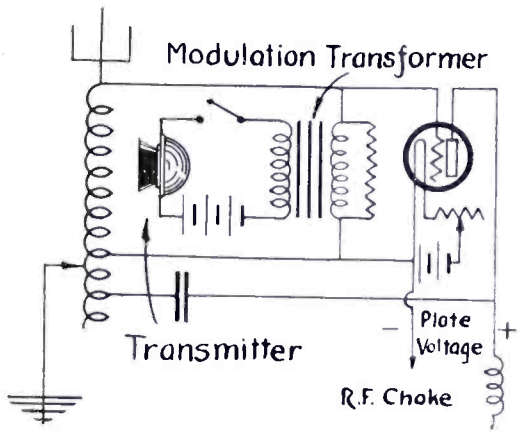

Fig. 4. Grid Modulation

As can be seen, a high alternating voltage, corresponding to the original sound waves, is created at the secondary terminals. This changes the grid potential and the change of grid potential changes the plate current. This change of plate current affects the amplitude and frequency of the antenna current, and modulation is obtained.

This method is perhaps the most efficient yet described. A small amount of grid energy can control a large amount of plate energy. Practically all modulation losses are at the expense of the 6-volt battery. Over-modulation may result. This is evidenced by raspy or broken speech. The trouble may be remedied by cutting down the microphone current, or placing a high resistance across the secondary of the modulation transformer. The writer recommends this method for those who do not care to use the better and more elaborate method to be described below.

We shall conclue with a description of the Heising, or constant current system of modulation. Without doubt this is one of the finest systems in use today. It is employed in one form or another by most all broadcasting stations.

For the simplest set, one oscillator and one modulator is used. If two oscillators are used, two modulators should be used, and so on. It will be noted, in Fig. 5, that the secondary of the modulation transformer controls the grid of the modulator tube, as in the grid modulation system. Here, however, a so-called bias or *C* battery is used. This controls the modulator grid potential and hence the plate current, preventing overheating and to some extent controlling the quality of the modulation.

It will also be noted that a plate reactor (several hundred turns of wire on an iron core) is in the plate lead. Often, if a large filter bank is used, the filter coils will serve and the plate reactor may be omitted. But unless it is too troublesome to procure a plate reactor it is best to have it in the circuit. The plates are connected together through a radio-frequency choke coil as shown. It consists of about 100 turns of wire on a 2 to 3-in. tube. It prevents radio-frequency from entering the modulator tube and becoming dissipated in its circuit.

Now, without going into too much detail, we see that if the plate current of the modulator increases, due to the action of the plate reactor, the plate current of the oscillator decreases. If the modulator plate current decreases the induced reactor voltage is reversed and the oscillator receives a higher voltage, which increases its plate current. The oscillator plate voltage then swings between limits determined by the modulator plate current, and the voltage induced in the reactor. At the plate potential source the current is practically constant. This system when properly adjusted can utilize and modulate the entire output of the oscillator. Modulation is controlled mainly by adjusting the filament rheostat of the modulator tube. If the plate of the modulator heats too much, more *C* battery must be added. Be sure to have the negative of the *C* battery on the grid side.

The writer uses this system on his present set. The modulation is perfect, breathing and whispering even, can be distinctly heard at stations several miles distant.

The sensitivity of pick-up of the transmitter can be increased by speech amplifier. In most cases this is not recommended because echoes and outside noises may become objectionable. Fig. 6 shows the connections of a speech amplifier.

Don't criticize the tonal qualities of the material sent out from broadcasting stations, until you are absolutely sure that your own receiver and reproducer is free from distortion. (Not many of them are!)

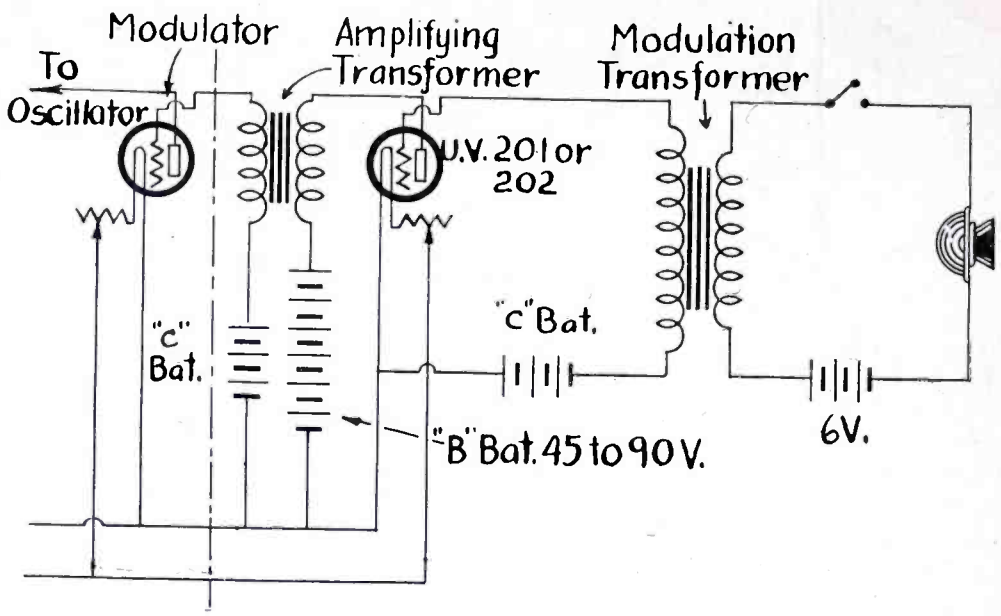

Fig. 6. Speech Amplifier

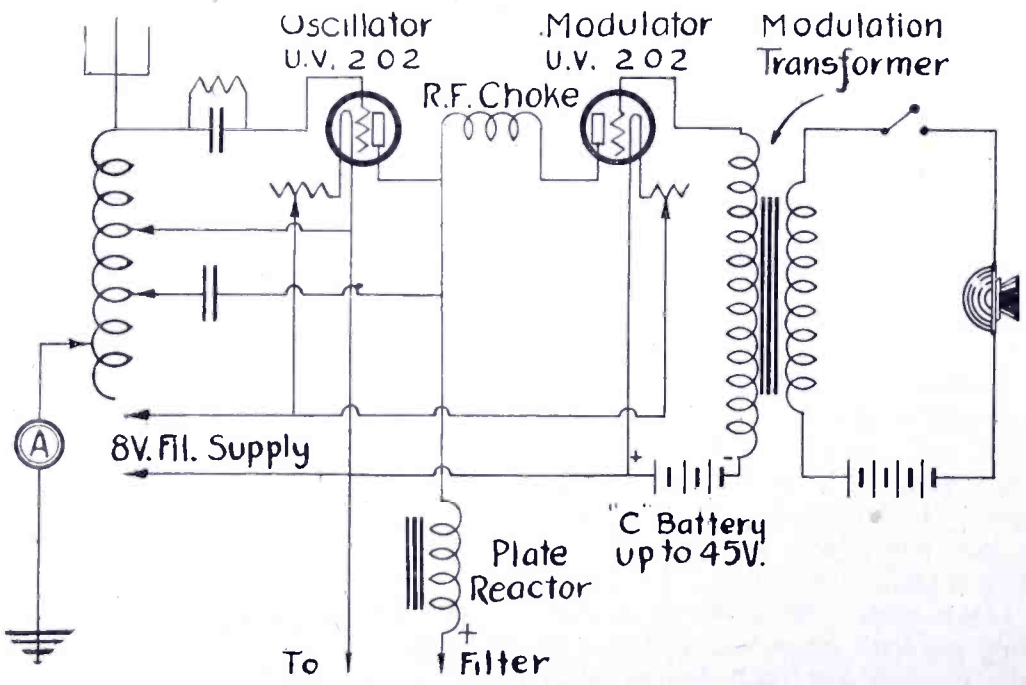

Fig. 5. Heising or Constant Current Modulation

Tone Transmission for Amateurs

By M. Wolf

This article is intended for the guidance of the amateur contemplating the construction of his first transmitting set. It discusses the construction of an I. C. W. transmitter using 60-cycle alternating current for plate and filament supply.

THE amateur who goes in for transmission may choose either telegraphy or telephony or both. Telegraphy is usually chosen first because telephony involves problems which are more easily solved after the ins and outs of telegraphy are mastered. In telegraphy the amateur may use a spark transmitter of the quenched gap type, straight C. W., C. W. broken up by a chopper, or buzzer-modulated C. W.

As spark gaps interfere with broadcast reception, and as C. W. has been demonstrated to be much superior in every way, spark should not be considered by the amateur. Straight C. W. necessitates reception by the heterodyne method and presupposes that all receiving amateurs have heterodyne receivers. This, of course, is not so. At the start it would therefore be advisable to avoid this method. Another reason is that straight C. W. implies the use of direct current voltages on the plates of the transmitting tubes, and obtaining these high d.c. voltages is not easy. A motor-generator is quite expensive, and rectifying systems cost considerable, too, besides being quite a difficult problem for the new transmitting amateur. Buzzer modulation of C. W. also implies the use of direct current voltages, and at the same time introduces the difficult problems involved in radio telephony. All of these methods of sending are very good, but should be tried after the amateur has had some experience in transmitting.

There is one method of tone transmission which is simple, does not involve difficult problems and does not necessitate using d.c. voltages on the plates of the vacuum tubes—it is therefore quite inexpensive. This method is the use of alternating current voltages for the plate circuit of vacuum tubes.

Suppose we have a vacuum tube oscillator circuit as shown in Fig. 1, and suppose an alternating voltage, Fig. 2, is applied to the plate of the tube. The

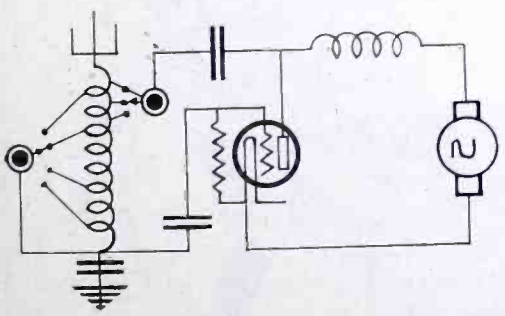

Fig. 1. Vacuum Tube Oscillator Circuit

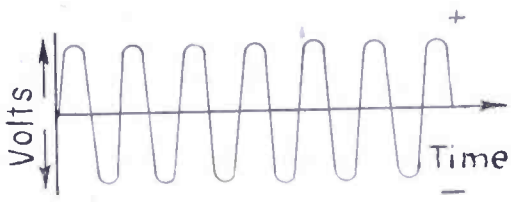

Fig. 2. A. C. Potential Wave

plate will therefore be alternatively at a positive and negative potential every other half cycle of the alternating voltage. During the positive half cycle the plate of the oscillator tube is positive and will therefore draw electron current. Hence the tube will oscillate during this period. During the negative half the plate of the oscillator tube is negative and will repel the electrons emitted by the filament. Hence no plate current flows and the tube will not oscillate. Thus the tube will generate a train of waves every other half cycle as shown by Fig. 3. This application of a.c. plate

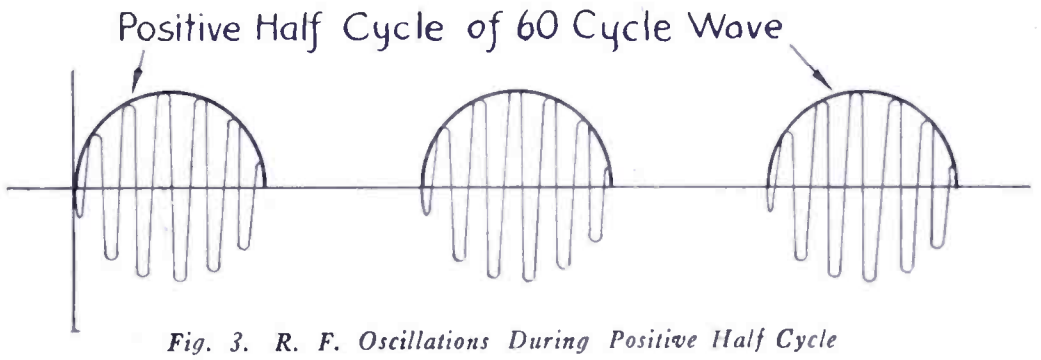

Fig. 3. R. F. Oscillations During Positive Half Cycle

voltage to the plate of vacuum tubes is thus seen to be similar in action to the insertion of a chopper in the plate or radio frequency circuit. The chopper breaks up the r. f. oscillations by a series of makes and breaks, resulting in a series of wave trains. The a.c. plate voltage does the same thing. Hence a note will be heard in the ordinary receiver, the pitch depending upon the number of wave trains per second. In the case of a chopper the pitch depends upon the rate at which the chopper makes and breaks. If it makes and breaks 60 times a second a 60-cycle note will be heard in the receiver; if 500 times a second, a 500-cycle note will be heard. The frequency of the applied a.c. voltage corresponds to the making and breaking frequency. Hence if a 60-cycle current is applied to the plate a 60-cycle note will be transmitted, and if 500 cycles is applied a 500-cycle note will be transmitted.

Thus by the simple application of available a.c. to the plates of tubes tone transmission is easily effected. Signals are sent by the usual methods of keying, by placing the key in the primary circuit of the step-up transformer, or by placing it in the grid circuit, or by any of the other methods commonly employed in telegraphy. Such a system of tone transmission is practically as effective as the application of d.c. to the plates of tubes, and has almost the same carrying power. Straight d.c. generally requires less power, but the advantage of utilizing available power without the cost of rectifiers or motor generators overcomes this. The use of a.c. involves another advantage, namely the same a.c. may be efficiently used to supply power for the filaments, by the simple expedient of another low voltage winding on the step-up plate transformer. The transformers required are a step-up transformer for supplying the necessary high voltage for the plates, and a step-down transformer for supplying low voltage to the filaments. One combination transformer having a common winding as primary, and one high ratio, and one low ratio winding as plate and filament sources, may be purchased at reasonable cost.

Not only may such a simple system be used for tone transmission and thus enable the amateur to reach every type of radio receiver, including non-regenerative, but it may also be used for heterodyne reception. The best receiver is adjusted to heterodyne the incoming signal, and generally the beat note is a high-pitched musical note, 1000 cycles or more. This is so much higher than the 60-cycle modulation that it is very easily picked out above the 60-cycle note. In fact the ear is very much more sensitive to 1000 cycles than to 60 cycles, and hence the 60-cycle note may easily be ignored with no interference.

There are two principal methods whereby this system of transmission may be utilized: (1) by using only one-half of each a.c. wave, and (2) by using both

halves of the a.c. wave. The amateur can readily see that if he uses both halves of the a.c. wave he can double his power output and thus increase considerably his sending range. The first method of using only one-half the a.c. wave is shown in detail in Fig. 4. It will be seen that only one tube is employed. The transformer T has a primary winding P which is connected to the 110-volt source of a.c. power supply. This voltage is then stepped up in the high-tension secondary winding of the transformer S_1, and is simultaneously stepped down to a low voltage by the low-tension secondary winding S_2. S_1 supplies the necessary plate voltage to the tube while S_2 lights the filament. Such a transformer is a good 60-cycle transformer and, of course, may be home made. It is best, however, to buy this ready-made, as the satisfaction derived from good performance pays in the long run. One of the best made transformers is that put out by the Radio Corporation of America. The Acme Co. also turns out a good transformer. Inasmuch as the only one tube is employed, only one-half of the a.c. wave is utilized, since the tube cannot pass plate current on the negative half of the cycle. The filament lighting winding should have a center tap to equalize the flow of plate current through the filament, and thus prolong tube life. In the circuit shown in Fig. 4 R is a radio-frequency choke coil to prevent the r. f. from backing up into the high-tension transformer, and should be about 3 milli-henrys. C_p is a plate blocking condenser which prevents the plate high tension from shorting through the antenna inductance L. Its capacity should be about .002 mfds.

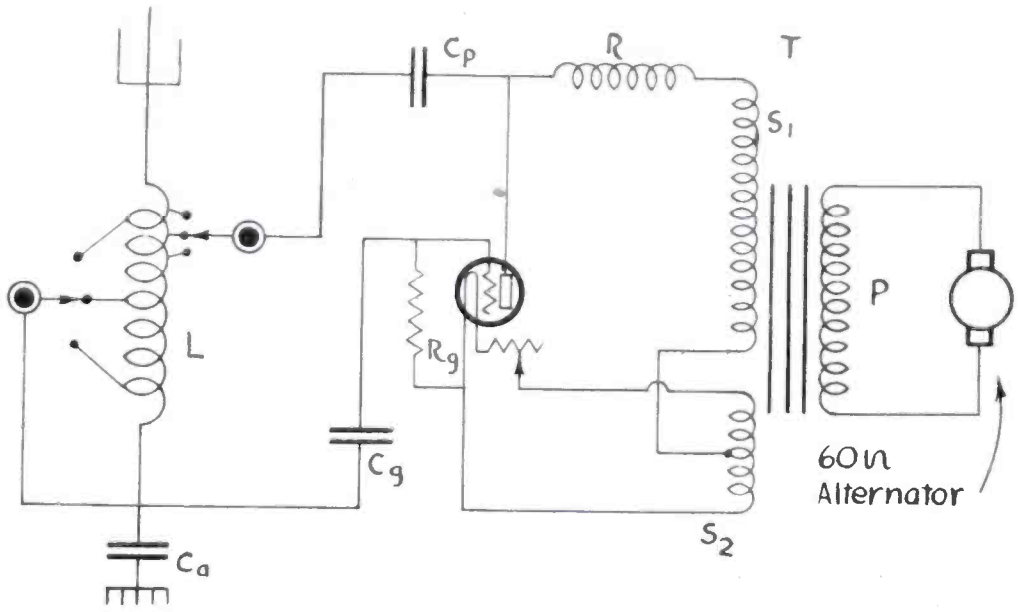

Fig 4. Circuit Diagram Using One-Half the Wave

In Fig. 5 is represented the circuit for utilizing both halves of the wave. It will be observed that two tubes are employed and that the high tension transformer winding has two halves with a center tap. Half of the winding supplies plate voltage to one tube, and half supplies plate voltage to the other tube. Otherwise the constants and connections are the same as in Fig. 4. During the positive half of the wave one end of the high-tension winding is positive while the other end is negative. The tube to which the positive end of S_1 is connected will therefore pass plate current and will oscillate, while the other tube is idle since its plate is negative. When the a.c. reverses and the other half comes into play, the potentials at both ends of the transformer winding S_1 also reverse. The end that was negative is now positive and vice versa. Hence the tube that was previously idle is now active and passes plate current and therefore oscillates, while the other tube is idle now since its plate is negative. Thus both halves of the a.c. wave are utilized, each tube operating on one-half cycle of the wave. In this way greater output is secured and longer distances may be covered. Such double winding transformers are likewise obtainable from the firms above mentioned.

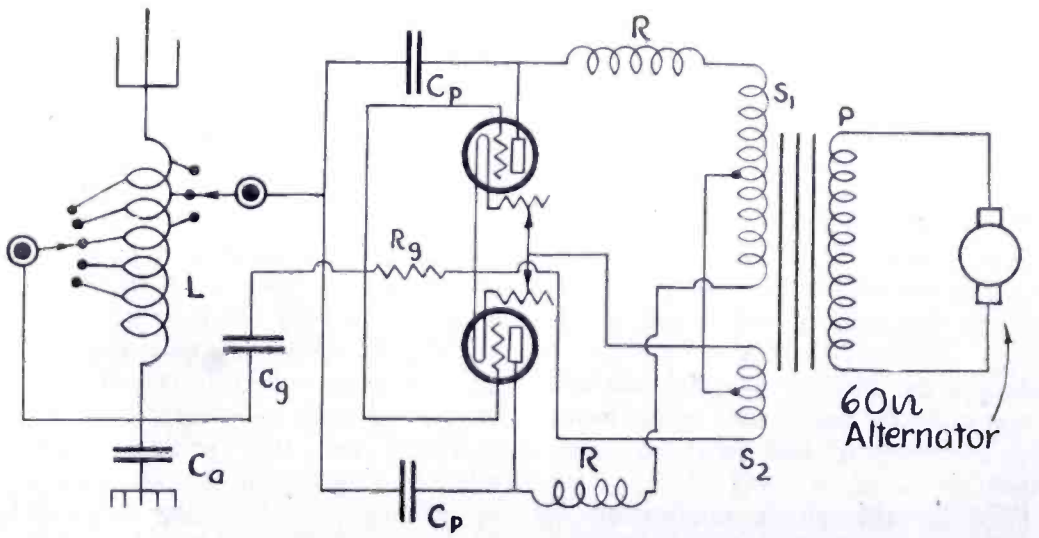

Fig. 5. Circuit Diagram Using Both Halves of the Wave

It is seen that the equipment required is practically the minimum for a transmitting set and the advantage is secured of utilizing directly available power. Such a system will give the same over-all results as the rectification and filtering of a.c. for plate supply, or the conversion of a.c. into d.c. by a motor generator, and this at considerably less cost.

HANDY HINTS

When using dry-cell tubes, remember that they will give about four times the useful service if you connect two sets in parallel, instead of in straight series.

Often a good amplifier tube makes a poor detector, and sometimes it will hardly work this way. Ever compare your present detector tube with one that is known to be pretty good?

If you don't know the code, you are missing at least 75% of the possible enjoyment you might have from your receiving set.

When making storage B batteries, you can make the whole thing up from negative plates, and then by a number of "forming" charges half these plates can be changed from spongy lead to lead peroxide. You will get good service from such plates.

If the bearings of a motor-generator start to heat badly, don't stop the machine, as they will freeze tight; pour oil, or even water on it, until it cools down, and then shut down.

A Motor Buzzer Transmitter

By F. L. Ulrich

If the amateur feels that he must use a spark transmitter the type herein described will give better efficiency and cause less interference for the same power than the ordinary spark gap.

A MOTOR buzzer set of the type described has been in use for some time at Station 2BDF and wonderful dx records have been accomplished using but very low power. It is intended as a low power transmitter for use on distances up to 75 miles. Instances are on record in which this set has transmitted satisfactorily up to 500 miles, but such performance is exceptional. The need of this set is brought about by the fact that when the present spark transmitters are operated on lowest power there is still sufficient energy radiated to cause considerable interference at short distances. The maximum radiation of the motor buzzer set is from 2½ to 3 amps and when lowest power is used but a few milliamps. It is believed that the motor-driven interrupter of the motor buzzer set insures constancy of note and reliability to a degree surpassing that found in transmitters of the vibrator type.

The fundamental theory may be stated briefly with reference to the accompanying diagrams. Fig. 1 represents

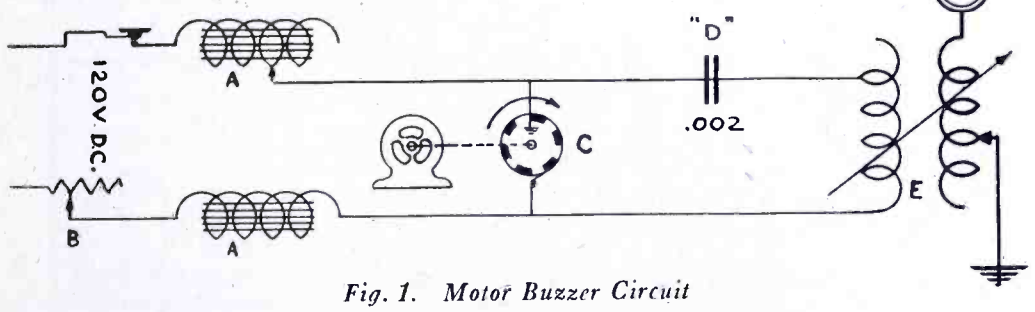

Fig. 1. Motor Buzzer Circuit

the motor buzzer circuit, not including the power supply for the motor. The 120 volts supply to the motor buzzer is lead to the buzzer wheel *C* through an iron core inductance *A* in each side of the line, and a resistance *B* assuming that the buzzer wheel is rotating as shown in Fig. 2. When the peripheral brush is resting on the metal wheel and in the

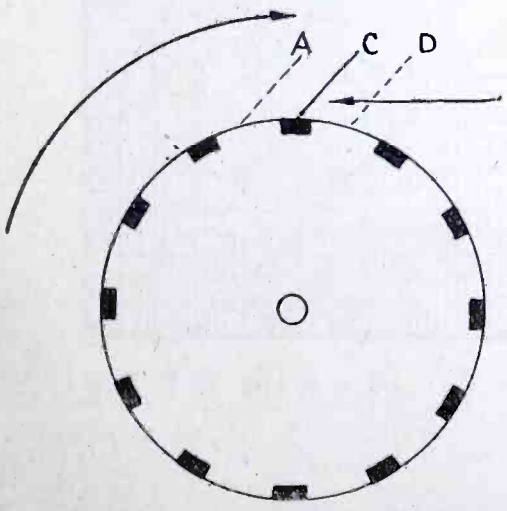

Fig. 2. Buzzer Wheel Action

position *A*, the d.c. circuit is completed throughout the inductances, resistance and the buzzer wheel, *C*. During the time the d.c. circuit is closed a field is built up around the iron core inductances and an instant later when the wheel rotates so that the brush is in position *B* relative to insulating segment, the d.c. circuit is broken and a high potential is generated at the brush terminals due to the collapse of field. When this potential is directly across the condenser *D* and the coupling inductance *E* the condenser becomes charged from the field, being transferred to the condenser.

As the wheel revolves further the brush approaches the metal segment of the wheel, and, when a position *C* has been reached, the distance between brush and conducting segment of the wheel has become so small that the potential of condenser *D* is sufficient to discharge across the intervening space. When this spark passes, oscillations are set up in the circuit. The energy from this circuit is transmitted to the antenna circuit by the oscillation transformer *E* and thence radiated. When the brush again comes in contact with the conducting segment of wheel as at position *D* the d.c. circuit is again completed and the cycle is repeated.

It should be noted that the buzzer wheel is a combined interrupter and spark gap. No spark occurs when the brush leaves the conducting segments. This can readily be verified by noting that while the buzzer is in operation the spark is mostly under the brush. Inspection of the buzzer wheel after operation will also show slight discolorations at the leading tip of conducting segments.

The resistance *B* is variable, and is used to vary the radiation of the motor buzzer. When all resistance is in the circuit the radiation is extremely low. With all resistance out the radiation should be about 3 amps. The speed of the buzzer wheel may be varied by an adjustable field rheostat, through a range from 2000 to 3000 r p m corresponding in a variation in spark frequency of from 333 to 500 sparks a second. This gives it a fairly good note of about 250 cycles.

The inductances *A* are also adjustable. The best adjustment for various wavelengths, powers, and wheel speed, may be found by trial. The value of inductance used is most largely a function of buzzer wheel speed and power. The condenser *D* will receive maximum charge if the d.c. circuit through the buzzer wheel is broken long enough to permit the condenser-charging current to fall to zero.

The impedance or inductance unit consists of two coils, one in each side of the d.c. supply to the buzzer wheel, wound on a common open core. Taps are taken off each coil to a dial switch on top, a separate switch being provided for each coil. The total inductance of each side of the impedance unit is about 3 henries.

The buzzer wheel is constructed from a brass wheel ½ in. in width, and 5 in. in diameter. A hole is drilled in the center to fit the motor shaft and a collar having a fastening screw in it is provided to secure the wheel to the shaft. Twelve ¼-in. square grooves are cut in the edge of the wheel as shown in Fig. 3 and

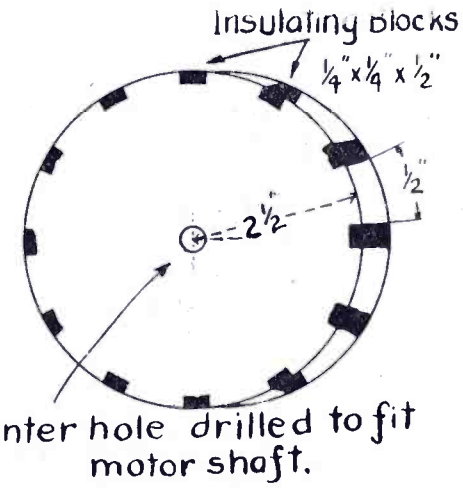

Fig. 3. Wheel Construction

twelve pieces of fiber are then cut to fit these grooves, thereby insulating the brush from the rest of the wheel when the brush passes over these insulated parts to make and break the d.c. circuit. Any key having fairly heavy contacts can be used to break the circuit and any ordinary spark oscillation transformer can be used for *E*. The condenser *D* should have a capacity of .002 mfd.

The buzzer wheel is driven by a ¼-hp shunt wound equipped with thrust

bearings so that all end play is eliminated. This motor requires 50 watts under load imposed by brushes. The resistance *B* may be a two-point series starting box. A piece of copper braid should be used for the brush of the motor buzzer wheel.

In operation, the motor buzzer spark should be crisp and cleancut, occurring mostly under the brushes between the peripheral and the leading top of metal segments. At low powers the spark is quite small and makes no audible noise. At full power heavy sparking occurs. This is not to be considered as undesirable, since the more powerful the spark the greater range obtained. The peripheral brush will wear away comparatively fast at full power and will require renewal of the sparking end either by cutting off and trimming the old brush or by replacing with a new one. Always use as much resistance in the circuit as possible, consistent with the range required. This will not only reduce interference, which is the chief object of the motor buzzer transmitter, but will preserve the conditions of the brushes and the wheel.

The wheel should be kept bright and clean by the use of metal polish only. Abrasives such as sandpaper or emery-cloth should not be used, since they will cause a deposit on the insulating segments and reduce their effectiveness.

Under certain conditions it will be found that the spark becomes long, taking place between the brush and the trailing tips of metal segments when practically no radiation will be obtained. This is caused by using either too much power or by an improper adjustment of the impedance. If while transmitting it is noticed that radiation falls appreciably the impedance and the power should be adjusted. The leading tips of the metal segments will in time become pitted. If this becomes bad enough to interfere with satisfactory operation a light cut should be taken off the wheel periphery. This cut should be carefully made, in order that the wheel remain perfectly true. The wheel may be so dressed as often as necessary until the depths of the insulation segments reaches approximately 3/16ths in., when the wheel should be replaced.

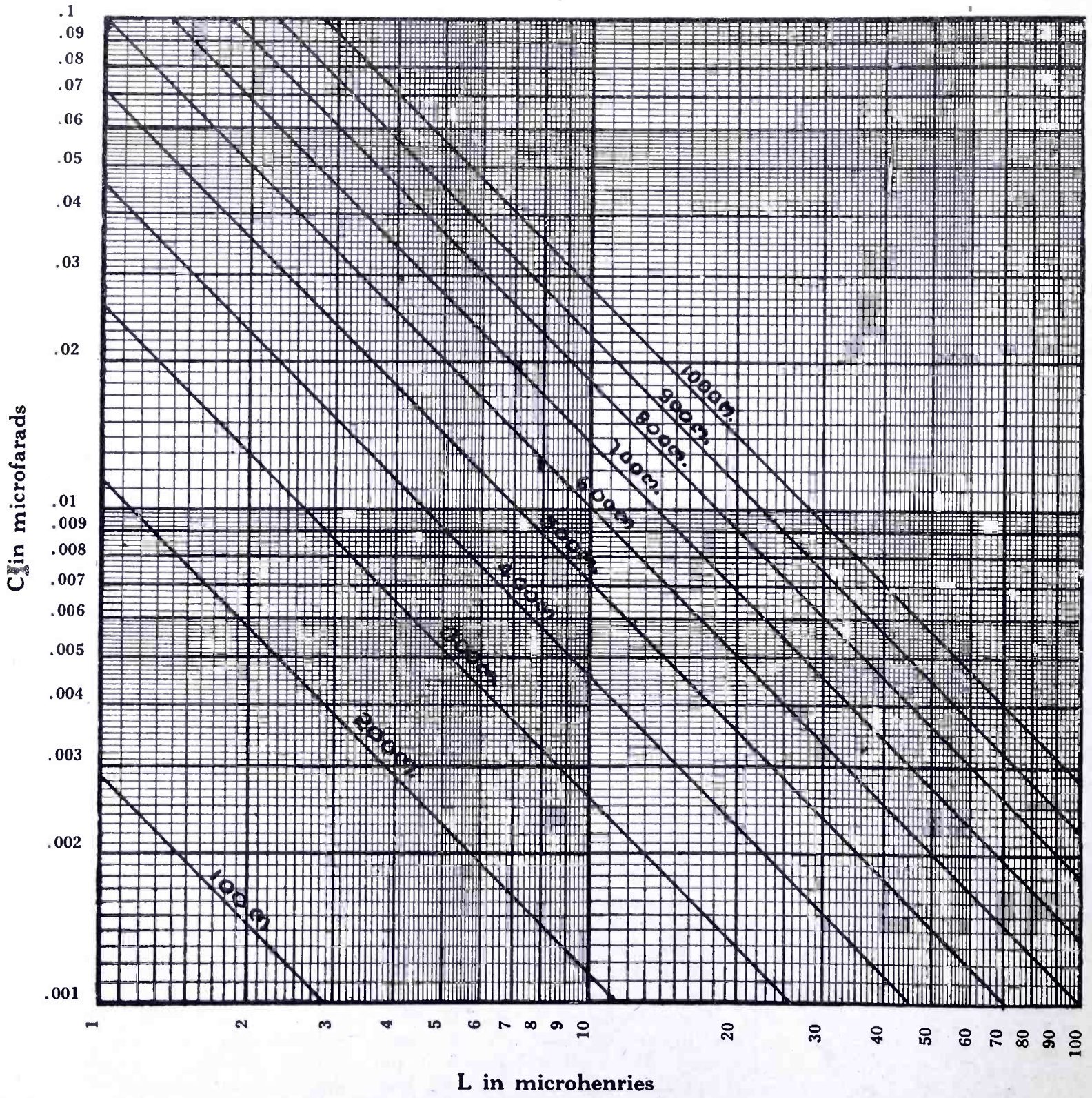

Fig. 2. Chart for Graphic Determination of Inductance, Capacity and Wavelength Relations

Capacity, Inductance, and Wavelength Chart

By Maurice Buchbinder

This chart and accompanying explanation gives a graphic determination of the inductance and capacity values corresponding to circuit resonance for any given wavelength. It will be found useful by the experimenter in the calculation of many radio circuits.

IN designing a radio circuit of any kind, such as a simple antenna or secondary circuit or a frequency trap, we ordinarily start with a knowledge of the wavelength, or range of wavelengths for which the circuit is required. Then, if we should fix the capacity at a definite amount, there remains to be found the inductance which will tune to the known wavelength. Or we might start with a fixed inductance and want to know the capacity which will tune to the known wavelength.

As is well known, the three quantities: capacity, inductance and wavelength are related by the equation

$$\lambda = 2 \pi v \sqrt{L C} \qquad (1)$$

where λ is the wavelenth measured in meters, v the velocity of light (3×10^8m. per sec.) L is inductance in henries and C capacity in farads. Henries and farads, however, are extremely large units to use for radio purposes (thus the capacity of the entire earth as a condenser is in the order of several farads). Consequently we use mircrohenries and microfarads and our equation reduces to

$$\lambda = 1885 \sqrt{L C} \qquad (2)$$

From this law, if two of the terms are known, the third is determinable. The calculation, however, involving as it does large numbers, squares and roots, is not easy to perform, and it is obvious that some chart which will tell at a glance these relations through a wide range would be useful to the designer and experimenter in radio work. It is possible to plot inductance and capacity for any one wavelength. Along an axis of L we have inductance laid out in units from 0 to 1000 microhenries. Perpendicular to it is the axis of C where capacity is laid out in units of 0 to 0.010 microfarads. For any one wavelength then we get a curve (Fig. 1) which is known to mathematicians as the equilateral hyperbola of the general form $x/y = k$. At other wavelengths we can plot other similar curves and in this manner, by a family of curves, we have before us a graphic picture of just how any value of L requires a certain C at a given λ, and vice versa.

As these curves are somewhat difficult to draw, it is much easier to plot the values on logarithmic cross section paper which converts the curves into a series of straight lines. This paper may be purchased from a dealer in drawing supplies, or may be laid off from a slide rule. By merely calculating several values of L and C from equation (2) corresponding to each wavelength and

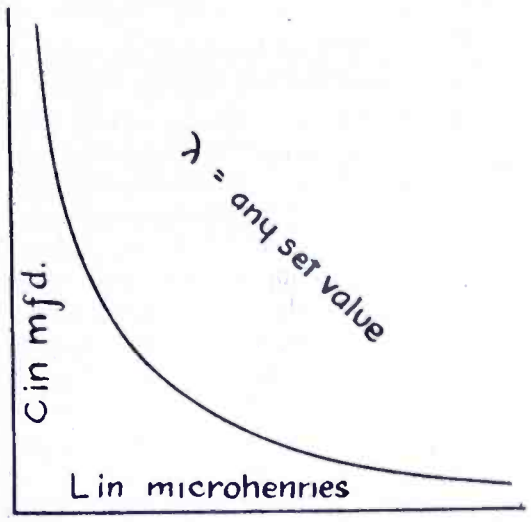

Fig. 1. Relation Between Induction and Capacity

connecting the plotted points we have the chart shown in Fig. 2.

To use the chart to find the inductance corresponding to a given capacity, which makes the circuit resonant for a given wavelength, merely find the intersection of the horizontal capacity line with the oblique wavelength line and follow down the vertical line (mentally or with a ruler) to the lower scale showing the inductance value. The procedure is reversed to find the capacity corresponding to a given inductance.

Though the scale is drawn to show the constants corresponding to a wavelength range of 100 to 1000 meters the range may be extended from 1000 to 10,000 meters by multiplying the corresponding inductance and capacity values by 10. Furthermore, if the capacity scale is multiplied by 10, and the inductance scale is divided by 10, or vice versa, the wavelength value is unaffected.

Intermediate values for any wavelength not shown may be interpolated on the chart by merely drawing a straight line connecting the corresponding values on the inductance and capacity scales. Thus, it will noted, eliminating decimals, that the 100 meter oblique line cuts the two scales at 281, the 200 meter line at 1124 (or 4x281), the 300 meter line at 2530 (or 9x281), the 400 meter line at 4500 (or 16x281) and so on, the 4, 9 or 16 being the square of 2, 3 or 4. Thus the 360 meter line would cut either scale at 3642 (3.6^2x281=12.96x281=3642).

RADIO POWER FROM LIGHTING CIRCUIT

By S. R. WINTERS

Patents have been issued to P. D. Lowell and F. W. Dunmore of Washington, D. C., embracing the invention of a radio receiver which derives its energy for the plate and filament circuits from 110-volt alternating current lighting power. The decision of the Radio Corporation of America to place on the market radio receiving apparatus which dispenses with the use of batteries gives definite cast to the possibilities of this type of receiving instrument. This writer learns from an authentic source that this corporation will offer a set which can be attached to a common electric-light socket in the home. The vacuum tubes employed in this new receiver will be type UV-201A.

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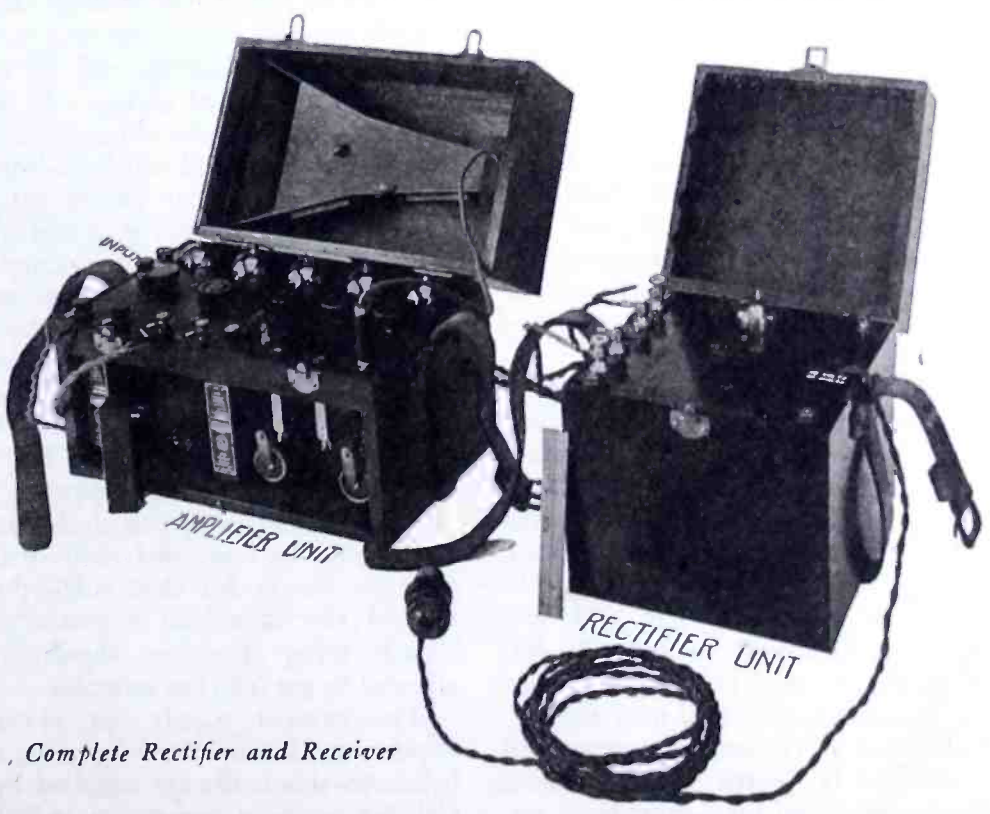


Complete Rectifier and Receiver

Nickel Plating

By D. B. McGown

Complete directions are here given for the nickel plating of brass, copper, iron and steel. Many an amateur constructor of radio parts can advantageously perform these operations at home.

THE most durable finish for small metal parts used in radio apparatus is nickel plating. Nickel is hard and tough, it takes and holds the highest polish, and is almost immune from ordinary corrosion. Even if tarnished it can be easily rubbed to its original luster.

The only satisfactory method of applying nickel is to deposit it on the surface of the base metal by an electrolytic process. This process consists of immersing the object to be plated in a solution of nickel salts, and passing a current from nickel electrodes, through the solution to the object.

The objects to be nickel-plated must be carefully buffed to as high a polish as the finished nickel-plated object must possess. This is due to the fact that the nickel, when covering the base metal, deposits in an absolutely even coating all over the surface, and does not fill up, or cover over any scratches or other imperfections in the surface of the metal. Brass, copper, or other soft metals are the most common to use for radio parts, and these can be best polished on a rag buffer, using rouge or tripoli, starting with a coarse grade and finishing with a finer one. Steel and iron must be actually ground to polish by the use of canvas or leather wheels, with fine emery glued to the wheel edges. It is almost imperative that an intermediate coating of copper be given the steel or iron, as nickel does not adhere well.

After polishing, the work must be very carefully cleaned in gasoline, which may be dried off by a blast of warm air or by burying in sawdust. Then it must be further cleaned by either immersing the work in a bath of boiling lye or by carefully rubbing the whole surface with slacked lime, using a soft swab. If the lye bath is used, the work should be dipped and quickly removed, and held in running water, until all traces of the lye have been removed. If the lime wash is used, the results will be slower but more easily handled.

The lime wash can be prepared by adding water to unslacked lime, forming a white soft mass which should be left to react and cool for 24 hours. Plenty of water can be added and excess poured off after the slacking is accomplished, leaving the slacked lime which should be poured into a shallow pan. A soft "swab" or a stick well covered with soft cloth should be used to apply the lime, which should be rubbed all over the surface and into every crack and cranny of the metal to be plated. The rubbing should be continued for a short time, until all the surface has been covered and the lime well rubbed into it. Then the object should be washed in cold water, to remove all traces of the lime. The work should be carefully examined at this time to see that the water adheres to the entire surface and does not collect in drops. If this happens, more lime should be rubbed onto the surface until all such tendency is eliminated and the whole surface is wetted thoroughly. No lime should remain on the metal, as it will ruin the plating bath. If the lime is pure, and has been prepared properly, it will be soft, and will not scratch the surface of the metal, even though rubbed vigorously with the swab, although at first sight this might seem that it would scratch considerably.

The work should be fastened to small copper wire before washing and stripping. This wire may be of any convenient size, but generally from No. 20 to No. 24 soft drawn bare wire is the most suitable.

The plating bath consists of a solution of what is known as "double nickel sulphate," or chemically, as "nickel-ammonium-sulphate," with the addition of an acid to give an excess of free acid to the bath. This salt is a brilliant green crystal, which can be obtained in the commercially pure grade from supply houses. From 12 to 14 oz. of the crystals per gallon of distilled water should be prepared. This should be mixed in a stone or glass jar, more distilled water being added until a hydrometer reads from 6.5 to 7.0 degrees Baumé. To this, a small amount of benzoic acid, or boric acid, should be added, not to exceed about 0.125 oz. per gallon. If neither of these acids can be obtained, a slight amount of citric acid can be substituted. This will result in an almost saturated solution, with a slightly acid reaction.

The nickel to be deposited comes from the "nickel anodes." These are sold by the pound, and unless a great deal of work is being done, will last almost indefinitely. They should be as large as possible, in order to expose as much surface to the solution as can be. The anodes are hung into the solution, from the anode terminal of the plating source, and should be immersed entirely in the solution, except for that portion which is used for suspension purposes, which usually being of copper, should not be allowed to get into the solution.

The current supply for plating is important. In commercial plating establishments this is always supplied by special low voltage generators, which deliver large currents. In the amateur's shop very good results can be obtained by using a 6 volt storage battery, especially where only small objects are to be plated, or where plating is done but seldom. The current should run somewhere in the neighborhood of 0.05 to 0.10 ampere per square inch of surface on the cathode, which is the object to be plated. Less current will do no harm, while too much is undesirable. If the object to be plated takes on a white color and covers with nickel inside of ten to fifteen seconds after it has been introduced into the bath, the current can be assumed to be about right. If there is any tendency to turn black, or streaked, this is a sign too much current is being applied, and this can best be reduced by a series rheostat of large current capacity. The plating process should be continued for from ten to twenty minutes, as a rule, depending on the size and shape of the object, and on the thickness of the coating desired. This is a matter of experiment, and after a few trials, should be easy to determine. The nickel coating should be thick enough to stand light buffing and ordinary handling.

When the work is removed from the nickel tank, it should be washed in running water and dried in sawdust or a warm blast of air. It should then be buffed with the very finest grade of tripoli, the buffer running at a high speed. But little buffing is needed. Great care is needed in this final buffing to avoid cutting through the nickel, especially if the work has sharp corners. After this final buffing, the work is rubbed off with a soft cloth to remove all of the buffing compound, and then it is ready for use.

The plating tank should be watertight and large enough to accommodate any work that will be plated, under the surface of the solution. Such tanks usually are made of wood, in the larger sizes, carefully mortised, and the joints well calked with pitch or tar. The inside of the tank is then given a complete coat of tar or asphalt paint, and allowed to dry thoroughly before the solution is put in it. For small work a glass battery jar is very good, or a one or two-gallon earthenware "crock" will also answer. The anodes should be at least two in number, and should be suspended at the sides of the tank and yet not allowed to touch them. They most commonly are hung on opposite sides on brass or copper rods run across the tank. Be-

Continued on page 65

QUERIES & REPLIES ON C.W. PRACTICE

BY

Gerald M. Best

TECHNICAL ADVISOR

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

Please publish a diagram of the latest receiver using two steps of audio and two steps of radio frequency amplification. I have an antenna 200 ft. long, 50 ft. high and with a 30-ft. lead-in, single-wire type. How could I better it? Does the length of the antenna have any effect on the tuning?—T. Y., Albany, Ore.

A good combination circuit containing two stages of transformer-coupled radio-frequency amplification, with detector and two stages of audio-frequency amplification is shown in Fig. 1. If you are near a large broadcasting station that is giving you interference, the antenna coupling coil should have a very small number of turns, a variocoupler rotor unwound to 6 turns generally being sufficient coupling. Your antenna will be all right for broadcast wavelengths, but rather long for 200 meters or under, in case you are interested in receiving amateur signals. The length of the antenna certainly affects the tuning, and a change in length will often necessitate a change in the values of the antenna condenser and inductance. I would not advise increasing the length of your antenna, and with the circuit you propose to use, a single wire antenna is all that you could possibly desire. The addition of other wires to the antenna will not materially increase the strength of received signals.

Please discuss the advantages and disadvantages of the Super-Heterodyne circuit with regard to the elimination of interference — particularly commercial code on 600 meters, range and quality of received signals.—V. C., Youngstown, Ohio.

A properly constructed super-heterodyne is practically the most selective receiver known at this time. Due to the fact that the amplifiers associated with the circuit will pass only a narrow band of frequencies, interference from nearby broadcasting stations can be entirely eliminated, and interference from ship spark stations reduced to a minimum. A super-heterodyne when connected to a loop can be expected to cut out practically all 600-meter interference, but when connected to an antenna some interference is bound to result if the spark station is within a few miles, and the receiver is adjusted to wavelengths from 500 to 550 meters. The range of a super-heterodyne receiver depends upon the number of intermediate frequency stages used, the degree of excellence of the material with which the amplifiers are constructed, and the skill of the operator. Under normal conditions, such a set should give considerably greater distance reception than any of the commercial types of receivers. The quality of the received signals should be perfect unless the intermediate frequency amplifiers are overloaded to such an extent that distortion is introduced, or if the amplifiers have a tendency to sing.

Is it possible to use the Cockaday four-circuit tuner in connection with a neutrodyne type of amplifier? If so, please publish a circuit.—J. S., Toledo, Ohio.

The regenerative feature of the Cockaday circuit would have to be omitted. However, the idea of using the so-called "stabilizer" circuit is a good one, and Fig. 2 shows this circuit adapted to a two-stage neutrodyne amplifier and detector.

Please give me a diagram of a good receiving set for broadcast reception.
—P. B., Winnemucca, Nevada.

The circuit shown in Fig. 1 should answer your purpose very well. The circuit indicates the correct values for dry cell tubes, but you may use the larger-sized tubes by increasing the filament battery to six volts.

Please publish a circuit diagram of the Grebe CR-8 receiver.—J. B. F., Philadelphia, Pa.

The circuit appeared in January RADIO, page 36, Fig. 4.

Referring to the article "Again that one-tube receiver" by C. S. Mundt, in December RADIO, what is the proper plate voltage for a C-299 tube in this set? The panel layout shown in Fig. 2 of this article shows two binding posts marked "f-f", and a phone jack. What are the posts for?—J. C. V., Pittsburgh, Pa.

The C-299 tube should employ a plate voltage of approximately 25 volts when used as

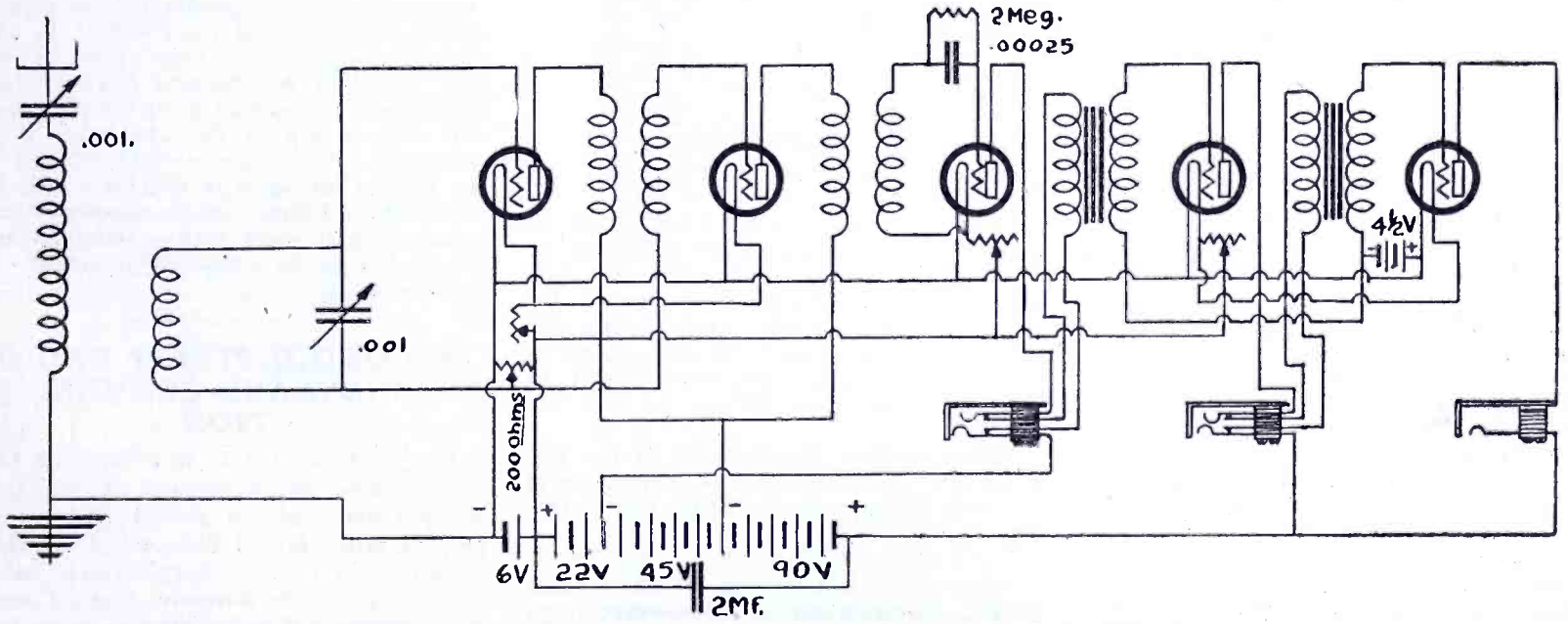


Fig. 1. Two Stages R. F., Detector and Two Stages A. F. Amplification

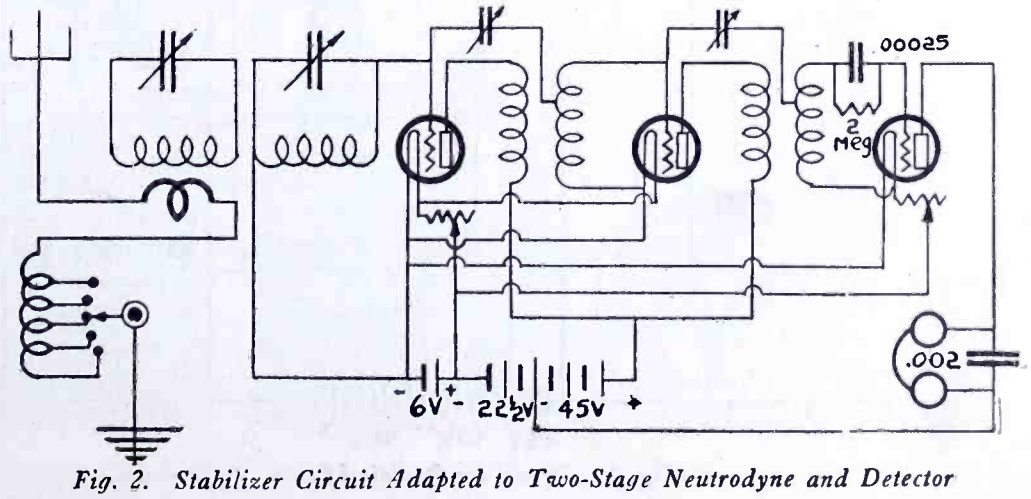


Fig. 2. Stabilizer Circuit Adapted to Two-Stage Neutrodyne and Detector

a detector. A standard 22½-volt *B* battery will serve very well for this purpose. The two binding posts shown are for the phones in case they are not equipped with a plug for the jack, and are multiplied with the jack on the back of the panel.

Please publish a circuit diagram of a detector circuit for use with the new Sodion vacuum tube.—H. J. E., Akron, Ohio.

The circuit for the Sodion tube is shown in Fig. 3.

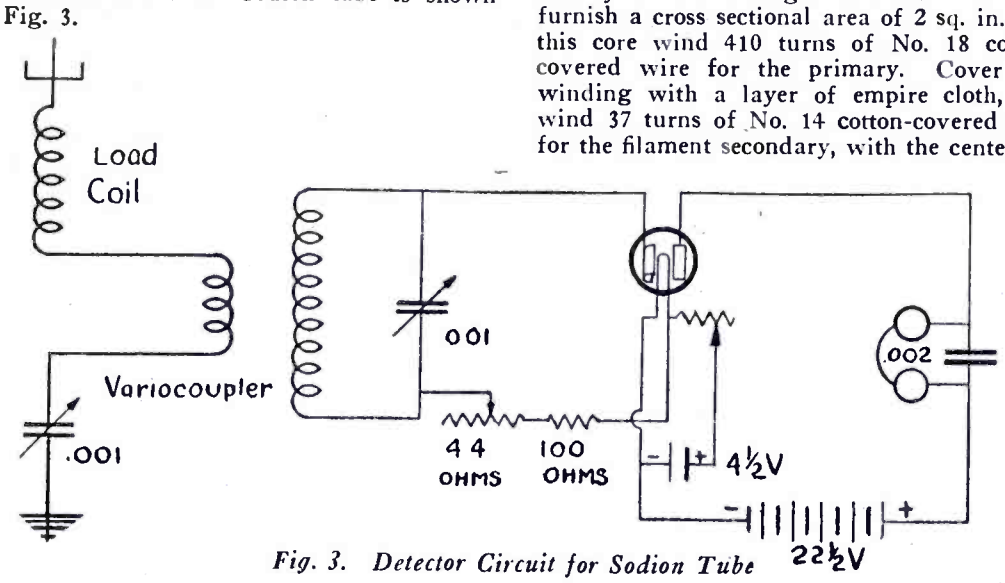


Fig. 3. Detector Circuit for Sodion Tube

In Radio for November, 1923, the circuit of the Grebe CR-12 receiver is shown. In the antenna circuit you show two variable condensers; the Grebe set has none. Why are they there? Is the variable resistance marked 200 a 200-ohm potentiometer? Is it necessary to re-wind the variometers I have, with 29 turns on each half of the stator and rotor, when a maximum range of 600 meters is desired?

—R. W. B., Chicago, Ill.

The condensers shown in the diagram are fixed condensers, and are plainly indicated as such. A variable condenser has an arrow passing through the center of the two parallel lines, while a fixed condenser has no arrow. The 200-ohm variable resistance shown in the sketch may be a 200-ohm potentiometer. It will not be necessary for you to re-wind your variometers for use in this circuit.

Please print the directions for making a transformer to supply filament and plate voltage for a five-watt tube.—F. B., Indianapolis, Ind.

It is best to plan the transformer with a soft iron core, since such material is easily obtained, and unless you were able to buy silicon steel from a reliable manufacturer you might get poor material and obtain poor results due to improper core construction. Build up a square core of soft iron strips 1 in. wide and 4 in. long, so that you have a closed window, each strip overlapping the one in the layer below it. Build up the core until you have a height of 2 in. This will furnish a cross sectional area of 2 sq. in. On this core wind 410 turns of No. 18 cotton-covered wire for the primary. Cover this winding with a layer of empire cloth, and wind 37 turns of No. 14 cotton-covered wire for the filament secondary, with the center tap at the 18½ turn. On the other leg of the core, wind 1865 turns of No. 28 black enameled or cotton-covered wire for the 500-volt secondary. Thoroughly insulate the coils from the core with empire cloth, and cover the outside of each coil with a piece of the same material. The core should be clamped in place as soon as the coils are assembled.

Please publish the diagram of the Radiola IV, manufactured by the General Electric Company.—A. T. E., Bellefonte, Pa.

The Radiola IV circuit is shown in Fig. 4.

What is the function of the three-point switch shown in the Cockaday circuit on page 13 of October RADIO?—F. S., Vancouver, Wash.

This switch is for the purpose of cutting C_4 in and out of the circuit. In this connection the condenser should not be used when the receiver is operating on broadcast reception of speech or music, as the presence of a large capacity across the secondary of the audio-frequency transformer will tune the transformers to one particular frequency, and will introduce a large amount of distortion into the voice or music being amplified. The condenser was intended for use only in the reception of amateur continuous wave telegraph signals, and should only be used in such work.

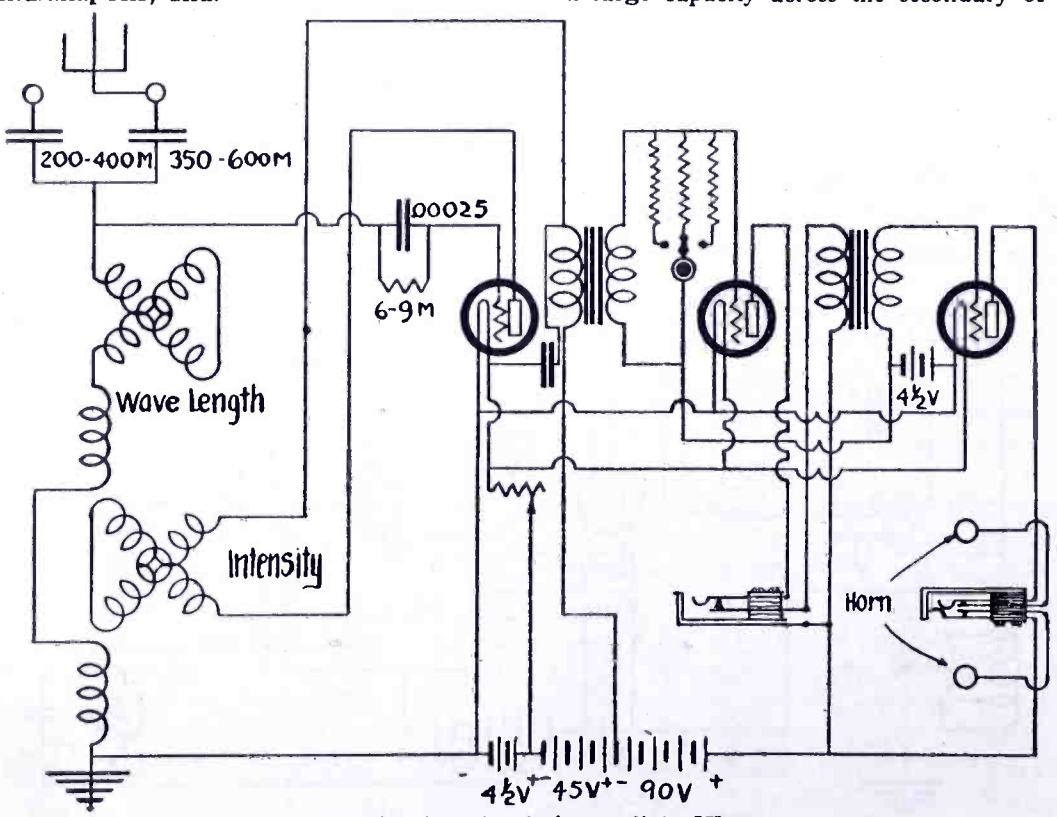


Fig. 4. Circuit for Radiola IV

Please give me the details of construction of the three-tuned radio-frequency transformers used in Hazeltine's neutrodyne receiver for antenna and secondary inductance, and for coupling the radio-frequency tubes to the succeeding stage. Could a variometer or conductive coupling be used for the antenna and secondary inductance? Could ordinary radio-frequency transformers be used with secondary shunted by an 11-plate condenser?—R. L., Dover, Ohio.

The antenna transformer and inter-tube transformers are wound on the same size tubes. The primary winding is placed on a 2¾-in. tube and mounted inside a 3-in. tube, on which is wound the secondary. In the case of the antenna transformer, the primary consists of 45 turns of No. 25 D. C. C. wire, and the secondary is 65 turns of No. 25 wire. The inter-tube transformers have 15 turns for the primary, and 65 turns for the secondary, with a tap at the 12th turn of the secondary. A variometer could be used for the antenna tuning, with perhaps a little less selectivity. Ordinary radio-frequency transformers can be used with a small air condenser, but not in a neutrodyne circuit such as Hazeltine's.

SECOND DISTRICT RADIO SHOW AND CONVENTION

The fourth annual Radio Show and Convention under the auspices of the Executive Radio Council of the Second District will be held in the Grand Ballroom of the Hotel Pennsylvania for five days—March 3rd to 7th inclusive. The Executive Radio Council, a non-commercial body of amateurs, is composed of delegates from practically every radio club in Greater New York and Jersey. Over fifty manufacturers are exhibiting their products. There are the many club booths with their original designs, home-made apparatus, etc., interesting and constructive lectures by the best men in the radio field every evening. In conjunction with this Show there is held a radio convention.

NEW SPECIAL CALLS

7XAE—Walter Hemrich (Grays Harbor Radio Co.), Aberdeen, Wash.; 6ZBH—James F. Brady, 2012 Pacific Avenue, Alameda, Calif.; 6ZBL—R. Wayne Goodale, 820 South Los Angeles Street, Anaheim, Calif.; 8XBL—David R. Inglis, 1025 Baldwin Avenue, Ann Arbor, Mich.; 9XN—Chicago Radio Laboratory, 332 South Michigan Avenue, Chicago, Ill.; 8XBI—Thomas W. Scott, 401 East Cedar Avenue, Connellsville, Pa.; 1ZH—James W. Carter, 24 Auckland Street, Dorchester, Mass.; 6ZBK—Park Borden, Route 3, Fullerton, Calif.; IXW—F. H. Schnell, 282 Fern Street, Hartford, Conn.; 9XAY—M. G. Sateren, 127 Blanche Street, Houghton, Mich.; 6ZBI—Maurice E. McCreery, 628 West Forty- ninth Street, Los Angeles, Calif.; 9XAX—Donald C. Wallace, 54 Penn Avenue, North, Minneapolis, Minn.; 1ZJ—Walter J. Klein, Jr., Natick, Mass.; 2ZB—John G. Arsics, Sussex Avenue and Jay Street, Newark, N. J.; 6ZBM—Alexander B. Stokes, 2812 Thirty-eighth Avenue, Oakland, Calif.; 8ZE—Everett W. Thatcher, 263 Elm Street, Oberlin, Ohio; 6ZBM—Charles W. Park, Riverbank, Calif.; 8XBJ—Michigan Limestone & Chemical Co., Rogers City, Mich.

WITH THE AMATEUR OPERATORS

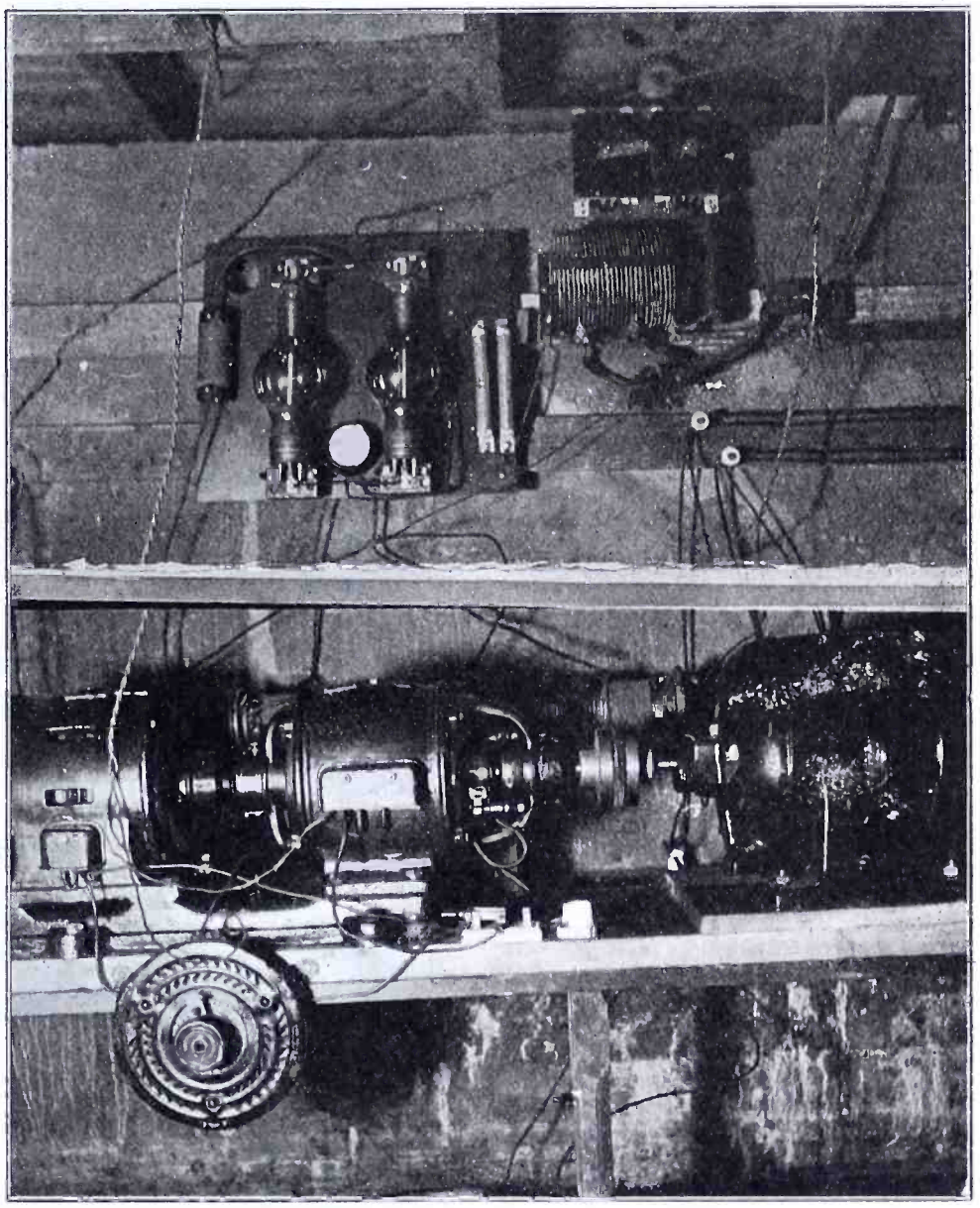
RADIO STATION 8VQ

The 500-watt, 500-cycle I. C. W. transmitter at 8VQ, Freeport, Pa., is heard all over the country, as well as in Hawaii, Switzerland and Greenland. Plate current is supplied to the two 250-watt tubes by a 250-volt 1½-kw. Telefunken alternator driven at 3400 r.p.m. by a 3-h.p. induction motor, the voltage being stepped up to 4000. With Hartley circuit and ground the radiation is 9½ amps.

This station is also equipped with a 500-watt C. W. set using a plate voltage of 2000 supplied from a motor-generator set. This set uses a 50-watt speech amplifier on the phone. It is not used as much as the other, as it does not raise the fellows so well.

The aerial is a flat top, 4-wire, 55 ft. high, 55 ft. wide and 50 ft. long. The lead-in drops to a 10x10 shed, which is used as an operating room, the transmitters being in the basement.

For receiving, an R.C. set and a Grebe 13 is used, with a 150-ft. single-wire aerial 65 ft. high at one end and 10 ft. at the other. The operators at 8VQ are Hugh Stewart, "A.M."; F. P. Yotter, "F.P."; and Alan Machesney, "R.U".



500-Watt I. C. W. Transmitter at 8VQ

RADIO STATION 8BDA

8BDA is situated on a hill in Parkersburg, W. Va., overlooking the Ohio river. The station is located in a small wooden building fitted up for the purpose. The antenna is a two 6-wire cage fan running from the top of a 90-ft. mast to the station building. A 12-wire counterpoise is used exclusively as the earth on top the hill is too sandy to permit the use of a ground.

The spark set is composed of a 1-kw. "coffin" transformer, a condenser made of copper sheets between ½-in. plate glass and Hyrad rotor sync gap. The split type OT is used with a normal antenna current of 8 TC amperes.

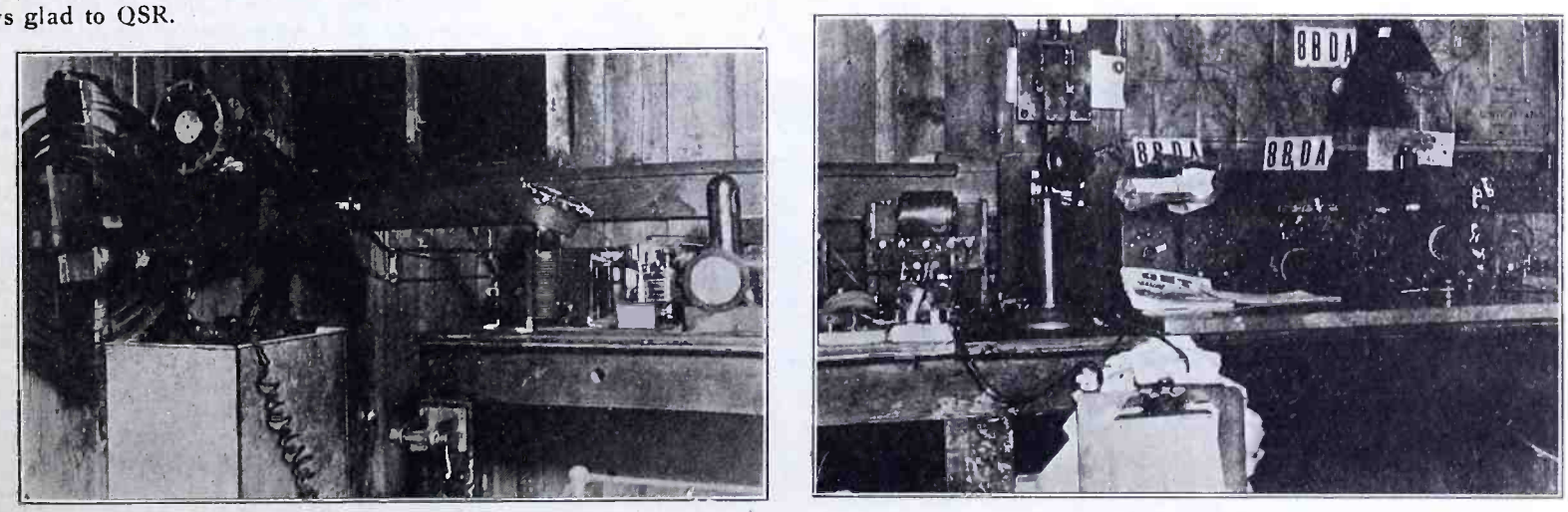
The C. W. set uses two UV-203's in a reversed feed-back circuit. The plate voltage is obtained from a 1500-volt transformer and a sixty-jar chemical rectifier filtered by an Acme 3-henry choke and 5 1-mf. R.C.A. condensers. The antenna current is normally 6.2 TC amperes.

The receiver is a conventional modified Reinartz with one stage AF. Considerable DX work has been accomplished with both transmitters. The spark has been reported many times on the Pacific Coast as well as 1000 miles south of San Diego in the Pacific, Porto Rico and several times in the Atlantic. The C. W. has been reported in 46 states, Hawaii, Panama, Porto Rico, Cuba, Alaska and by WNP in Greenland. The sixth and seventh districts have been worked many times. 8BDA is an ARRL station and is always glad to QSR.

MILWAUKEE RADIO AMATEURS' CLUB

The Milwaukee Radio Amateurs' Club, Inc., has been especially honored by having two of its members selected by the American Radio Relay League to fill high positions in the League's operating department for Wisconsin. Clarence N. Crapo, 9VD, for some time past a local operating department officer, was appointed Assistant Division Manager in charge of the state, and Mark H. Doll, 9ALR, former West Allis City Manager, was selected as District Superintendent for Milwaukee County, the smallest League traffic section in the state but probably the most active one.

Meetings continue to be held weekly at 8:00 P.M., Thursdays, in the Trustees' Room of the Milwaukee Public Museum, and technical committee reports as usual are principal features on the program. G. Forest Metcalf, 9CKW, well-known Wauwatosa amateur, is now chairman of that committee, and his own reports, having such themes as a description of the transmitter at 1QP and 1XAM and the construction of plate voltage transformers, are of the greatest interest. Reports by other members of this committee are frequent and include such topics as a description of 9ELV given by J. W. Blauert and accompanied with stereopticon slides, the prevention of regeneration in radio-frequency amplification



Radio Station 8BDA

circuits given by M. F. Szukalski, Jr., 9AAP, and lastly a very important paper describing a new method of measuring antenna resistance given by Edward T. Howell, Sc. M., 9CVI, who has taken a well-known method for measuring the resistance of closed oscillatory circuits and perfected and adapted it for use with amateur aerials.

The program committee arranged for a very instructive talk entitled "100 Meter Amateur Radio Transmission" which was given by Ben J. Chromy, 9CJO, a Minneapolis amateur who did some pioneer work in this field. Push-pull amplifying circuits were the subject of a report by J. A. Rose, publications committee chairman, and one meeting was entirely devoted to discussions of improvised apparatus members had pressed into service at various times.

In the last membership drive, which brought the total number of members well over a hundred, all individual records were broken by Business Manager L. S. Hillegas-Baird, who brought in sixteen, and for each five was awarded an A.R.R.L. emblem. E. G. Nickle, 9ATO, and F. W. Catel, 9DTK, were also awarded pins for getting five members each.

All local complaints of amateur interference reaching the Supervisor of Radio, Chicago, are being turned over to the club, and B.C.L.'s are requested to send them direct to the Club's office, 601 Enterprise Bldg., Milwaukee, Wis., where they will be given attention by the City Manager and the traffic committee. The local electric light and power company has promised co-operation in the matter of interference from defective power equipment.

RADIO IN NEW SOUTH WALES

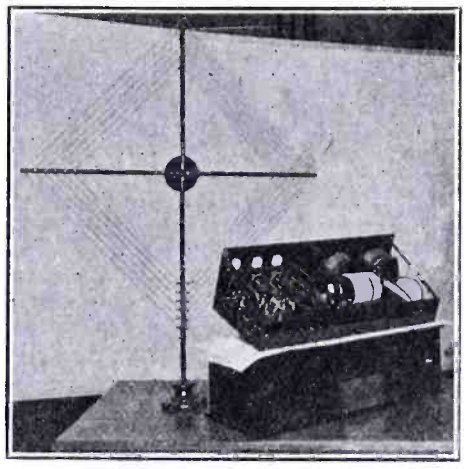
Two broadcast stations are operating in Sydney and several more will soon be established. A 500-watt station on a 350-meter wavelength is operated by Broadcasters Ltd., a firm composed of Sydney dealers in radio supplies. A 5 k.w. station, 2 F C, is operated on an 1100 meter wavelength by Farmer & Co. Ltd. This station has a 550-ft. T aerial supported by two 200-ft. steel towers on a hill near Sydney. Programs are broadcast from a studio in the city and from several theaters. A submarine cable under the harbor connects the station with the remote control apparatus in the city, the speech amplifier being installed at the microphone end of the circuit. This station is on the air daily from 5 p.m. to 5 a.m., Pacific Standard Time.

As it is felt that Australia's population is not sufficient to support broadcasting from the sale of sets, a recent conference recommended that each receiving set be constructed so that it will respond to a very narrow wave band, the broadcast station to which the receiver will respond through collecting an annual subscription for its service. The sets are sealed and subject to government inspection, so that no alterations may be made. This plan has met with considerable opposition, but is being given a fair trial.

A successful radio exposition was held in Sydney December 3 to 8 under the auspices of the New South Wales Division of the Wireless Institute of Australia. Over 14,000 visited the show and much publicity was given by the press. There were 34 exhibitors, displaying Australian, British and American apparatus.

Cabinet types of broadcast receivers predominated. Among the novelties were a 20-watt duplex radio telephone set operated by merely lifting the receiver off the hook, a loud speaker that folded up and looked like a camera, for the benefit of campers, and a ¼ k.w. spark ship's lifeboat set with a generator driven by a small gasoline engine and employing a compensating resistance across the generator terminals when the key was up to keep the engine from racing.

Experimental exhibits formed the most interesting section of the show, over one hundred pieces of apparatus being exhibited. The winner for the best transmitting set was L. Schultz; best multi-valve set, E. W. Cropley (This set was built from the description of

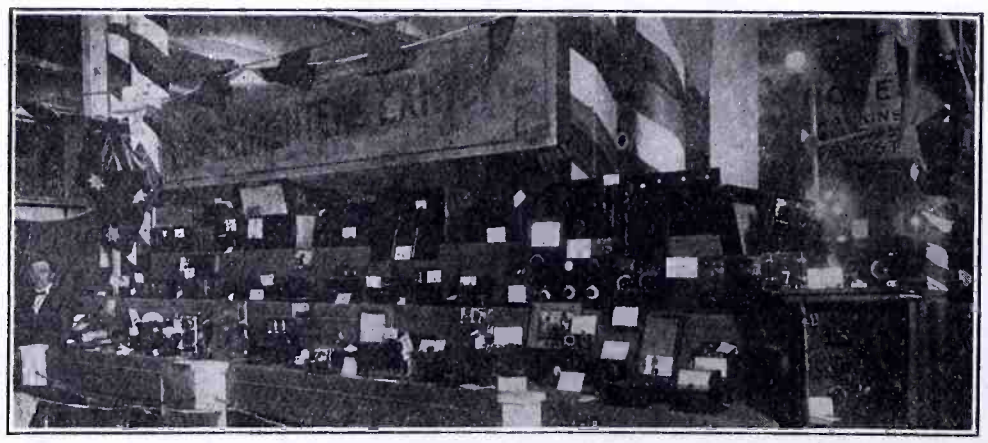


Best Multi-Valve Set at Australian Radio Show

the "DX bringer-in" in May, 1923, RADIO.); best single-valve receiver, H. Turner; best crystal receiver, A. L. Prince; best amplifier, H. K. Thomas; and the best piece of isolated apparatus, H. A. Stowe. The "freak" sets were in evidence, one crystal set being built into the shell of a walnut, another into a shaving soap tin, while one, built by a lady, consisted of a set of toilet articles, the powder-box containing the inductance, the buzzer going into the puff-box, and so on.

The humorous side was supplied by a "sealed set" from "Woop Woop", this being a hit at the government regulations. It was built on a base that had done duty as the lid of a gasoline case, the inductance being wound on a beer bottle. The slider was labeled "tuning fork", being one of the table variety so pivoted that the sole remaining prong made contact with the inductance. The crystal was mounted in the metal clip of a suspender, with the metal leg of a compass as the catwhisker. All connections were soldered barbed wire. The seal was red wax holding white tape tied around the neck of the bottle, the ends being brought out to the base and held down by the bottle cap. Strange to relate, it was possible to receive signals on the "gadget".

A case of historical apparatus created much interest. It contained detectors of all types, coherers, two-electrode tubes, and some of the early model three-element tubes. Another interesting exhibit was a complete telegraph outfit captured from a German Zeppelin; this was loaned by the Sydney University.



Experimenters' Exhibits at Australian Radio Show

DX LIST AT 6XAD-6ZW

(From December 28th to January 28th.)

Stations Worked

1ajp, 1er, 1cmp, 2bsc, 2adm (see later note), 2aco, 2rk, 3bva, 3bpf, 3cbm, 3iw, 3bgj, 3te, 3auw, 3qv, 3aqr, 3ajd, 3aro, 3ab, 3yo, 4fg, 4jk, 5jf, 5kp, 5bz, 5tj, 6's too numerous, 7el, 7gf, 7zu, 8qb, 8aa, 8adg, 8bnh, 8dlh, 8ve, 8bxx, 8adt, 8pl, 8brm, 8rm, 8vq, 8cwp, 8bfm, 8aih, 8amr, 8zd, 8bda, 8ue, 8cei, 8ab, 8bcp, 8oe, 8dhq, 8bch, 9avc, 9boe, 9afy, 9dlo, 9cp, 9bij, 9acl, 9and, 9diw, 9bdu, 9ajv, 9ato, 9bze, 9ecb, 9zt, 9aad, 9amk, 9dsl, 9ccs, 9elv, 9dhg, 9dkv, 9vz, 9dhr, 9ash, 9avc, 9ccm, 9aou, 9cp, 9cjj, 9ecb, 9bri, 9bje, 9dlo, 9bth, 9afy, 9djb, 9mc, 9aju, 9cuc, 9ap, 9awf, 9cfk, 9avg, 9bch.

Canadian—3zl, 3adn, 3tb, 4hh, 4cl, 5hg.

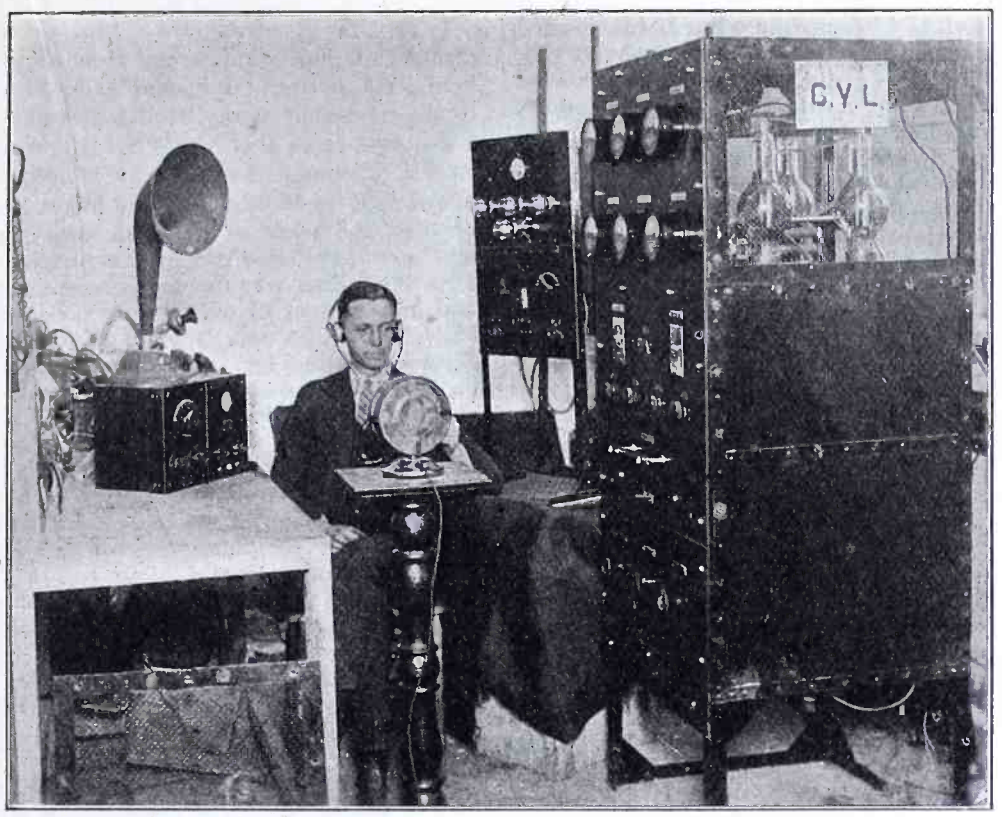
Mexican—"bx".

Of especial note: 4FG works 6XAD from Athens, Georgia, on *spark!!!* Is consistently QSA. 2ACO works 6XAD from Roselle Park, New Jersey, with but 10 watts and is reliably QRK. 8QB works 6XAD from Buffalo, N. Y., with only 5 watts and is always QRK. 9DKV works 6XAD from Hobart, Indiana, with 20 watts—QSA. 9ACL works 6XAD from Champaign, Ill., with 10 watts—QSA. 9DOE is QSA at 6XAD on 5 watts. 9DLO is QSA at 6XAD on fone. FB! He is in Streator, Ill. 9DC is QSA on fone from Cambridge, Ill. Also FB! 9BOE is FB at 6XAD, from Lebanon, Indiana, on 15 watts. 2EL, at Freeport, Long Island, N. Y., copied 6XAD correctly on December 23rd at 1:15 (noon) E.S.T. L. S. Spackman, 1AC, New Zealand, and Mr. Edwards of the same city (Auckland) report 6XAD loud enough to "blow one's head off", with one tube. Mr. Edwards correctly reports 6XAD working 2RK and . . . correctly reports 2RK, *also!* An astonishingly successful DX reception! A good many eastern stations report 6XAD as QSA long after daylight. Worked 2ADM at 9:30 a.m., *his time;* hence *full daylight for 2-way results* between Avalon and Schenectady! 2ADM used but 10 watts. This is the record, I *believe!* 9ATO works 6XAD on 5 watts—9SA.

Work with WNP has been desultory. I have not been on the air much during the month whose reports I give. WNP, on such occasions as I have worked him, delivering messages from Eugene Macdonald, Jr., of The Zenith Radio Corporation, Chicago, signals from the Polar ship have not been as steady and as loud as earlier in the season. QSS much more troublesome. On the whole, WNP has been more QRZ than QSA.

Stations Reporting 6XAD-6ZW

1cpn, 1bop, 1hx, 1jv, 1aiq, 1bsg, 2buy, 2awh, 2aay, 2xna, 2bwt, 2bbn, 2cso, 2le, 2wb, 2aar, 2kf, 2atf, 2crp, 2aur, 2adk, 2bwm, H. Wolf (Brooklyn, N. Y.), 2aaz, 2cmj, 2acs, 3bwg, 3bvl, 3abw, 4hs, 4mv, 5gp, 5acz, 5qi, 5zav, 5amh, 5aom, 5ut, 5ado, 6cjb, 8aeb, 8bms, 8gh, 8aex, 8jq (qsa on bedsprings at Pittsburgh, Pa.), 8dcw, 8bgh, 8coj, 8bnh, 8cuv (N. Fontana, Buffalo, N. Y.), 8jy, 8bng, 8bde, 8dgo, 9rc, 9aht, 9cck, 9agy, 9ceu, 9cwz, 9eiu, 9awu, 9bep, 9avg, 9dgv, 9beo, 9ciu, 9ake, 9egh, 9tv, 9elh, 9wu, 9ox, 9bgy.



Radio Station CYL

MEXICAN RADIO CYL

Radio CYL at Mexico City is owned and operated by LaCasa del Radio in conjunction with *El Universal,* a daily newspaper. It has been on the air each evening as a 500-watt station since December 7, 1923, reports having been received from Canada, Havana, Central America and nearly every state in the United States. All broadcasting is on a wavelength of 500 meters. The programs consist of war bulletins and music from the many fine musicians and singers in Mexico City.

The transmitting equipment was installed by the Texas Radio Syndicate of San Antonio, Texas, under the personal direction of S. A. Hodges.

RADIO CLUB OF BROOKLYN, N. Y.

The officers elected for this term are: President, Dr. L. J. Dunn, 2CLA; Vice-President, Mr. J. N. Herland, 2BPF; Secretary, Mr. D. F. Kirchick; Treasurer, Mr. D. Talley, 2PF. At the sanction of the Executive Radio Council of the Second District, the Club has formed a QRM Investigation Committee, which probed into all complaints laid to amateurs in Brooklyn. This committee is always ready to investigate any such complaints, and renders an unbiased report of its investigations. And, in co-operation with the Traffic Committee, it has made Brooklyn a place as free from "CQ's" and QRM as one would want. It would do well for other amateur organizations to emulate this example, and render a distinct public service to their city. The Club also conducts a code class, which is primarily for the benefit of the BCL desiring to learn the code. This class is in charge of two of the most competent instructor-operators, Messrs. Glaser, 2BRB, and Schudt, 2CHY. The Club has been of assistance to many desiring to form radio clubs, and will be pleased to send its advice to any group contemplating formation of a club. A letter to the secretary will suffice. Meetings are held the second and fourth Fridays of the month at 2211 Bedford Ave. Visitors are always welcome, and can gain some good pointers by attending, for a feature is arranged for every meeting.

Call 6AKJ has been reissued to Nelson E. Poe of Healdsburg, Calif., who will answer all QSL's.

NEWS OF THE AMATEUR OPERATORS

QRA of Station 6AAJ has been changed to 1356 Vancouver Ave., Burlingame, Calif.

Call 8DLI has been re-assigned to Walter A. McAllister, 474 Freeport St., Parnassus, Pa.

QRA of 2ADH is E. Peacox, 52 Radford St., Yonkers, N. Y.

Call 6AMM has been re-assigned to Bruce Stone, Route 2, Box 124, San Jose, California, who would appreciate cards from those hearing him.

Call 8ZE has been re-assigned to Everett W. Thatcher (ex 6AWP), Oberlin, Ohio. This station will be operated in conjunction with the Oberlin College station, 8YAE. Using two five-watt tubes in a Colpitts circuit, 8YAE has been heard by Mr. F. D. Bell Radio 4AA of Otago, New Zealand.

Call 8ANM has been assigned to H. J. Crisick, W. Washington St., Medina, Ohio. He requests QSL of his sigs and will answer all cards.

Call 3KJ has been re-assigned to Francis J. Kern, 5745 Walnut St., Philadelphia, Pa., who is operating 5 watts, phone, C. W. and I. C. W. All cards answered.

Few amateurs appreciate the necessity of measuring their transmitted wave and as a result several of the western amateurs have had their licenses suspended or revoked.

The present trend of amateur activity seems to be toward the shorter waves. Many amateurs now realize the possibilities which lie in the short waves. C. W. signals can now be heard on nearly all waves from 100 to 220 meters. A great deal of difficulty is being encountered in trying to get transmitting sets to oscillate on these short waves.

7IT is not in Alaska as the call book shows. This call has been re-assigned to Mr. Ashley C. Dixon Jr. of Stevensville, Mont. Although the station has been licensed only a comparatively short time, its signals have been heard in the greater part of North America, by WNP, and in England.

1AW, Hiram Percy Maxim, President of the A.R.R.L., recently sailed for the Mediterranean. He carried with him a complete short-wave receiving set, with which he hopes to hear American amateurs all the way across the Atlantic and even in the Mediterranean. Permission was granted him by the steamship company to erect a special receiving aerial on the ship. It is hoped that much will be learned regarding foreign amateurs through Mr. Maxim's experiences.

During the recent Trans-Atlantic tests none of the French or English amateurs were heard on the west coast. 7MT heard French 8AB sign off but could not make out his code letters.

7ABB continues to maintain a schedule with WNP. Press reports are sent to WNP every Monday night and a good number of messages have been exchanged during the last month. WNP's signals are reported by everyone who hears him to be very weak. Serious fading is also noticed and it is believed by many that the aurora borealis may be the cause.

7CO owned by Einar Twilde of Glendive, Mont., is one of the busiest amateur stations on the air. Mr. Twilde has worked WNP repeatedly. He has also handled a great many messages to and from the coast.

7HG, Charles York of Tacoma, Washington, now holds the world's amateur record for long distance worked. Recently, York worked a Japanese amateur station in Tokio, Japan. The Japanese station sent one complete message to 7HG and then signed off. The total distance between Tokio and Tacoma is approximately 4700 miles.

ILLEGAL TRANSMITTER CAUGHT

Through the efforts of Radio Inspector Ben Linden, ably assisted by E. M. Sargent, an amateur who has been transmitting without a license as 6LL and who has been disturbing B.C.L.'s in the San Francisco Bay region during concert hours, has finally been run to earth. His apparatus, a ½ kw. spark set, has been confiscated and he faces prosecution for operating without a license with a penalty of heavy fine and imprisonment.

As this individual had boasted over the air that he could not be caught, it is interesting to note that his downfall was brought about in a few hours by a loop aerial and reciving set in an automobile. The detecting apparatus has been developed to such an extent that the culprit could be located if he only sent four or five dashes. It pays to respect the law.

HORN DESIGN

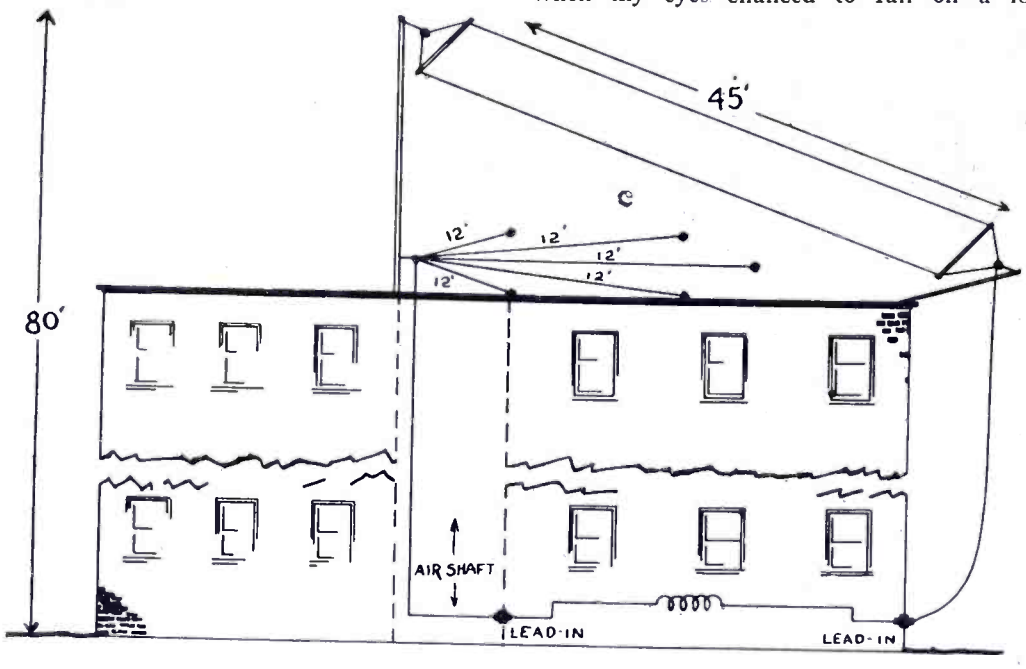
A good horn for use with a telephone diaphragm in a radio loud speaker, according to C. R. Hanna of the Westinghouse Company, should cause the diaphragm to radiate almost uniformly at all frequencies. Its walls should be non-vibrating and its air column resonances should be slight within the range of frequencies used. Its function is to load the diaphragm so as to cause more sound energy to be radiated. It does not amplify the energy but merely gives the diaphragm a better grip on the surrounding air and thus increases its efficiency.

Theoretically its size should gradually increase from a small initial opening to a large final opening in accordance with an exponential law. This should not exceed 20 per cent increase in area per inch of horn length. The initial opening should not be less than ¼ in. The large final opening is necessary to reduce reflection at the end. This design law makes for a long horn. Short horns cannot be expected to give as good quality of reproduction, as the long horn is decidedly more uniform in its response to the different frequencies.

THE CONDENSER LOOP

By ALEXANDER MAXWELL, 9BRE

The loop seems never to have been taken seriously in regard to transmission. The purpose of this article is not to persuade all the hams to can their flat tops, cages, flattop cages, vertical flattops, fans, or what not, but to tell of the transmitting loop and some of the results that may be obtained with it. This new form, new to amateur radio, or at least not in general use.



Some time ago I had a lovely cage aerial and counterpoise, but the building to which the far ends of the open circuit were moored has been amputated, and now a large business block is going up where it, and my yard, was. The thought of missing all the winter DX was unbearable. Hemmed in on all sides as I am, the only way I could expand was upwards, so upwards I went.

I needed a mast, so I absconded with three of the contractor's 2x4's in return for his having used my counterpoise for fence wire. Next I called the gang over and we built a beautiful 40-ft. mast. A 40-ft. mast is not to be sneezed at, and especially when it is on the roof of a 55-ft. building. It is the highest mast in town, being 7 ft. 3 in. higher than 9BP's, which held the record before.

With such an imposing mast to start with, I felt that I could eat the world. The next thing to do was build an aerial. To begin with I bought 200 ft. of ½-in. braid, the same as we used to hook up our spark sets with in the past. As the demand had dropped considerably, I got it cheap, so I bought all the dealer had. The gang came over again and we made a two-wire flattop that would reach from the top of the mast down to the gunwale of the roof; and from there down the side of the house to my window we ran a single strand of the braid.

Now that I had an aerial I thought that I would simply ground to everything in sight and work DX beautifully. But I was doomed to disappointment, for, no matter what I did, I couldn't make the bloomin' ammeter even shiver. So, after exhausting both my efforts and vocabulary, I turned my attentions elsewhere. I strung wire around the picture mouldings and laid it under the rugs. With this I got half an amp, and actually worked a fellow three miles away.

That night I went over to tell an enthusiastic BCL what a wonderful set he had, when my eyes chanced to fall on a loop aerial. Suddenly something hit me a terrific wallop behind the ear. When I recovered I found that it was a bright idea, so, without waiting to tell the BCL how much better a condenser was than a fone plug, I ran out on the street and rushed home shouting Eureka much better than Archimedes ever did. I sped to the store room where the half ton or so of assorted radio magazines is stored. I picked up the first one I came to and glanced through it. Then the next, the next, etc. By 2 a.m. I had gone through the entire pile. I gazed at the stack I had set aside, and to my amazement and disappointment found exactly six. SIX radio magazines out of six hundred contained articles on loop transmission. With aching heart and much sleepiness I picked up the six and went to bed.

The next day I read all six articles. They all said the same thing, that was, nothing. In glancing through one of the magazines I came across an article on condenser antennas Then another brilliant idea ran into me. Why not combine the loop and condenser. No sooner said than did. I dragged the rest of the braid from under the bed and climbed up on the roof and began. I made a five-wire fan which I fastened to the mast and anchored each arm to a guy wire. The whole was 3 ft. off the roof, and about 10 ft. from the aerial at the nearest point, and setting at an angle of 35 degrees to it.

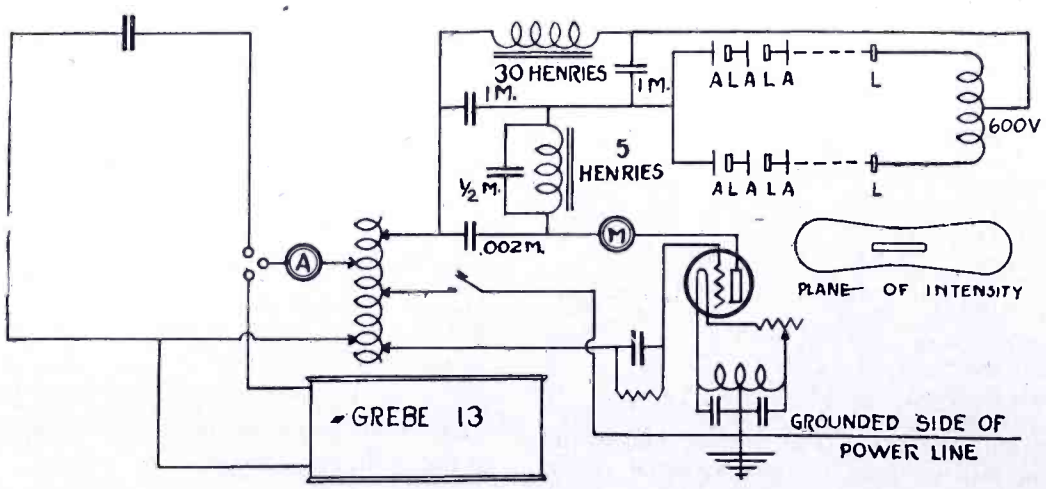
I ran the lead-in down the air shaft, through the hall window and from there over to the transmitter. I hooked everything up, lit the tubes, but as my hand touched the key a doubting came over me. What if it wouldn't work? No one had said that it would, to my knowledge, so it might and it might not. I recalled the story of the man who ate the first oyster, then thought of how much worse a fix the fellow was in who invented powder and had no way of telling how far it would blow him. The comedy of it assured me, so I leaned on the key. The tubes turned red, but the ammeter stood still. My heart beat about five rpm slower, and I began to believe that I was right after all. The only thing left to do was to juggle the clips and see if something wouldn't happen. The suspense was terrible. I worked for fifteen minutes shifting combinations, till at last I wished the tubes would blow and end my misery, when by chance I moved the plate clip up one turn. The result was wonderful. The reluctant needle perambulated nimbly up to one amp. With a sigh of relief and a yell of joy I grabbed up the wavemeter and found the QRH to be 194 meters. Wonderful, marvelous! I now sat down and called the first guy I heard. He came right back and said "Sa om u got a 50 nw ur abt twice as QSA as b4". I called him a liar, but he swore up and down that he wasn't, so I tried another fellow. He said same as first one, so I begged the most humble pardon of the first, and for my trouble got invited to QTH.

Now I began to think that I had hit something after all, so I went out and walked around the block to cool off. The next a.m. early I arose and went to the set. I heard a fellow in South Dakota, so I called him. He came right back saying "Fb vy". Next I worked an 8, then a 1. I noticed, however, that I could work only those stations which were east or west of me. That is, in the plane of the loop. I could call till the key jammed and couldn't raise anyone north or south. Several days later I was rewarded by two cards from California—my first.

In summing it all up I believe that this type of aerial will solve the problem for many of our unfortunate hams who have good intentions but are unfortunately located in a place where a ground or counterpoise is out of the question. It is entirely contained on the op's house, is easy to build, and really works.

As a word to the wise I'll state that it should be made large enough, as it works best on the fundamental.

My transmitter is a 10-watt Hartley, using 500 volts chemical rectified AC at 140 mills. All parts of set are R.C.A. save the meters and transformers. When tuned to 194 meters the set puts from 1.2 to 1.5 amps in the loop. This looks small besides that which can be had with an open aerial, but it seems to mean as much, as I can easily work as far as ever before with twice the current.



ALPHA DELTA PROFESSIONAL RADIO SOCIETY

Alpha Delta was organized last fall at the University of Washington, Seattle, as a professional radio operators' society. It has a present membership of 15 commercial first-class operators and one faculty member. It is hoped to grant charters to similar societies in other universities. Wm. D. Wood of 5212 18th Ave. N. E., Seattle, is president and E. A. Kraft, same address, is secretary.

NEW RADIO CATALOGS

Bulletin No. 210 from Roller-Smith Co. of New York City illustrates and describes their direct current portable ammeters, voltmeters and galvanometers.

LETTERS TO THE EDITOR

Dec. 30, 1923.

Sir: Your letter from Dr. Banks in re N. P. L. proved interesting because it brings up the question of who is paramount today in regard to radio legislation. My whole sympathies are with radio amateurs, yet we must all remember that one big thing about radio is the ability to communicate from ship to shore. That is, Radio is the life-saver on the sea. And all other interests must bow to the ship-to-shore stations who must of necessity rely on radio alone. One ship in danger or one life at sea saved is worth a year of radio sermons, radio jazz or radio lectures. Now ships receive with crystal sets, and therefore the use of spark because it is easily heard on crystal sets. And I, for one, feel that Dr. Banks, on second thought, will agree that N. P. L. is a station that is probably eagerly listened for by ships and therefore should use spark so as to reach ships. Even though not in danger, there is a great feeling of security if one is Q.S.O.

B. S. BICKELHAUPT, M.D.,
New York City. 2CBA

What's In A Name?

Sir: A few days ago I visited the port of Vancouver, British Columbia, and, as is my usual practice, I visited my friends who run a radio store there. While in the store, an elderly man came in with a complaint that he could not get his set to work. He said that it was a "Super Auto Simplex Circuit", a diagram of which he had with him. The name almost floored me. But as I am getting case-hardened to high-sounding names for radio circuits I inspected the "Super Auto Simplex Circuit" and then collapsed. The shock was too much even for a hardened brass pounder to stand, for it was our old familiar friend that has been popularized by another hardened old brass pounder, David P. Gibbons, through the columns of RADIO. Why do they do these things? Isn't there anything new in radio to bring out without digging up old circuits and loading them up with high-sounding appellations? I don't blame the man that had trouble with this circuit. He was only a beginner. But he got that title out of some magazine and that's where the blame lies. One day there will be a "ninteenth amendment" against this, but in the meantime I suppose that we have to "grin and bear it".

L. S. Lane, A COMMERCIAL OPERATOR.
"Allowrie", Silver St.,
Randwick, Sydney, N. S. W.

NAVAL CO-OPERATION

Sir: The "Radiotorial Comment" in your February, 1924, number of RADIO contains statements to which, knowing the conditions, I feel that I must enter a protest. In particular, on the subject of interference experienced by the Broad Cast Listener (B.C.L.) you state, "That the same co-operation has not been extended by the Navy is most regrettable", and further, "Nor has the Navy made sufficient effort to eliminate harmonics".

Just what you may mean by "sufficient effort" is a matter for conjecture. The Navy Department has, for some time, appreciated the viewpoint of the B.C.L. and others, and has made every effort consistent with the funds made available by Congress to eliminate all forms of radio interference which might transgress on the rights and desires of the public and of commercial radio enterprises.

While other purposes as well as the desire to eliminate interference may have contributed to prompt the action of the Navy Department, the following steps, which the Navy has taken, all of which *do* tend to eliminate interference, surely indicate the Navy's policy and desires in this matter:

(a) Substitution of tube transmitters for the very objectionable spark type at the most important Navy shore stations. (This work is still in progress).

(b) Use of wavelengths considerably removed from the "broadcast band" at all shore stations.

(c) Expenditure of large sums in efforts, which, by the way, *have* been rather successful, to eliminate arc harmonics.

(d) Substitution of the uniwave system in place of the compensating method on all arc transmitters.

All of the Navy's arc stations on the Pacific Coast are "remote controlled" over distances ranging from seven to twenty-five miles, and the fact that simultaneous arc transmission and distant reception is an accomplished fact at these stations is prima facie evidence of successful elimination of arc mush and harmonics.

Please let me invite your attention to the fact that in every Naval District there is assigned an officer known as the "District Communication Superintendent". Any complaint of interference experienced from Navy radio stations, if forwarded to the proper District Communication Superintendent, would, unquestionably, be given prompt consideration and investigation, and every practicable means taken to eliminate the trouble. The Navy desires to co-operate, but co-operation, like a quarrel, has two sides.

Sincerely yours,
A. N. OFFLEY,
U. S. Navy Yard, Lieutenant U. S. Navy,
Bremerton, Wash. Radio Material Officer.

Down with the Spark

Sir: Dr. A. E. Banks of San Diego, Calif., with whom I agree to the last line, is more than right regarding the awful spark interference that now prevails all over the world from different sources such as ships and land stations, government and commercial. Ships are not supposed to transmit on 450 meters before 10:30 at night, but they do transmit on any wavelengths, at any time. Close to this place you can hear ships from 300 meters up to near 700, meter by meter, and they are supposed to use three wavelengths: 300, 450 and 600 for traffic purposes! And what about those "ops" that they sit on their keys to adjust their "stone-crashers", sometimes—much too often—over two minutes? This happens night after night, and how beautiful it is to hear the "pretty" spark notes—some sounding like mosquitos, 500 cycles, and others like frogs, low-pitched notes—and nearly everyone, of course with a few exceptions, using a wave as broad as the Golden Gate. Now here comes the worse pest: the fellow that calls and calls, and just keeps up calling for near twenty minutes. Many times they don't send their call letters, the word "de" and the call letters of the station being called three times as the radio laws and regulations urge to do, but they send the call letters over fifteen times. Most of this unnecessary "noise" here is due to the fact that we have no radio inspector to check the air.

I want to express my deep appreciation of the American amateur. I am and have been one for a long time, and I don't think it is right to blame him all the time for the interference that many BCL's complain about. I am sure that this interference is from ship and land stations using an obsolete transmitter: the spark type. I have the pleasure to operate a "super-heterodyne" receiver, and, while listening-in to concerts broadcasted from the U. S. A., I have never been troubled

Continued on page 64

CALLS HEARD

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

By E. Wiseman, 1004 Fulton Ave., Hollywood, Calif.

1yb, 2bva, 2cxl, 3ni, 4ay, 4by, 4cl, 4cs, 4dy, 4fn, 4ft, 4hn, 4jk, 4jx, 4ku, 4ob, 4pb, 4qf, 4xj, 4za, 5aa, 5au, 5az, 5bi, 5cy, 5ek, 5er, 5ft, 5fv, 5gi, 5gj, 5gp, 5hl, 5hv, 5if, 5ik, 5jf, 5jz, 5kg, 5lh, 5mr, 5nn, 5pb, 5px, 5ql, 5rv, 5sn, 5to, 5uk, 5vv, 5xd, 5xv, 5za, 5zb, 5zh, 5zu, 5zav, 5zax, 5ado, 5agj, 5ahr, 5aiu, 5ajj, 5akn, 5aky, 5ama, 5amh, 5amj, 5anc, 5aog, 5aom, 5aqt, 6ceu, 6's too numerous, 7ak, 7bj, 7co, 7dc, 7em, 7eo, 7fl, 7gq, 7hw, 7io, 7it, 7iw, 7je, 7ks, 7ku, 7lh, 7lu, 7ly, 7mc, 7mp, 7ob, 7ot, 7pj, 7qd, 7qj, 7qt, 7rd, 7sc, 7sy, 7to, 7tt, 7ve, 7wm, 7ya, 7yl, 7zd, 7zf, 7zj, 7zz, 7abb, 7aci, 7adr, 7agr, 7agv, 7aho, 7ahn, 7ahz, 7aiy, 7ajy, 7ald, 8aa, 8ab, 8er, 8fu, 8gz, 8hn, 8jj, 8jy, 8kg, 8pl, 8tr, 8tv, 8wx, 8xe, 8yg, 8yn, 8zy, 8zz, 8aaj, 8abm, 8adg, 8agp, 8agv, 8aib, 8aih, 8aim, 8ajh, 8ame, 8apy, 8ard, 8ave, 8bci, 8bda, 8bfh, 8bfm, 8bhn, 8bvt, 8bzd, 8cdg, 8ced, 8cgj, 8com, 8dat, 8dgo, 8djf, 9ap, 9bg, 9bj, 9bp, 9dn, 9dx, 9ec, 9ei, 9eq, 9fm, 9lz, 9mc, 9mk, 9nr, 9ox, 9pw, 9rc, 9ss, 9wu, 9xaq, 9yy, 9zt, 9zv, 9zy, 9aaq, 9aar, 9aau, 9aaw, 9aed, 9ahq, 9ahz, 9aii, 9aim, 9amb, 9anq, 9aon, 9aou, 9apf, 9att, 9avn, 9avz, 9awv, 9bai, 9bak, 9bbw, 9bdy, 9bez, 9bhd, 9bhz, 9bik, 9bji, 9bjk, 9bkk, 9bkf, 9bly, 9blx, 9bof, 9bou, 9bpu, 9bqy, 9bri, 9brk, 9bsp, 9btt, 9bun, 9bxq, 9caa, 9caj, 9ccv, 9ccz, 9cga, 9cgw, 9chc, 9cip, 9cjc, 9cjy, 9ckw, 9ckn, 9clq, 9cns, 9cnv, 9cpa, 9cpu, 9crr, 9cvc, 9dcw, 9ddf, 9dfh, 9dhn, 9dhq, 9dhv, 9djb, 9dkq, 9dky, 9dli, 9dlm, 9dqu, 9drw, 9dsg, 9dsw, 9dte, 9dug, 9dyr, 9dxy, 9dzy, 9edm, 9ehj, 9ehn, 9eky, 9elv.

Can.: 3bp, 3co, 4cn, 4hh, 5go, 9bx.

By Harold T. Mapes, Rdo. "BX", Guanajuato, Gto., Mexico

1ajx, 1cmp, 1yb, (1zl) pse qsl, 2brb, 2rk, 3auw, 3hg, 4cs, 4cr, 4dp, 4el, 4ft, 4ku, 4my, 5akn, (5ama), 5aky, (5alr), (5adi), 5aiu, 5aec, (5ajj), 5ado, 5ahr, 5aat, 5aij, 5ajt, 5amu, 5akf, 5aju, (5amw), 5aic, 5aht, (5amh), 5anc, 5abb, 5adv, (5adb), 5au, 5ahd, 5air, 5ana voice, 5alj, 5bm, 5bx, 5by, 5cl fone, 5dw, 5ek, 5fc, 5fx, (5fp), 5ft, 5gi, 5gn, 5gf, 5ga, 5hl, (5hz), 5in, 5iq, (5jc), (5kg), (5kn), 5kc, 5kx, (5lr), 5mo, 5nr, (5nk), 5nz, 5na, (5ov), 5ot, (5ph), 5pw, 5qw, 5qi, 5qy, 5ql, 5qx, 5rv, 5sd, 5tj, 5ua, 5ua, 5uk, 5vf, 5vm, 5xv, 5xac, (5xd), (5xaq), (5xaj fone), 5xt, 5xar, 5xap, (5yk), 5yg, 5yt, 5yw, (5zav fone), 5zg, 5zu, 5zas, (5za), 5rb, (qsa wi 3-ft. loop, 5abb, 5dn, 5jj, 5lr, 5xap), 6aak, 6asx, 6aaj, 6awq, 6auu, 6aos, 6arb, 6alk, 6bic, 6bjj, 6bfg, 6buo, 6buf, 6bua, 6bjq, 6bcl, 6bis, 6ckp, 6cnh, 6cdg, 6cfz, 6zh, 6cgw, 6ckr, 6cie, (6fp), 6ii, 6ka, 6mh, 6pl, 6ts, 6amb, (3-ft. loop 6acm, 6aak, 6zh), 7co, 7sc, (8aib), 8ab, 8aa, 8bfq, 8bda, 8bhn, 8bjy, 8cei, 8czz, 8dkm, 8fu, 8uk, 8vy, 8wx, 8xe, 8xan, 8yn, 8zc, 9anq, 9awf, 9aim, 9aar, 9aml, 9aep, 9bji, 9bly, 9bzi, 9bds, 9bri, 9cbj, 9cte, 9ccg, 9cly, 9cfi, 9ccz, 9ccs, 9dug, 9dhz, 9dxy, 9dyr, 9dqe, 9dte, 9ehj, 9mc, 9xaq, 9yu, 9yy, 9zt, (9avn).

Can.: 3zt, 3co, 4cn, 4cb, 4cl.

Mex.: (1b), (1k), (1j), (1p), 1g, (md), (ax). Wud appreciate repts on my sigs.

By 6CDP, 3009 Wheeler St., Berkeley, Calif.

5akn, 5lg, 6adk, 6afh, 6afz, 6agk, 6asa, 6bah, 6bll, 6bso, 6cax, 6cib, 6chj, 6cmr, 6cmu, 6cng, 6ddd(?), 6ei, 6et, 6ka, 6km, 6pe, 6zh, 7adg, 7ads, 7ajy, 7akz, 7em, 7io, 7it, 7kv, 7ln, 7oh, 7ot, 7pf, 7sc, 7sf, 7to, 7tt, 7vj, 9aig, 9bab, 9bun, 9cjy, 9ctg, 9eky, 9zt.

Can.: 5cn, 5go.

All heard from Nov. 5 to Nov. 20. Will anyone hearing my 5 watts cw pse qsl crd.

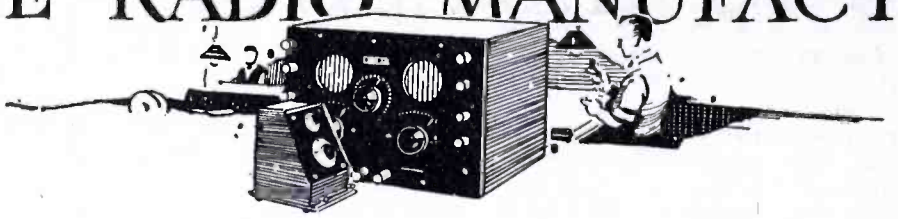
By 7YL, Spokane, Wash.

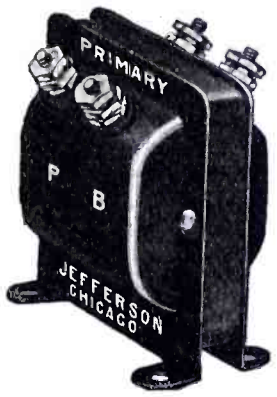
1aja, 1awy, 2by, 2bgh, 2ctu, 2cva, 2cwp, 2cx, 2clx, 2jf, 2xq, 3ai, 3adf, 3pz, 4aa, 4ef, 5agi, 5air, 5ams, 5ank, 5au, 5bm, 5ci, 5ek, 5gj, 5lr, 5mm, 5gy, 5qq, 6's and 7's too numerous, 8aem, 8amm, 8apt, 8atc, 8awj, 8bda, 8bfh, 8bzk, 8cej, 8ctp, 8dgr, 8do, 8ii, 8jy, 8tr, 8uf, 8zz,9aby, 9afw, 9amb, 9aml, 9amf, 9amr, 9ape, 9awm, 9awv, 9bey, 9bhq, 9bis, 9bsp, 9cbp, 9ce, 9co, 9coc, 9cwf, 9dgi, 9dgv, 9dky, 9dsl, 9dsw, 9duj, 9dxy, 9eau, 9efu, 9ehj, 9ig.

Can: 3oh, 7cl, 9bp.

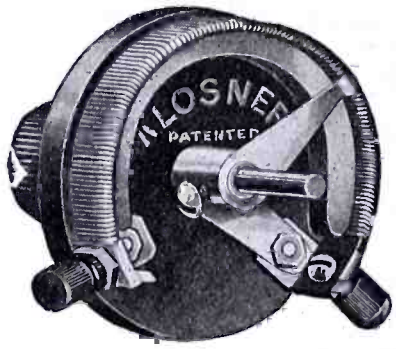
Continued on page 44

FROM THE RADIO MANUFACTURERS

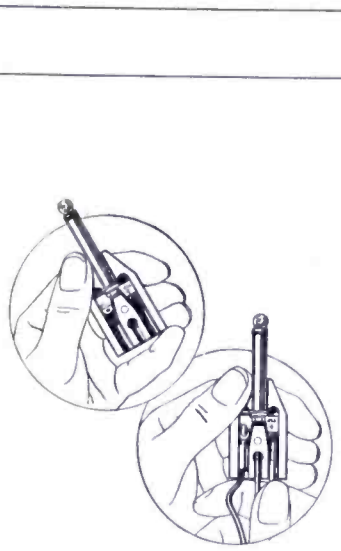




Two new Jefferson radio-frequency transformers have been developed after 18 months of laboratory research. No. 80 is for the first stage and No. 85 for the second stage of r.f. amplification from 200 to 650 meters in any standard circuit. Capacity coupling has been minimized by the use of distributed windings in the primary and secondary coils. Silicon laminations give the required inductive coupling and shield the winding from any external capacity. The core is built to minimize eddy currents.

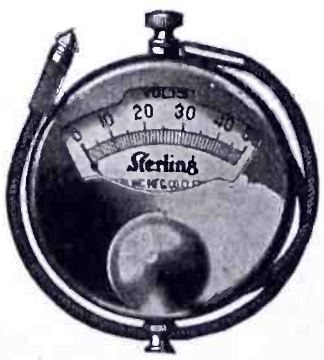


The new Klosner tube protecting rheostats are made with either 6 or 30-ohms resistance. The base, knob and dial are of bakelite. The resistance wire is wound by a new process so that it cannot loosen and the broad contact area eliminates clicks in the phones, the positive electrical contactor being of thin, springy phosphorus bronze. It has convenient binding posts and standard 1-in. spaced mounting holes. The "off" and "on" contacts are positive.



The improved Pacent "Forty" universal plug may be easily and conveniently attached to the phone tips and plugged into the jack. It has a bull-dog grip of new design and its conducting parts insure perfect contact. The gripping parts are stamped with polarity data and no live parts are exposed. Assembling the plug shell locks the grip and taking it apart unlocks the grip and releases the cord tips.

The Grewol Vari-Grid is a combined variable condenser and variable grid leak that occupies but 1¾-in. space on the panel and is mounted by but one hole. As the grid leak is removable and replaceable this instrument may be used for either or both functions. It is adapted for use in the aerial and secondary circuit, as well as in the grid circuit.



The Sterling "Right Resistance" Pocket Voltmeter is especially designed for the measurement of *B* battery voltage. It has a resistance of 800 ohms. It may be used to test the voltage of both *A* and *B* batteries.

The new 1924 Four-Way switch plug has positive spring locking terminal connectors that do not allow tips to work loose. With this device two head sets or a head set and loud speaker may be switched on or off without removing the plug from the jack.

CALLS HEARD

Continued from page 41

By 9ZT, 54 Penn Ave., No., Minneapolis, Minn.

(1er), (1hx), 1ll, 1sn, 1xm, 1vv, (1yb), 1yd, 1yk, 1ada, 1aja, 1aqi, 1bcg, 1bgk, 1boq, (1ckp), (1cmp), 1crw, 1csu, (xaq), 2ah, 2bx, (2gk), 2ig, 2kf, 2ku, 2pa, (2rb), 2rk, 2sh, 2ts, 2wb, (2xq), 2afp, 2agb, 2ana, 2awh, 2bkq, 2bmr, 2brh, 2brb, 2brc, (2bte), 2bxp, 2bxw, 2cfb, 2cjr, 2cka, (2cqz), 2csl, (2cxd), (2cxl), (2xaq), 3ab, 3bw, 3hg, 3hs, 3jj, 3me, 3pz, 3ur, 3vo, (3wf), 3xi, (3yp), 3abn, (3adb), 3ajd, 3aln, 3auv, 3avp, 3cfv, 4cr, 4cs, 4db, 3eb, (4fa), 4fg, 4ku, 4mb, 4qf, 5bw, (5ce), (5ga), 5gf, (5gj), (5gm), (5hy), 5in, 5je, 5kc, (5kk), 5kp, 5lr, 5mi, (5mo), 5ql, 5qw, 5sk, (5tj), (5uk), (5ur), 5we, 5wo, (5xv), (5za,) 5zg, 5zm, 5aaw, (5abg), 5abh, (5adh), 5afq, 5agj, 5ago, 5ahh, (5ahr), 5aic, 5dat, 5zas, 5zav, 6ak, 6ao, (6cu), 6fh, 6hp, (6km), 6nx, (6pl), (6ve), 6zh, 6zw, 6adp, (6ahp), 6ahu, 6ajd, 6akz, 6alk, (6alv), 6anb, 6aoi, 6aos, (6avv), (6awt), 6bbc, 6bbu, 6bbw, 6bcl, 6bfg, 6bih, 6biq, 6bjc, 6bjq, (6bpz), 6brf, 6bua, 6buq, 6bur, (6bvg), 6cbp, (6cdg), 6cfz, 6cgw, (6ckr), 6cnh, 6cwa, 6xad, 6zah, (7hg), (7hw),(7ih), (7ks), 7ln, 7lr, (7qj), 7ry, 7sc, (7sf), 7to, 7wm, 7wp, (7ws), 7zi, (7abb), 8aea, 7ael, (7afn), (7age), 7agr.

Can.: 2bn, 2cg, (5go), (5cn).

Bowdoin—wnp.

By 9EFC, 404 Brice Ave., Columbia, Mo.

1aky, 1apc, 1asi, 1aur, 1bdi, 1bhk, 1cm, 1cmp, 1cpi, 1cpn, 1fb, 1jt, 1mo, 1pa, 1sd, 1sn, 1vv, 1yb, 2awf, 2cqz, 2cxl, 2kk, 2om, 2rb, 3abw, 3adv, 3bcn, 3bdo, 3bei, 3bni, 3bnu, 3bwt, 3lp, 3me, 3su, 4ag, 4cs, 4eb, 4eq, (4ku), 4mb, 6aak, 6agk, 6ajd, 6ajf, 6alv, 6ao, 6arb, 6aup, 6avv, 6awt, 6bbc, 6beo, 6bgy, 6bh, 6bjq, 6bpz, 6bql, 6buo, 6cai, 6cbd, 6cbi, 6cek, 6cff, 6cfi, 6cfs, 6cfz, 6cgw, 6chl, 6ckp, 6cu, 6fy, 6hp, 6ii, 6pl, 6rm, 6ts, 6vf, 6xad, 6zr, 6zar, 7abb, 7aek, 7bj, 7cf, 7go, 7hg, 7hw, 7ks, 7lw, 7ly, 7nn, 7oh, 7qj, 7sc, 7sf, 7wm, 7ze, 7zu.

Can.: 2cg, (3ad), 3bg, 3fc, 3gk, 3he, 3in, (3jt), (3ko), (3ni), 3qs, 3xi, 3yh, 3zt, 4cl, 4cn, 4co, 4cr, 4nq, 4er, 4fn, 4hh, 5cn, 5go, 9bx.

Mex.: (bx).

By 6BUR, Whittier, Calif.

1sg, 1aiv, 2rk, 2bqh, 2brb, 3ab, 3gk, 4cn, 4eb, 4el, 4kc, 5ks, 5bm, 5ct, 5di, 5ek, 5fa, (5hq), 5ht, 5in, 5kc, 5kg, (5lr), 5ph, 5qi, 5qq, 5vf, 5abb, 6adb, 6ado, 6agj, (5ahd), 5ahr, (5aij), 5aiu, 5akc, 5aky, 5ama, 5xv, 5za, 5zav, 5zax, 6fy, 6pe, 6rm, 6buh, (6bui), 6cev, 6chw, many others, 7af, 7dc, 7go, 7hw, 7ih, 7io, 7it, 7iw, 7jd, (7lh) daylite, 7ln, 7ly, 7no, 7ot, 7qd, 7qj, 7qt, (7rd), 7sc, 7sh, 7so, 7sy, (7to), 7uu, (7vn), 7wm, 7abb, 7aby, 7acx, 7adg, 7adr, 7age, 7ajy, 7akh, 7ya, 7yl, 7zn, 7zo, 7zt, 7zu, 7zv, (8aa), 8ab, 8gz, 8afc, 8aib, 8bda, 8bdu, 8bfh, 8bvt, 8cko, 8xe, 8yn, 8zz, 9bp, 9cr, 9mc, 9wu, 9aau, 9aaw, 9afm, 9afy, 9aim, 9amb, 9ami, 9ape, 9apf, 9aph, 9aps, 9ars, 9auu, (9avu), 9avz, 9aws, 9bgc, 8bis, 9bji, 9bjk, 8bly, 9bof, 9bop, 9bpu, 9brk, 9bvo, 9bzi, 9caa, 9cap, 9ccz, 9cfy, 9cga, 9cjg, 9cjy, 9cld, 9cly, 9cte, 9cvs, 9cvu, 9cyb, 9czg, 9czm, 9dfh, 9dhg, 9dky, 9dlf, 9dug, 9dun, 9eae, 9ees, 9eky, 9yu, 9zt.

Can.: 4cl, 4ea, 4er, 5hh, 5cn, 5ej, 5go, 9bp, 9bx.

Mex.: bx, na qra?

Reports on 6bur's 5-watter will be appreciated.

By 5AHD, Altus, Okla.

1bwj, 2wb, 4lj, 4eb, 6awt, 6bh, 6bur, 6cfz, 6cng, 6cmr, 6cbu, 6chu, 6mh, 6cgw, 6aoi, 6buh, 6cgg, 7zd, 8aaw, 8aih, 8apn, 8bcf, 8bfm, 8bnh, 8bda, 8cwc, 8czz, 8cgx, 8cwk, 8daw, 8dgo, 8dat, 8mf, 8pu, 8wx, 8zc, 8sz, 9ady, 9aod, 9ahu, 9aon, 9aje, 9ase, 9aog, 9arc, 9aou, 9agl, 9afr, 9aed, 9ahm, 9awg, 9ait, 9bjr, 9bbw, 9bxy, 9bdu, 9ban, 9bgc, 9bf, 9bcx, (9bji fone), 9boj, 9bqy, 9bnf, 9bjk, 9blg, 9btl, 9huk, 9bvn, 9bir, 9ces, 9czo, 9ckw, 9cjd, 9cgu, 9cdo, 9cea, 9clj, 9cjy, 9cgy, (9ccv fone), 9cml, 9cdb, 9cfi, 9cou, 9day, 9dtt, 9dnd, 9dej, 9dkx, 9dfh, 9dsw, 9dgx, 9dpx, 9dkq, 9dhb, 9dvk, 9dgv, 9dch, 9eky, 9efu, 9egg, 9ekc, 9edm, 9eld, 9eht, 9mc, 9qw, 9zy, 9iw, 9elw, (9wi fone), 9gc.

Can.: wkd, 3ir, 3ni, 5cn.

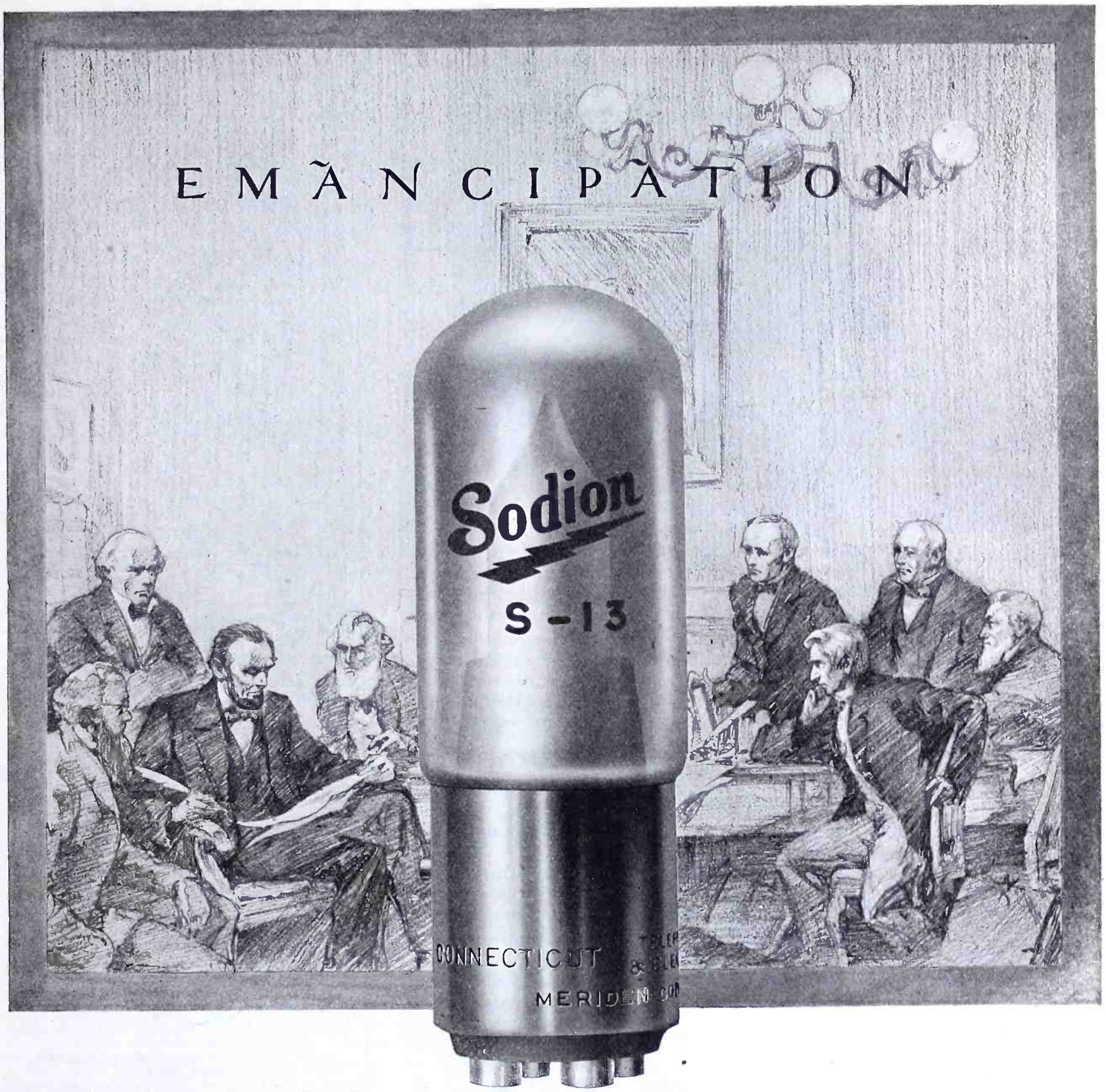
By 5AHD, B. H. Huff, Box 424, Altus, Okla.

(1atj), 1boq, 1wd, 1xm, 1yb, 1zi, 2bjx, 2bqe, 2cda, 2ckk, 2cpa, 3ab, (3agf), 3bij, 3btl, 3lv, 3ph, 3tr, 3uz, 4au, (4co), 4db, 4ku, 4lm, (4mi), 4rr, 5's too numerous, 6ajj, (6aqd), (6aru), 6bjj, 6bve, 6cae, 6cbg, 6cgw, 6chu, 6cnh, (6cnl), 6eu, 6mh, (6nb), 6nn, 6zh, (7abb), 7adr, 7aje, (7oo), (7hw), 7ly, 7mp, 7sc, 7to, 7yl, 7zu, 8agc, 8ago, 8ajh, 8aju, 8ard, 8bbi, 8buv, (8cgm), (8cgu), (8cmu), (8coj), 8cpk, 8czz, (8dbm), (8dcb), 8ei, 8gz, 8hy, 8vg, 8za, 8zc, 8zf, 8zz, 9's too numerous—over 150.

Fone—5agg, 5ahj, (5amf), 5amw, 5ej, 5fa, (5uy), (9aic), (9cnt), 9csv.

Can.: (3gc), (3ia), 3om, (3si), (4cl), (4dk), (5cn).

Continued on page 46



The Golden Rule Tube

The Sodion brings a benefit to Radio infinitely bigger and better than any superiority of range, strength or quality of tone.

It opens the way to emancipation from one of the greatest faults in broadcast reception today—reradiated interference.

Based on an entirely new principle; Differing materially both in the design and in the arrangement of its elements;

Making an absolutely original use of the peculiar properties of the sodium ion;

The Sodion not only produces stronger signals than any other detector on the market, but it does this without resort to oscillation, regeneration or other expedients.

Just what this means to you—to every other broadcast receiver—and to the art of radio in general, will best be understood when you realize that the whistles, squeals, and howls that interfere so seriously with your reception are due to nothing other than the oscillations in ordinary detectors.

Descriptive Circular upon request.

Under date of January 21st a Boston user, among other things writes:

"May I add that it is a source of satisfaction for me to know that in operating my Sodion I am in no way interfering with the pleasure of my neighbors."

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
MERIDEN Radio Division **CONNECTICUT**

Tell them that you saw it in RADIO

Continued from page 44

By 7AIY, Frank A. Mueller, Jr., 514 N. 2nd St., Wenatchee, Wash.

C. W.: 1bhw, 1yb, 2ayv, 1ccd, 2rk icw, 2wr, 2zt, 3cjn, 3jj, 4aw, 4db, 4jh, 5abh, 5ahr, 5aij, 5akn, 5bw, 5ek, 5gj, 5gm, 5km, 5kn, 5lr, 5mi, 5pa, 5qi, 5uk, 5up, 5yg, 4zav, 5zax, 6aak, 6acm, 6acw, 6adm, 6afq, 6afz, 6age, 6agk, 6agt, 6ahc, 6ahp, 6ahu, 6aji, 6alk, 6ame, 6anb, 6aoi, 6aos, 6apr, 6arb, 6atc, 6atv, 6atz, 6auc, 6auu, 6auy, 6avv, 6awt, 6bbw, 6bdb, 6bds, 6bez, 6bic, 6biq, 6bjq, 6blm, 6blz, 6bmy, 6bni, 6bon, 6bpl, 6bql, 6brf, icw, 6brk, 6bts, 6bsg, 6bsj, 6bua, 6buh, 6bur, 6bvn, 6bzs, 6cbk, 6cde, 6cdg, 6cec, 6cee, 6cej, 6cet, 6ceu, 6cfy, 6cfz, 6cge, 6cgw, 6chc, 6chl, 6chu, 6chw, 6cia, 6cjj, 6ckp, 6ckr, 6ckv, 6cmi, 6cmt, 6cmu, 6cnh, 6czk, 6ak, 6ao, 6cc, 6ea, 6eb, 6et, 6fc, 6hc, 6hp, 6js, 6jx, 6km, 6lv, 6lx, 6mh, 6nx, 6pe, 6pl, 6su, 6xad, 6xl, 6zah, 6zau, 6zbc, 6zh, 6zx, 8aaf, 8ack, 8ago, 8aih, 8aje, 8ajh, 8bbw, 8bcp, 8bda, 8bfm, 8bwz, 8cci, 8cez, 8cjd, 8cjm, 8cjp, 8cpd, 8crw, 8cud, 8cyt, 8daw, 8dbl, 8dgo, 8dig, 8dio, 8ab, 8av, 8bf, 8bt, 8cc, 8dw, 8fm, 8kg, 8px, 8rk, 8tr, 8ue, 8xan, 8xe, 9aav, 9aaw icw, 9aec, 9aem, 9aic, (9aim), 9afm, 9amb, 9ami, 9amp, 9aou, (9apf), 9aps, 9asf, 9auu, 9avz, 9awv, 9bez, 9bfp, 9bhd, 9bji, 9bjk, 9bly, 9bmx, 9bxm, 9bxu, 9bzi, 9cfy, 9ccz, 9dfh, 9dge, 9dhg, 9dkx, 9dgn, 9dlf, 9dmj, 9dnx, 9dsw, 9eea, 9elv, 9bg, 9dc, 9ei, 9mc, 9nu, 9vm, 9xi, 9zg, 9zt, 9zy.

WNP, 500 cycle icw.

Can.: 2bn, 3bp, 3co, 3si, 3tc, 4cl, 4cw, 4sh, 9bp.

By 3BVA, 40 S. Beaver St., York, Penna.

C. W.: (4af), (4ay), (4bw), 4bx, (4by), 4cm, (4cs), (4dx), (4eq), (4el), (4ft), (4gx), 4hs, (4hw), 4hz, (4mi), 4nv, (4oa), 4od, (4pk), (4rh), (5aag), 5aac, 5aat, 5agd, 5ajj, 5ajp, 5akn, 5aki, 5air, 5aiu, (5alx), 5amh, 5ap, 5bz, 5cv, 5ek, 5fv, (5ga), 5gg, 5gp, 5ht, 5in, 5je, 5kn, (5kr), 5lg, (5lr), 5nn, 5nv, 5ov, 5pv, 5qi, (5ql), 5qq, 5qy, 5tj, (5uk), 5vv, 5up, 5ws, 5xd, 5yw, (5zav), 5zb, 5zax, 5zap, 6acm, 6adt, 6agk, 6aja, 6ajh, 6akz, 6aos, 6auu, 6awq, 6awt, 6bcl, 6beo, 6bh, 6bic, 6bih, 6bpz, 6bqb, 6bra, 6buh, 6buo, 6bum, 6bve, 6bvg, 6cbg, 6cbu, 6cdg, 6cfi, 6cfz, 6cgd, 6cgw, 6chl, 6cjb, 6ckp, 6cmr, 6ec, 6fp, 6fy, 6gr, 6mh, 6pe, 6pl, 6pp, 6pz, 6vf, 6wt, 6zah, 6zaj, 6zar, 6zh, 6zp, (6xad), 6zba, 6zbc, 6zbk, 7abb, 7aci, 7adr, (7co), 7fd, 7hg, 7it, 7jd, 7lu, 7qj, 7sc, 7sf, 7yl, 7zr, 7zt, 7zu, 7zx, 9aec, 9aep, 9ago, 9ajl, 9ahz, (9ahj), 9aon, (9and), (9aom), 9aou, 9apf, 9aps, (9aqk), 9aqr, (9arf), (9aru), (9ash), 9asn, (9asl), 9asr, 9auw, 9avu, (9awf), 9awv, 9axd, (9axx), (9ayl), (9ayx), (9bab), 9baf, (9bby), 9bde, (9bed), (9bff), (9bfi), 9bg, 9bgi, (9bgt), 9bhy, 9bji, 9bjk, 9blg, (9bp), 9bqj, (9bqy), (9brk), 9bdi, 9bto, (9buh), 9bvn, 9bxt, 9byc, (9ca), 9caa, 9cah, 9ccs, 9ccz, 9cdo, 9cho, 9cih, (9ckm), (9clj), (9clz), 9cnb, 9col, (9cra), (9csn), 9cte, 9cui, 9cvs, (cwz), 9czo, (9cyw), 9czm, 9dcr, (9dct), 9dcw, 9ddi, (9ddu), 9dge, (9dhs), 9dhr, (9djn), (9dhg), 9dli, (9dmc), (9dni), 9dnd, 9doe, (9dra), 9dsq, 9dsw, (9dvw), (9dwa), 9dxu, (9dyy), 9ecn, (9ecv), 9edg, (9eez), 9eea, 9eer, 9efe, 9efh, 9egp, (9ehi), 9ehn, 9ehq, (9eht), 9ehx, (9elv), 9eky, (9ir), 9lk, 9ln, 9ma, 9mc, 9qj, (9qr), (9st), (9vm), (9vz), 9zt.

Can.—1dd, (2bg), (2bn), (2dn), 2hv, 2iv, (2ic), 3at, (3cq), 3ds, 3gk, (3jl), (3oh), 3om, (3ph), 3pz, (3xi), 4cl, 4dy, 4ea, 4hh, 5go, 9cd.

English—2sh, 6ni. French—8ab.

Spark: (4bl), (4mv).

By 8ATN, 166 Grand East, Highland Park. Mich.

6acm, 6ah, 6ahf, 6amb, 6anc, 6aoi, 6auu, 6bcl, 6beh, 6bji, 6bjj, 6bjy, 6bua, 6bun, 6buu, 6buy, 6cdg, 6cfz, 6cgw, 6cgu, 6cha, 6ckp, 6en, 6et, 6fp, 6gr, 6ha, 6lu, 6lv, 6mh, 6qx, 6su, 6xad daylite, 6zar, 6zh, 6zt, 6zx, 7abb, 7adh, 7aki, 7co, 7hw, 7io, 7mp, 7sc, 7zu, 7zt, wnp. Glad to have reports on my 50-watter.

By 8CQH, 1221 Ninth Avenue, Huntington, West Virginia

(1af), 1aw, 1de, 1kc, 1my, (1on), (1rv), 1xm, 1zd, (1adn), 1aez, 1atj, 1apm, 1avj, (1bhq), 1boh, (1bqk), 1caz, (1cki), 1cmp, (2by), 2lv, (2atz), 2bjo, 2bjx, 2brb, 2bum, 2ckj, (2cpo), 2cwj, (2xna), (3hs), (3ud), (3yp), (3cel), 4db, 4mb, (4qw), 5bw, (5da), 5ek, 5lr, (5nz), 5nj, 5ql, 5sg, (5uk), 5vv, 5za, (5aag), 5ajq, (5agj), (5amh), 5zas, 6bh, 6fc, 6fp, 6gh, 6jx, 6ka, 6km, 6lv, 6mh, 6nx, 6pl, 6vf, 6zh, 6zq, 6ajh, 6aos, 6aov, 6auy, 6avv, 6awk, 6awt, 6bbw, 6bcl, 6bcs, 6bhu, 6bic, 6bih, 6bjj, 6bli, 6blm, 6bnc, 6boh, 6bqb, 6brf, 6bsh, 6bua, 6buo, 6bve, 6cbu, 6cde, 6cfz, 6cgo, 6cgw, 6chu, 6chv, 6cic, 6crr, 6ckr, 6cts, 6ctt, 6xad, 6zbl, 7du, 7em, 7gs, 7km, 7ng, 7we, 7ve, 7zd, 7zo, 7zu, 7abb, 7agr, (9af), 9eq, 9in, 9ot, (9tn), (9vc), (9aad), (9aag), (9aek), 9amb, 9avg, 9bak, 9bji, 9blt, 9bnb, 9bri, 9brx, 9buk, (9bwf), 9bwn, 9bxq, 9ccf, (9cfz), 9cho, 9cjy, 9cmd, 9csy, 9dct, 9dlr, 9dnd, 9dnn, 9dro, (9dsl), 9dsw, 9dte, (9dxn), 9dyy, 9dyz, (9eac), 9eak, 9ecv, 9eea, 9ehx, 9ell.

Can.—2be, 2bg, 2hv, (3jj), 3oh, (3tf), 3vw, 5cn, 5go.

By 8DBM, Wooster, Ohio

C. W.: (1ah), 1ap, 1er, (1ez), (1fd), 1hx, 1ka, 1iv, (1jv), 1ln, 1lc, (1lmy), 1oa, 1rv, 1se, 1sn, 1mc, 1uo, (1va), 1vo, 1vv, 1yb, (1yk), (1afa), 1ajx, (1all), 1aol, 1aqm, 1arp, 1ary, 1aur, (1avk), 1avl, (1awe), 1awk, 1awy, 1bbh, 1bcu, 1bdi, 1bel, (1bgq), 1bop, 1bqc, 1bqm, 1bqd, 1cab, 1ckc, 1cmk, 1cmp, (1cpc), 1cpk, 1cpn, 1cri, (1csw), 1csx, 2af, 2al, 2dx, (2kf), 2ku, 2iu, 2et, 2gk, (2rb), 2rk, (2ts), (2wr), 2acd, 2acs, 2ahf, (2atf), (2atz), (2awf), 2bbx, 2bbn, 2bgc, 2bjx, 2bmq, (2bdg), (2bqb), 2bqc, 2bqh, (2brb), 2brg, 2bsc, 2bsy, 2bte, 2bwp, 2bxp, (2bxw), 2ccd, 2cee, 2cei, 2cgb, 2cgi, 2chx, 2cla, 2cmf, 2cnk, (2cpa), 2cpk, 2cur, (2cvj), (2cwj), 2cwp, 2cxy, 3ab, 3cc, 3gc, (3gl), 3hh, 3hj, (3hs). 3ii, (3iw), (3lg), 3lx, 3me, 3mk, 3oq, (3qt), (3tr), 3uu, (3vo), 3wf, 3abw, 3acy, 3adb, 3adq, (3aek), 3agf, 3afs, (3ahp), 3ajd, (3aln), 3aqr, 3arm, (3atb), 3avm, 3avy, 3bav, 3bbv, (3bdo), 3blp, 3bml, 3bmo, 3bof, (3bpf), (3btl), (3cah), 3cbg, 3ccv, 3cdv, (3bvl), 3cfi, 3chj, 3cjn, (3ckl), 4ab, (4af), (4ay), (4dx), 4ea, 4eb, 4el, 4fz, 4hw, 4ik, 4iu, 4jk, 4ku, 4ld, (4lj), 4na, 4ms, 4qf, 4rr, 4sb, 5bm, 5ek, 5fj, 5fv, 5fx, 5hl, 5je, 5kc, 5kh, 5mm, 5nn, 5pb, 5ph, (5qi), 5qq, 5qt, (5vm), 5ua, 5vv, 5wo, 5ws, 5xk, 5za, 5zb, 5abb, 5abd, 5adc, 5adh, 5ado, 5afq, 5agv, (5ahd), 5ahr, 5aiu, 5ajj, 5ajt, (5alx), 5amh, (5amu), 5anv, 5aom, 6lv, 6pl, 6ik, 6ru, 6fp, 6ss, 6vf, 6zr, 6aau, 6abx, 6agl, 6awq, 6bbc, 6bda, 6bic, 6bkx, 6blg, 6bnc, 6cgw, 6cnh, 7fy, 7jd, 7sc, 7uk, 7wp, 7zd, (8mt), (8acm), (8anm), (8cdi), (8cej), (8cse), 9af, 9ei, 9eq, (9er), 9fm, (9fp), 9fu, 9gd, 9ir, 9lw, (9mc), 9px, 9qb, 9qe, (9st), 9tn, 9ur, 9vm, 9vz, 9yu, 9yy, 9zt, 9aad, 9aaq, 9aau, 9adm, (9ady), 9aec, 9aej, 9aem, 9ael, (9aep), 9agb, 9ahq, 9ahv, 9aiu, 9ali, 9amb, 9amu, 9amv, (9ach), (9aog), 9aon, 9apf, (9aqb), 9aqd, 9arc, (9arr), (9ase), 9ash, (9atn), 9aud, 9aus, (9avf), 9awv, 9axu, 9ayl, 9ayx, 9azp, 9bab, 9bak, 9bal, (9bcx), 9bdl, 9bdu, 9bed, 9bgc, 9bgt, 9bhd, (9bhi), (9bhx), 9bis, 9bko, 9bkr, 9blg, 9bmx, 9bop, 9bri, 9brk, 9brs, 9bsg, 9bta, 9bvu, 9bwb, 9bwv, 9bxq, (9byc), 9caa, 9ccn, 9ccs, 9ccw, (9ccz), (9cdo), 9ced, (9ceh), 9cej, (9cfk), 9cgy, 9cga, 9cjc, 9cjh, 9cil, 9cip, 9cji, 9ckw, 9cmc, 9cms, 9cno, 9cow, 9csy, (9cte), 9ctu, 9cwf, 9cyd, 9cyf, 9cyv, 9cyw, 9czi, 9czm, 9day, (9dch), (9dhr), 9dky, 9dli, 9dlw, 9dmj, 9dmn, 9dov, 9dpp, 9dpx, 9dqm, 9dqs, 9dqu, (9drc), 9dro, 9drw, 9dso, 9dsw, 9dsz, (9dxu), 9dyh, 9dyr, 9dzi, (9dzs), (9eac), 9eae, (9eak), (9edm), (9eer), 9efh, (9efu), (9efz), 9ehj, (9eht), (9eja), 9eju, 9ejz, 9ekf, (9eky).

I. C. W.—1af, 1ckp, 2cx, 2kf, 2kv, 2rk, 2wz, 2aiv, 2cpk, 3qt, 3bwt, 3ckw, 4bq, (5amu), (8eb), 8ve, (8avj), 8awp, 8bgd, 8cdi, 8cga, (9mc), 9aaw, 9amk, 9aml, 9ash, 9ayh, 9bds, 9bed, (9bjr), 9bwu, 9cax, 9ccs, 9cfi, 9cvo, 9cwl, 9dcw, 9dqu.

Can.—1ee, 2ad, 2az, 2bg, 2cg, 2bn, 2by, 2hm, 2mz, 2ts, 2wc, 2bdz, 3ag, 3ia, 3om, (3si), 3tb, 3tr, 3pg, 3qs, 3xi, 3yh, 3zl, 3adu, 9ia.

Mex.—hv, km.

Fone: 4mt, 8bnu, 8dig, 9cfp, 9civ, 9dwk, xyz, (qra?).

Spark: 2ayv, 2bpr, 2bqd, 2bqz, 2cjp, 2ctd, (3bpj), 3brl, 4fd, 4hs, 4mv, 5jd, 8tj, 8bda, 8coa, 9aaw, 9amz, 9bpd, 9bux, 9crm, 9dil, 9dwk, 9edf, (9efc), Can.—2ad.

Daylite—C. W.: 1fd, 1ii, 1kc, 1kx, 1um, 1wj, 1xm, 1yk, 1aez, 1afa, 1afn, 1alj, 1bcu, 1boq, 1bqd, 1bqk, 1bqm, 1cmp, 2xq, 2aay, 2bmr, 2bnu, 2bqd, 2bsh, 2cla, 2cpa, 2cvj, 2cvs, 2cwj, 2cxl, 3as, 3ba, 3ck, 3iw, (3pz), (3yp), 3ahp, 3bhm, 3bva, 3ccv, (3ckl), 4ft, 4fz, (4mi), (el-5), wx-5, 6aak, 6bih, 9es, 9kd, 9mc, 9pf, 9vc, 9vz, 9wy, 9ach, 9arc, 9arr, 9ayj, 9bak, 9bex, 9bez, 9bgc, 9bjr, 9boe, 9byc, 9ccn, 9ccs, 9cdo, 9ctr, (9daw), (9diw), 9dix, 9dkx, 9dlo, 9dsl, 9dsw, (9dro), 9dwa, 9dyy, 9efz, 9eja, 9eld (Can.), (3aec), 3adu, 3om. Spark: 1bjp, 2buc, 3acy, 8ahe, 8ahu, 8axn, (8bco), (8bfy), (8ctd), 9dqu. I. C. W.: 1dc, 1yp, 2fq, 2lg, 8jj, 8gz, 8wg, (8abl), 8ard, 8dat, 8djf, (8dkm), (9vz), (9ase), 9amk, 9bak, (nkf). Fone: 8al, 8aje, (8djf).

At 8HJ, Elmira, N. Y.

6zah, 6fp, 6cgw, 6aos, 6brf, (6xad), (6chz), 6pl, 6chc, 6zh, 6bcl, 6acm, 6alk, 6bve, 6zar, 6awt, 6mh, 6bbc, 6bih, 6ajp, 7yl, 7alk, 7sc, 7co, 7adr, 9auw, 9apf, 9caa, 9azp, 4ja, 5xd.

Can.—4hh, 5cn.

By 6XBJ-6ZE, 1247 Forty-seventh Avenue, San Francisco

2bn, 2co, 3co, 5cn, 5ct, 5ek, 5lr, 5qr, 5ado, 5xd, 5zb, 5zg, 5zav, 6ceu, 8ab, 8mz, 8xe, 8bda, 8cgx, 9kp, 9aim, 9bed, 9bxx, 9cji, 9cld, 9daw, 9dfh, 9dhw, 9dlm, 9xi, 9xaq, 9ym, 9yy, 9zt.

Can.—4cl, 4cn, 4cn, 5ee.

By 6CNL, Myron Hexter, 127 N. Serrano Ave., Los Angeles, Calif.

1er, 1hx, 1kc, 5gj, 5gm, 5in, 5pb, (5ht), (5sd), 5tj, 5xv, (5ahd), 5ahr, 5zav, 5zax, 6ceu, other sixes too numerous to mention; 7co, (7ez), (7ks), 7gi, (7lh), 7lr, (7ob), (7sc), 7zf, 7zu, (7zz) qra?, 7ahi, 7ahv, (7ajy), 7aqt, 8zz, 8bda, 8bfm, 8bnh, 8boy, 9an, 9rc, (9ss), (9vm), 9zt, 9aim, (9amb), (9apf), 9awc, 9azg, 9bhd, 9bik, (9bsg), 9bxq, 9caa, 9ccs, 9cea, 9ctn, 9cvo, 9czg, 9dfh, 9dli, 9dxn, 9dxy, 9auw, 9yy, 9yaj, Can. 4cl, 4ea, 5cn, (5go).

Anyone hearing my C.W. sigs. pse. qsl crd. All reports answered and appreciated. qrk?

By Can. 3DU, 424 Horton St., London, Ont.

1ci, 1ee, 1er, 1fd, 1gl, 1gs, 1ii, 1il, 1jv, 1kc, 1mq, 1og, 1rr, 1va, 1vq, 1uo, 1wo, 1xm, 1xp, 1yb, 1yk, 1zh, 1zi, 1afa, 1agi, 1ahl, 1aja, 1ajt, 1alj, 1aoc, 1aol, 1ary, 1asu, 1avf, 1avj, 1awe, 1aww, 1axo, 1bdi, 1bdt, 1bgt, 1bkr, 1bkz, 1blu, 1bnl, 1boa, 1bom, 1bsj, 1btt, 1boq, 1buy, 1bvb, 1cab, 1cak, 1caz, 1cki, 1cpn, 1csw, 1cus, 1xam, 2ah, 2by, 2di, 2dh, 2em, 2gk, 2fz, 2hg, 2mj, 2mu, 2pv, 2rm, 2rk, 2rb, 2sm, 2sq, 2up, 2wb, 2aar, 2acc, 2acs, 2aja, 2ajf, 2ami, 2anh, 2aqb, 2aqr, 2ars, 2azy, 2bdg, 2bbx, 2bei, 2bkl, 2blm, 2bms, 2bqu, 2brb, 2bri, 2bum, 2bxd, 2bxw, 2byg, 2bzv, 2cvj, 2cyx, 2cpa, 2coh, 2cnh, 2cxd, 2cyw, 2cwk, 2chg, 2cph, 2cwp, 2cpq, 2cwj, 2ccd, 2csb, 2cee, 2cqn, 2cua, 2cwi, 2cgh, 2xna?, 3zm, 3tr, 3zo, 3gc, 3oq, 3vw, 3hh, 3dj, 3bd, 3su, 3as, 3bx, 3iw, 3sh, 3pz, 3ay, 3ft, 3lg, 3vo, 3wx, 3qt, 3ay, 3lx, 3vp, 3agb, 3ajd, 3ahp, 3acr, 3ahy, 3ajb, 3amw, 3arm, 3anq, 3brl, 3bof, 3bez, 3blc, 3bss, 3bfx, 3brw, 3bfq, 3bqp, 3bif, 3buv, 3bjy, 3bwt, 3bva, 3bgj, 3bji, 3btq, 3bta, 3bpm, 3bei, 3cjn, 3cej, 3chg, 3cho, 3ccx, 3caf, 3cvc, 3cjp, 3cel, 3cdv, 3chb, 3cfv, 3ccv, 4af, 4on, 4oa, 4mb, 4gw, 4el, 4go, 4eq, 4by, 4lj, 4me, 4db, 4qf, 4ob, 4gl, 4my, 4fg, 4dk, 4ll, 4mb, 4za, 4qw, 4eb, 4mr, 4hs, 4iu, 4sb, 4ku, 4ot, 4jk, 4ft, 4ea, 4av, 4dx, 4av, 4bk, 4lp, 4it, 4sh, 4dw, 4cg, 5uk, 5qq, 5lr, 5oo, 5ht, 5mo, 5nn, 5mm, 5za, 5hl, 5kc, 5zg, 5pw, 5tj, 5yw, 5fv, 5ek, 5gj, 5nk, 5qw, 5sg, 5wx, 5hr, 5uo, 5kg, 5zk, 5ac, 5sy, 5xt, 5nw, 5up, 5ql, 5bm, 5xd, 5rh, 5vt, 5be, 5dr, 5mq, 5tm, 5in, 5hz, 5zb, 5bz, 5fx, 5dq, 5abh, 5amh, 5akn, 5aga, 5aki, 5anp, 5agj, 5acm, 5aiu, 5air, 5afq, 5abn, 5abd, 5akj, 5ajp, 5aom, 5abb, 5aju, 5ahj, 5afs, 5aby, 5abd, 5amw, 5ado, 5akf, 5zas, 5zav, 6zh, 6su?, 6fp, 6mh, 6lu, 6yb, 6lv, 6wt, 6jx, 6ol, 6bm, 6arb, 6ahu, 6alv, 6awx, 6awt, 6bnt, 6brf, 6bic, 6bve, 6bih, 6bnc, 6bcf, 6blm, 6bpr, 6bcl, 6bqb, 6bur, 6bua, 6beo, 6buo, 6cgw, 6cfz, 6ckp, 6cdg, 6cmt, 6cgb, 6zah, 6zar, 6xad, 7em, 7sc, 7zt, 7zd, 7co, 7yl, 7ba, 7abb, 7adh, 7adr, 8's too numerous, 9auw, 9apf, 9amb, 9avu, 9bjk, 9bji, 9bun, 9bkf, 9bto, 9bvo, 9cld, 9dfh, 9dte, 9eae.

Can.—1dd, 2by, 2az, 2be, 2bg, 2bn, 2cg, 3ni, 3ws, 3nf, 3afp, 4cl, 4hh, 9bx, 5go.

Fone—9dfc, 9ehi.

By 6BEZ, 407 Hillside Court, Piedmont, Calif.
(Near San Francisco)

U. S.—1aac, 1cmp, 1ts, 3bgj, 4ft, 4io, 5adb, 5ado, 5agj, 5ahr, 5aiu, 5ajj, 5akf, 5akn, 5alj, 5alx, 5ama, 5ap, 5au, 5be, 5bm, 5dw, 5dn, 5ef, 5ek, 5fa, 5fv, 5ga, 5gm, 5ht, 5if, 5jj, 5kc, 5kg, 5la, 5lg, 5lr, 5ml, 5mn, 5mo, 5ov, 5ph, 5qi, 5ql, 5qt, 5qy, 5rg, 5sg, 5tj, 5ua, 5ui, 5vf, 5xd, 5xt, 5yw, 5za, 5zas, 5zav, 5zax, 5zb, 5zk, 8agc, 8aih, 8ard, 8asv, 8bda, 8bdo, 8bfm, 8bmg, 8bvt, 8bxx, 8cdd, 8cgx, 8cjd, 8co, 8cp, 8cpp, 8crn, 8cyx, 8dig, 8do, 8dkb, 8fu, 8gz, 8hv, 8ju, 8kg, 8oz, 8pl, 8qk, 8xan, 8xn, 8xt, 8yn, 8yv, 8zy, 8zz, 9aa, 9aau, 9abx, 9acz, 9ady, 9aec, 9aem, 9afo, 9afy, 9agb, 9ahj, 9ahq, 9aim, 9ajv, 9amb, 9aon, 9aou, 9ape, 9apf, 9aps, 9arm, 9atn, 9aua, 9aus, 9avn, 9avs, 9avu, 9avz, 9aws, 9awv, 9axb, 9axx, 9azg, 9bak, 9ban, 9bds, 9bdu, 9bed, 9bez, 9bg, 9bgh, 9bis, 9bji, 9bjk, 9bly, 9bmz, 9boe, 9bof, 9boz, 9bqj, 9bri, 9bto, 9btt, 9buh, 9buj, 9bun, 9bvo, 9bxq, 9bzi, 9caa, 9ccm, 9ccs, 9ccv, 9ccz, 9cdj, 9ceh, 9cfy, 9cga, 9cgu, 9cht, 9cid, 9cil, 9cjc, 9cjs, 9cjv, 9cjy, 9cld, 9clq, 9cly, 9cns, 9cpu, 9cr, 9cra, 9ctr, 9cvc, 9cvi, 9cvs, 9cvt, 9cxp, 9czg, 9czm, 9czw, 9daw, 9dce, 9dcw, 9dep, 9deq, 9dew, 9dfh, 9djb, 9dkb, 9dky, 9dli, 9dly, 9dmj, 9doe, 9dsw, 9dug, 9dun, 9dvw, 9dxn, 9dxy, 9dyr, 9eb, 9ebt, 9eea, 9eeg, 9eer, 9efe, 9eg, 9ehj, 9eht, 9ei, 9eky, 9ell, 9elv, 9eq, 9fm, 9hg, 9mc, 9nu, 9qe, 9rc, 9ss, 9uh, 9uu, 9vm, 9vz, 9xaq, 9xi, 9yam, 9yat, 9yy, 9zg, 9zn, 9zt, 9zy.

Can.—3co, 3ni, 4cl, 4cw, 5ah, 5cn, 5ct, 5go, 9bp, 9bx. Mex.—bx. Crds answered promptly. Any rpt on my 10 watts?

By 2ZA-2AFP, Geo. Milne, 142 Totowa Road, Patterson, N. J.

U. S.—3yw-fone, 4af, 4ag, 4ai, 4ay, 4dl, 4ea, 4el, (4iz), 4jk, 4jr, 4nv, 4on, 4pk, 4pv, 4qw, 4rr, 5abm, (5abn), 5aew, 5agj, 5agv, 5ahj, (5ahr), (5aiu), 5akn, 5anc, (5be), 5bs, 5bw-spk, 5bx, (5dw), 5ft, 5fv, 5ht, 5in, 5iq, 5kn, 5nn, 5nq, 5ov, 5pa, 5qi, 5qt, (5sd), 5tj, 5to, 5uy, 5vf, 5vm, 5vv, (5zav), 5zax, (6aak), 6akf, 6akm, 6anb, 6aos, 6atz, 6auu, 6awt, 6bc, 6bic, 6bjj, 6brf, 6cfi, 6cfz, 6ccw, 6chz, 6cmr, 6cnh, 6gn, 6gr, 6lv, 6oa, 6ol, 6pl, 6xad, 6zah, 6zba, 6zw, 7abb, 7abt, 7agf, 7hw, 7ih, 7sc, (7to), (8aab), (8oe), 9aaw, 9aci, 9aec, 9ael, 9aem, 9aic, 9aje, 9amb, 9amu, 9aog, 9ap, (9arf), 9ash, 9atn, 9aud, 9aus, 9avn, 9awf, 9awz, 9axb, 9axx, 9ayh, 9ayx, 9bbi, 9bbv, 9bcb, 9bdk, (9bed), 9bfb, 9bgc, 9bib, 9bic, 9bis, 9bjc, 9blf, 9blg, 9blu, 9bmx, 9boz, 9bpy, (9bqj), 9bqy, (9bri), 9brk, 9brx, 9bsi, (9bwn), 9bwp, 9cao, 9ccn, 9ccs, 9cdo, 9cdv, 9ce, 9cea, 9cee, 9cho, 9cks, 9clq, 9clz, 9cnb, 9col, 9con, 9cp, 9csb, 9ctc, 9ctr, 9ctu, (9cuc), 9cvd, 9cvo, 9cvv, 9cwf, 9cyf, 9cyd, 9czl, 9czm, 9czs, 9czw, 9dbn, 9dcw, 9ddh, 9dek, 9dfb, 9dhg, 9dhr, 9djn, 9djq, 9dkb, (9doe), 9dqu, 9dsw, 9dvq, 9dxh, 9dxn, 9dyj, 9dyy, 9dzx, 9eak, 9ear, 9eer, 9efj, 9efq, (9eky), 9ela, 9eq, 9es, 9ih, 9hk, 9lz, 9mf, 9mm, 9qr, 9ru, 9wu, 9xn-fone, 9yu, 9zt.

Can.—1bq, (2bn), 2dn, 2ic, 3gg, 3if, 3iv, 3qi, 3qs, 3nf, 3tb, 3xi, 3yv, 4er, 4hh, 9bj. English—5ad, 5at. French—8bm.

Continued on page 79

TO SEA OR NOT TO SEA

Continued from page 22

from his uncle who owned a ranch a few miles off the railroad in the coast range foothills. He was invited to visit the ranch and stay as long as he might wish.

He resigned, outfitted himself, and wired his uncle all in the same afternoon.

The next day found him rattling along, more or less uncomfortably, in the inevitable Lizzie, to his future home. He unburdened his wave-washed soul to his uncle who, though expressing the keenest sympathy, seemed to see a certain amount of humor in the situation.

"Well, Jimmy, we're only twenty miles from the coast here, you know."

"Holy mackerel!" ejaculated the other, "is that all?" He looked apprehensively over his shoulder as if expecting to see the waters of the Pacific rolling up behind them and gave vent to a sigh of relief when the broad fields and green foothills were the only things which met his view. The half day's ride from San Pedro had lead him to believe that they must be at least a hundred miles inland. In reality they had been traveling straight up the coast.

"You're safe enough here", his uncle reassured him as they neared the ranch house. "The only person in the whole country that smacks of salt water is Captain Nelson, and he lives five miles away."

"Who's he?" questioned the other suspiciously.

"A retired sea captain. Bought a place here about a year ago. Said he came here to get away from the ocean. In two months he was trying to put a rudder on the plow and was hollerin' starboard and port at the horses." O'Brien's uncle chuckled.

The ex-brass pounder sniffed. Five miles was quite a distance. He could easily keep away from Captain Nelson.

Safely ensconced at the ranch bungalow in a cheerful room opening upon the veranda, O'Brien sat by the open window looking out over the surrounding hills. He drank in huge breaths of the spring-scented air. Sweet, fresh air—not a whiff of salt! And how peaceful! No rattle of chains through the pipes forward; no "Steady" rolling down from the bridge; no midnight frolic with lumbering cockroaches who galavanted indiscriminately over your face. At last the place of his dreams! He would stay here forever.

FOUR wonderful weeks slipped by, four weeks filled with a great peace and much fresh air. O'Brien was transcendently happy. He had found the ideal life. Then suddenly one day a subtle change seemed to creep over things. He wasn't quite so peaceful as before. He developed a restlessness and he couldn't sleep. He seemed to be look-

Continued on page 52

Continued from page 50

ing for something that wasn't there, expecting something to happen that didn't. He took to sitting at his window evenings, looking westward over the hills, and, after a while, he began to wonder just where the blue waters of the Pacific joined them and if ships passed within sight of land.

The ranch had no daily newspaper, but one day at the little railway station O'Brien bought one from the "newsie". He kept the shipping page for days and made no attempt to explain the satisfaction which came from scanning over and over again the ships' radio position reports.

"There's the *Havana*", he would muse. "2000 south of Frisco. Bet he relayed it through the WDF 'cause the mess of gear he has on her ain't good for mor'n 1000 at the outside."

Then he ran across the name of his last ship, the *Crudol* from San Pedro to Yokohama "2900 miles west of San Pedro at 8 P.M".

"Wonder if the red lead artist is still aboard", he chuckled, and somehow the thought almost made him homesick.

Often he accompanied his uncle to the station. As they neared the brow of the highest hill one afternoon on their return journey O'Brien turned around more and more frequently to gaze westward. Something in the blue haze reminded him of the Santa Barbara channel, and it fascinated him. He was roused with a jerk by the quick stopping of the car. His uncle was peering at a black object which lay in the road just ahead of them. O'Brien got out to investigate. His yell caused his uncle to push the flivver into low and almost run him down.

"Good Lord, is it a snake?" he cried as he brought the machine under control.

"A snake? Great gobs of corned beef, no! It's an antenna switch." O'Brien had picked up the bit of gear and was dusting it off with his handkerchief, muttering to himself the while, like a mother who had found the proverbial long lost offspring.

"Come to your father, you relic of old United days. Why, oh why did you ever leave the museum, and how, oh how did you ever get so far from the rest of your antique family?"

He exhibited the find to his uncomprehending uncle, explaining that the thing which had nearly unnerved them both was an old United Wireless antenna switch of the vintage of 1908. They were at a loss to understand how it came to be out there in the road.

"It certainly must have fallen from some machine. Let me see. You remember that other car at the station? That was Captain Nelson's. I remember now that he loaded several crates

Continued on page 54

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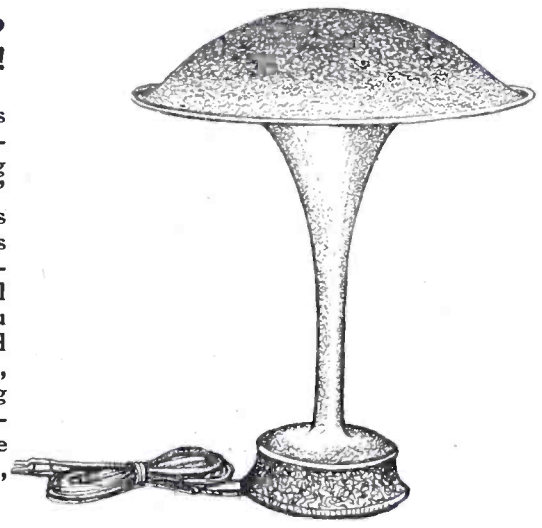

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The Magnavox R3, $35.00 Reproducer is offered this month only. You can have one of these dandy instruments for securing only 20 subscriptions to "RADIO" for one year each. Send us $50.00 and the Magnavox is yours. Shipments made direct from jobbers. All instruments guaranteed to be new and perfect in every respect.

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The 2000-ohm T. B. H. headphones will be given free this month in return for only two subscriptions to "RADIO" for one year each, or one subscription for two years. Send only $5.00 in full payment. This is a $10 offer. You save half. Quick action necessary to get a pair of these good phones.

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

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.....

This premium is to be mailed to:

Name.....

Address.....

Continued from page 52

from the platform. Maybe he dropped this."

O'Brien did not remember the incident, but he took a new interest in Capt. Nelson.

"I'll drive over by his place if you think the thing's worth it?"

"By all means let's see if it is his." Right then that old antenna switch appeared of priceless value to O'Brien.

They stopped in front of the old skipper's house to find him and his son Morris unpacking several boxes which were scattered about the dooryard. After formal introductions, O'Brien held up the switch.

"We ran across this back there in the road. Thought you might have dropped it." A glance at the boxes had told him that they had come to the right place.

"Is that your missin' part, son?" asked the Captain, turning to his boy.

"That's it", said the youngster eagerly. "One box was broken open and I thought sure the switch was gone for good."

"You see", said the retired mariner by way of explanation, "when I was up to the city a few days ago I bought this wireless outfit. It's old stuff and isn't worth much, I guess, but the boy will get a lot out of it."

Wasn't worth much! O'Brien almost snorted. It looked like a million dollars!

"Mind if I give you a hand unpacking it?" The ex-operator tried in vain to make his tone casual.

"Be glad to have you. You and the boy can do it while I show your uncle around a bit."

Before the last crate was emptied, the man who had gone down to the sea in ships and the boy who was just feeling the first thrill of the game, were fast friends.

O'Brien was in his element. He explained the reason for rounding the corners of the foil on the condenser plates and why the reactance coil was wound with large wire. Often he burst forth with tales of many lands recalled by the old equipment. He found the youngster well versed in radio fundamentals, and was surprised to discover that he could already do about fifteen words on the receiving end.

The last piece of apparatus to be unpacked was the old United "coffin" and the two had a good laugh struggling to get it under the table in Morris' room.

"Say, I wish you could come over tomorrow and help me hook her up?" The boy's voice was pleading.

"Will I? Well, I guess yes!" O'Brien grinned at the other. "I'd felt bad for a month if you hadn't asked me." And he meant what he said.

The following day was as happy a one for O'Brien as for the old skipper's son. The latter had just been issued an

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amateur license and already had a receiving station equipped with a vacuum tube detector and two-stage amplifier which he himself had built. They went to work in a businesslike manner to install the new equipment. By noon they were through.

"Guess we've used about everything", O'Brien observed as he finished connecting up the reactance coil, "except that antenna loading inductance. We can't use that on two hundred meters". Reluctantly he laid the piece of apparatus aside.

Then came the testing of the set, and the boy was not the only one who felt a thrill as the key was pressed the first time. When O'Brien left for home that night they had worked four or five amateur stations within a radius of fifty miles.

IN the days that followed the old commercial man was a frequent visitor at the Nelson place. Sometimes his quest of distant ship stations led him to stay far into the night. That invisible web which draws men back to the sea once they have tasted its lure was being slowly rewoven about him. Sometimes he would excuse himself by saying that he was only trying to break the monotony of ranch life; but more often he forgot in his eagerness to offer any excuse at all.

Late one night, after O'Brien had been at the ranch about two months, there came a knock at his door. It was Morris Nelson, his face aglow with excitement.

"Say, just copied an SOS!" he blurted out as soon as he could catch his breath. "Thought you'd like to know."

O'Brien sat up. This kid was sure a dyed-in-the-wool fan to drive five miles just to tell about copying a distress signal. He was not a little thrilled himself. He had copied them too and he knew the kick.

"That so? What was his call and where was he?" he asked quickly.

"Signed WQU and he must be right down here. He's been calling for half an hour but don't seem to raise anyone. That's the reason I came for you. He's below six hundred and usin' a buzzer or something. Anyway it's got an awful note."

O'Brien was hurriedly pulling on his clothes. The boy might be wrong, but it didn't matter. His motto was—if in doubt, make sure. He would have a listen for himself.

The two were soon bumping over the country road.

How natural it seemed to be getting up in the middle of the night! The wind blew from the west in their faces. He had felt the same kind of a wind many times at sea. He thought, no, he was sure it carried a tang of salt. He

Continued on page 58

Far swifter than those of Jack the Giant Killer are the Seven League Boots of the modern boy, who roams the wide world over with his C&W Receiver—"listens in" on New York—strides over a continent to San Francisco—back over the mountains to a far-off southern city, getting news and song and story from every corner of his country.

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Continued from page 56

would not have minded a little rain. He could almost hear NPL's press pounding in at the phones, and the swish of the "old man's" oilskins as he stepped into the radio room and shook water all over the generator.

Twenty minutes later he was at the receiving set and listening on six hundred. Not a peep! Could the boy have been mistaken? Then he remembered that Morris had said that the wave was low. He dropped down a little. A scratching sound, and then—characters of the continental code. O'Brien might have been handling rare china so light was his touch on the dials. His arm stiffened; his hand drew away. He had crossed the spot he had been looking for. A low frequency buzzer was sending:

"We are hard on the rocks. Can't anyone hear us?" Then silence.

Without waiting for more, O'Brien flipped the antenna switch into send position. He turned to the boy.

"You say he signed WQU?"

The other nodded.

Crash, crash, went the old United set on two hundred meters. O'Brien knew that the transmitter was quite broadly tuned and if the other fellow was feeling around he would cross them, especially if he were close.

"WQU! WQU, that you, how?"

The buzzer was back at him. "Who was that called? Pls QRL- min". It was good steady sending even if the note were rough. As he made a few V's for the other fellow, O'Brien remembered where he had heard that sending before. It was Dugan, formerly of the *Bosworth*. He had a peculiar oil-tanker swing!

The old pumphandle key rattled with a professional touch. "That you, DU?" growled the antique.

"Yes, yes," the note was eager now, "wo you?"

"OB", flashed O'Brien. "Shoot me the dope quick and I'll see what I can do for you." He had forgotten the old farmhouse. He was back in the wireless shack, a storm pounding the ship, danger stalking about him. Now as then he rose to meet the emergency, calm and cool, a smile on his lips.

"We're on the rocks fifty miles north Santa Barbara. Generator armature gone—hooked up this buzzer but don't seem to get out with it. Heavy sea running and we're broadside to, pounding heavily. Hw?"

"R, R, R", shot back O'Brien. "QRX, I'll see what I can do for you, OM." Before the last word was hurled into space his alert mind had formed a plan.

Grabbing the antenna loading inductance which had been useless on two hundred meters, he inserted it in series with the antenna lead. The primary reactance coil was quickly shorted out, and

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the antenna coupling tightened. Then with a whoop of sheer joy, O'Brien tapped the key. A crash like the crack of doom filled the room and he was nearly blinded by the flash from the nearby gap.

"She's as broad as the Pacific and if they don't hear her on six hundred it'll be because the first blast will kill 'em all off."

And then into the ether, under the touch of a master hand, crashed the dreaded signal of the seas.

"SOS, SOS, SOS, de WQU, WQU, WQU!" fairly roared from the flaming gap.

Into the shore station at San Pedro it clamored like a god of thunder. It bore down upon ships at sea like a mighty howling wind. It trickled into the earphones of far-off stations.

After a few moments of calling, O'Brien cut in his receiver and listened. In the space of a few seconds he was paid in full for the months of dreary watches at sea. Joy sang in his heart, for out there in the night the voices of the six hundred meter crew were becoming still. The relic of bygone days had done its work.

Down the coast the Pedro land station snapped its authoritative "QRT—BK", into the blackness. And in another minute NPG was down on six hundred whipping the northern sea with an order to pipe down. And then when Pedro called him O'Brien was waiting.

"KIK de WQU", roared the smoking electrodes. Concisely and accurately he gave the details of the disaster as they were given to him. The station operator did not question the straight gap, although, at a time of less stress, he would have remembered that the ship whose call letters followed the distress signal was equipped with a quenched outfit, and O'Brien did not want to complicate matters by trying to explain the situation.

In less than thirty minutes the shore station had raised a freighter whose operator had just gotten up to copy press. They were only twenty-five miles from the wreck. In another ten minutes they were standing inshore headed for the distressed vessel.

On reduced power at two hundred meters, with a sharp coupling, O'Brien kept in touch with the WQU until he was informed by "DU" that the freighter could read the buzzer.

Two hours later O'Brien got up from his chair. The freighter had taken the passengers and crew on board. There was nothing more he could do. A feeling of peace, not born of rolling foothills nor sweet-scented air, pervaded his being. Over him had come the feeling of a man who was getting back on the right course after being blown off on the wrong track.

Day was breaking when he returned to his uncle's ranch. At breakfast he announced briefly that he would leave for San Francisco that day. His uncle had a good deal to say about the storms they were having at sea, but O'Brien only laughed mysteriously.

Noon saw him taking leave of his friends at the station. Before boarding the train he had sent a wire to the chief operator of a well-known radio company in San Francisco.

The next day a certain "static-room" near the waterfront welcomed a familiar figure. The chief operator, wearing a broad grin, called O'Brien into the sanctuary. He held a letter in his hand, addressed to the skipper of the steamship *Hilo*.

"This is the best I can do for you on short notice." The chief held out the letter. "If you hadn't said you wanted to sail today I could . . . . ."

O'Brien gestured with an air of finality.

"Man, I don't give a continental hang if she's a cross between an opium smuggler and a rum-runner, or if there's a roof on the radio shack,—if she's tuned to six hundred, let me at her." He grabbed the letter from the still-grinning chief operator and disappeared in the direction of the Embarcadero.

HONEYCOMB COIL WINDER

Continued from page 18

may get a slight grip on the edge as it makes its turn in direction of lay. This will be assisted if a little of the burr of sawing is left on the core. After the first layer is wound the friction between turns will suffice to hold the turns in place.

With the machine so assembled, a 100-turn honeycomb coil can be wound in one minute without hurrying, and at a cost almost negligible. When the winding is on, it can be made more rigid by the application to its sides of collodion or airplane dope. The latter is celluloid dissolved in amyl acetate, and smells like bananas. It is also in the market as lacquer, but in buying it as such make sure that the characteristic odor is present, as lacquers also are made with alcohol as a solvent of gums, which have a higher specific inductive capacity and are less desirable.

Of course there is some increase in the between-turns capacity when collodion or its like is used to stiffen the coil, but unless applied too freely, as by dipping the whole coil, the increment is allowable; the coils of the market are so treated.

A good acid-proof container for a lead battery can be made by lining a shallow wooden box with felt-base roofing paper, and giving it a couple of coats of asphalt paint.

The best way to ruin a storage battery is to "flash" it with a piece of wire, to see if it is well charged—that is, if it is a lead battery; if it is an Edison, it will do nothing but reduce the total charge by a small amount.

4-TUBE GRIMES

Continued from page 15

panel. Then come the four sockets and at the front two radio frequency transformers. Some concern was felt at first over the possibility of inter-transformer coupling with the audio frequency transformers so near together. In practice, however, it was found that no trouble of any kind was caused by this layout. In the wiring diagram all the terminal markings are given. These must be followed absolutely, for reversing a primary or secondary winding causes trouble.

If, instead of using the fixed amplifying transformers, you want still sharper tuning and somewhat greater efficiency, you can substitute fixed couplers for the radio frequency transformers. In that case, the leads now running to the *P* and *B+* terminals should go to the primaries of the fixed couplers and the *G* and *F* connections to the secondaries. Then a variable condenser of 0.0005 mfd. must be connected directly across the secondary terminals of each fixed coupler.

While the tuning is very sharp, sufficiently so even when local interference is bad, with the fixed couplers for radio frequency transformers, it becomes even sharper than on Neutrodyne sets.

Some experimenters want to operate the set on a regular antenna and ground. While they can be connected to the ends of the loop, the tuning is then broadened considerably. A more satisfactory way is to substitute for the loop a coil of 40 turns on a 3½-in. tube, and tapped at the 5th, 10th, 15th, 20th, 25th and 30th turns. This is for the volume control switch, the use of which was explained in the first article of this series. Then the antenna and ground should be joined to a coil of six turns, wound at the end of the tube, with a space of about ⅛-in. between it and the end of the coil which is connected to the filament side.

The receiving range and volume is about the same whether transformers or fixed couplers are employed for the radio frequency amplifiers. Although results vary somewhat in different

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locations, a range of 1000 miles for loud speaker reception appears to be quite dependable. This is based on reports received from districts around New York, Massachusetts, California, Illinois, and South Carolina. Just as there are some special installations where the range falls somewhat short of the average, other sets do very much better. As a matter of fact it has not been found necessary to add a power amplifier to operate a loud speaker for in almost every case sufficient range can be obtained without any outside amplification.

The tuning in the 3 and 4-tube sets is about the same. In congested areas, where there are a number of broadcasting stations operating, no difficulty is experienced in getting through to distant cities except where, in special instances, stations operating on the same wavelength lie in a direct line from the receiver. The reason for the success of the inverse duplex set in cutting through interference is due to the combination of the directional effect of the loop and the high efficiency of the tuning circuit. The latter is accomplished by doing away with a positive bias on the first tube, and by the use of a very low loss condenser for tuning. To use this crystal set alone—without the single-tube unit that is designed to go with it—it is connected up as shown in Fig. 4.

To operate the set: with the left-hand, or 43-plate, condenser set at about half capacity, the crystal detector is adjusted to a sensitive point, and tuning is done with the right-hand, or 23-plate, condenser. After the desired station is tuned in with the right-hand condenser, the final adjustment to the point of maximum audibility is made with the left-hand condenser.

The next installment will describe a simple, one-stage, audio-frequency amplifier that can be used in conjunction with the crystal set just described. If properly constructed, it will considerably more than double the audibility of the music received on the crystal set.

LETTERS TO THE EDITOR

Continued from page 41

from C. W. or spark signals from American amateur stations, and all the troubles we have here are from ships and land stations using spark transmitters.

In Salvador we have been allowed to use transmitting apparatus with the condition that we send out continuous waves, using tubes as the generators of C. W. and as near as possible a well-filtered d.c. plate supply; NO SPARK ALLOWED HERE. I think this will be, in the near future, the right step to clear the air from the heavy interference that is experienced now. Do away with all spark transmitters and use only the efficient vacuum tube transmitters.

The power of progress will kill the spark as a nuisance-producer, inadequate, very inefficient, and in every way unsatisfactory, and will open the door to the highly efficient tube transmitter; only then the air will be free from all the "noise" that now is goin' "full blast".

JOSE VELASCO.
Santa Ana, El Salvador, C. A.

NICKEL PLATING

Continued from page 34

tween these anodes the work is to be hung, and this forms the cathode of the tank. A suspending bar of brass or copper should be fastened across the top of the tank and connected to the other terminal of the current source.

The above refers only to plating on copper, brass, or similar metals. If it is necessary to plate iron or steel a copper plating tank should be made up, also, and a solution prepared of either copper sulphate solution, where about a 12% bluestone solution should be made, and acidified by the addition of a small amount of free sulphuric acid, or a copper cyanide solution may be used. To each gallon of distilled water add 5 oz. of copper carbonate, 2 oz. potassium carbonate and 10 oz. of potassium cyanide. Dissolve about 90% of the cyanide in a portion of the water, and add almost all of the potassium carbonate, which has also been dissolved in water, and slowly stir, until completely mixed. Now add water until the solution is about 160 degrees Baumé, and the solution is ready for use. The preparation of the work for plating, the construction of the tank, etc., are exactly the same as for nickel plating, except that copper anodes must be used, instead of nickel. The current density is lower than for nickel, running about 0.01 ampere per square inch.

After the basic plating of copper has been put on the work can be carefully washed and immediately placed in the nickel bath, and given a plating of nickel, which will then adhere to the copper, which already is held tenaciously to the steel or iron. After plating, the object can be buffed on the same buffer as was used for polishing the nickel plated brass. If the nickel is to be exposed to the elements or to a great deal of wear it may be found advantageous to cover it with a coating of lacquer. This will make it last almost indefinitely and will preserve the bright finish much longer.

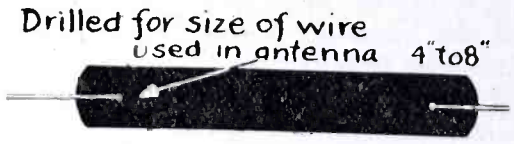
RADIO CONSTRUCTION POINTERS

Continued from page 19

for those who have a prejudice against the use of large contacts on account of possible capacity effects between points, this objection is overcome. A whole box of these points may be taken to a nickel-plating establishment and plated for a small sum, the white "dip" finish being given them, which makes it unnecessary to handle each contact separately, and at the same time imparts a neat finish.

A Use for Scrap Bakelite

THE average constructor, after sawing up a sheet of bakelite for panels, finds that he has considerable scrap left over. Strips of bakelite or formica may be cut up in 4, 6 and 8-in. lengths to make suitable insulators. Drill at each end for the wire, allowing a space from the end equal to the width. Strips one



Scrap Bakelite Insulator

inch wide are excellent. Even eight-inch material will be found strong enough to support considerable strain. Hard rubber may be used, for light aerials, but as this is not mechanically strong, it should only be used in short spans. If the bakelite is given a high polish on a buffing wheel it will shed rain much better than when unpolished.

Strength of Panels

WHERE economy is a feature in construction work, one does well to consider that ⅛-in. bakelite or formica may ofttimes be used. It possesses considerable strength, and panels of good size may be cut from it without any loss in appearance or mechanical efficiency. The writer states this because he has noticed a tendency upon the part of constructors to use ¼-in. material where ⅛ in. would have been ample. And it costs just one-half.

About Soldering Connections

IN present-day radio construction, soldering plays a most important part. In the construction, for instance, of the two-stage regenerative receiver, there are a multiplicity of contacts to be soldered. Poor workmanship in this regard causes much trouble. In the one matter of soldering fluxes alone lies a fine source of trouble. Although there are a dozen compounds on the market that are claimed to be non-corroding, the writer has yet to come across any which could truthfully make this claim stick, unless any excess was most carefully cleaned up. Rosin core solder, or the use of rosin as a flux, insures a non-corroding job, but it is harder to handle than are the paste fluxes, and for this reason there is a ten-

dency upon the part of the inexperienced worker to discard it in favor of the faster working trade fluxes.

There is no better flux made for soldering purposes than a mixture of muriatic acid and zinc, diluted with half its volume or less of water, as far as regards speed in taking the solder, but it is a good form of radio suicide to attempt to use in radio instrument work. Under the heat of the iron, fine drops of the acid spray surrounding parts and metal, and active corrosion sets in within a short while. Most of the paste fluxes seem to possess this spraying property in part. A part, to be soldered, must be clean. It is the property of a flux to clean the part to be soldered quickly, and as a rule the quicker this action takes place the more acid base will be found in the flux. Rosin flux, on the other hand, generally means cleaning the part to be soldered with fine sandpaper, unless it is already tinned, which is seldom.

If one must use the acid fluxes in soldering, by all means wipe very carefully all parts soldered. It is well also to swab such connections with alcohol or even gasoline, again wiping carefully. But use rosin flux if possible. For small jobs, rosin core solder is the more practical form.

The electric soldering iron is far more practical for good work than the flame-heated type, cleaner, easier to handle, and faster. But a poor soldering iron of this type is a curse, and the constructor should take pains to select the better known makes, even though he must pay twice as much as may be asked for some of the cheap irons. The irons with a removable point are the most practical.

A small file should be a companion to the iron. At least every half hour of running, the point should be filed clear of corrosion, and retinned. Never dip the point of the iron directly in the flux, if it be of the paste kind. At the end of the job, if the point is removable, it should be removed and left out of the iron until the next job. This will prevent the point sticking, which, if it is permitted to do for any period of time, will make it impossible to remove the point for renewal.

Where bus-bar wiring is being done, more attention must be paid to the joint than in the case of using flexible connections. Hard drawn bus is harder to hold in place than is soft drawn, for the reason that it is ofttimes under tension, and especially where the set is being used for portable work, vibration in transportation by machine or otherwise is liable to loosen connections. In line with this, where soldering to nickel parts, it is better to scrape through the nickel plating so that the solder takes hold of the metal beneath. Otherwise, many a fine looking joint will let go when least wished.

In using the electric iron, it is advisable to make up a stand of a piece of

pipe large enough to contain the point and heating element. This short length of pipe is mounted on brackets, secured to a baseboard, and serves both to hold the iron and to retain its heat while not actively employed on a job.

Another point to be borne in mind is that not all solder is uniform in its qualities. At times it will be found a job is not secure, and the substitution of another lot of solder will correct this. This applies more particularly to the wire solder than to the bar metal.

REFLEX RECEIVER

Continued from page 17

the two dials are mounted on the condenser shafts, thin washers of leather or metal are put over the shafts to prevent the dials rubbing on the panel. No dimensions are given for the construction of the cabinet, as many articles have appeared on that subject, and the builder can suit himself.

The only extra things necessary with the crystal set here described are a pair of receivers, an aerial, and a ground connection. Any standard make of radio head phones will work with the set. Whether these receivers are of 2000 or 3000 ohms resistance does not make as much difference as the beginner usually imagines.

To make the ground connection: scrape a gas or water pipe until it is clean, and then attach the lead from the set to it with a standard ground-clamp, which can be bought at any radio store. A water pipe is preferable to a gas pipe. Either an outside aerial can be used, or a special plug attached to a light socket in the house and used in place of it. No. 14 bare copper wire, with an insulator at each end, should be suspended between the house and any point 80 to 100 ft. away that is over 15 ft. high. The higher the better; but 50 ft. is about the practical limit. One wire is plenty. A lead-in of weatherproof, No. 14 rubber-covered wire is soldered to the end of the aerial nearest the set, and brought down and connected to the aerial binding post on the set. This lead-in should be kept away from all objects as much as possible, and where it does approach anything, it must be well insulated. A lightning protector should be used with an outside aerial; one can be bought at any radio store, and complete instructions come with it. Where it is not possible nor desirable to put up an outside aerial, a Ducon or Antenella can be plugged in an electric-light socket and used in its place. In some houses an electric-light socket aerial cannot be used; but, as a general rule, the light-socket aerial is about 60 per cent as efficient as an outside aerial. One thing to remember is that the location of a receiving station seems to have more to do with its range than any other thing.

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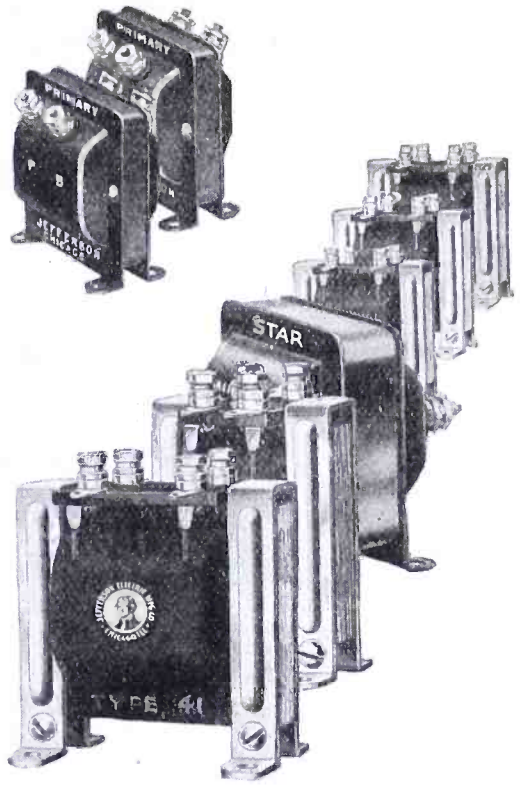

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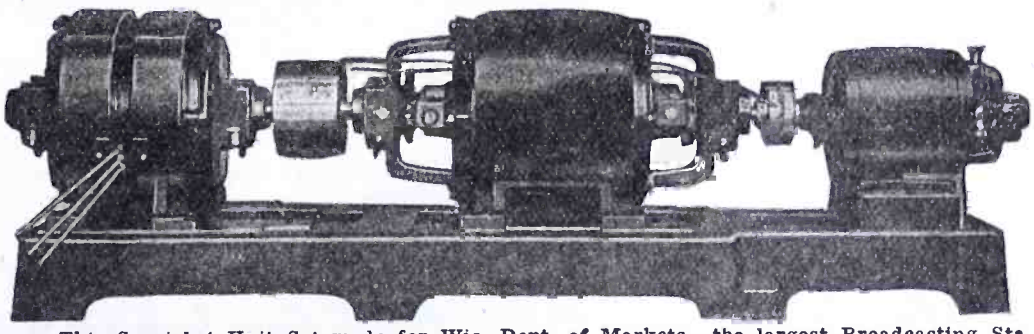
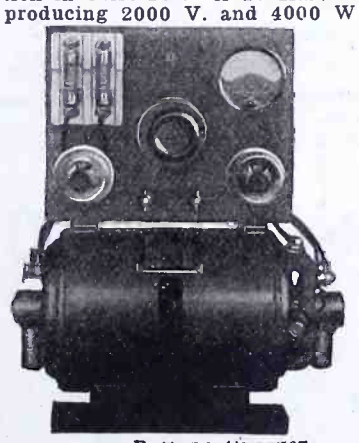
GENERATORS—MOTORS—DYNAMOTORS—MOTOR-GENERATORS
STAND SUPREME IN WIRELESS FIELD



This Special 4 Unit Set made for Wis. Dept. of Markets—the largest Broadcasting Station in existence. A 10 H.P. Motor—two 1000 V. 2000 W. Generators to operate in series, producing 2000 V. and 4000 W. and one 12 V. 2000 W. Filament Current Generator.

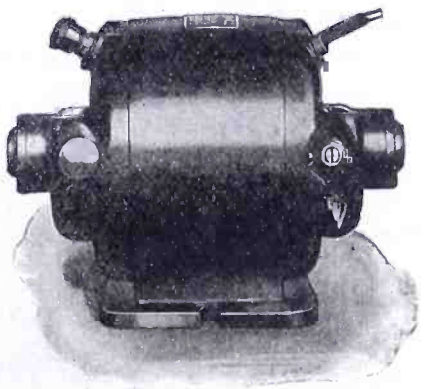


Battery Charger
Many sizes, with or without panels.

SEND FOR BULLETIN 237-A

Listing over 200 combinations. We design and develop Special Apparatus for Special Purposes.

Sold by Principal Dealers Everywhere



Dynamotor
Sizes to fit all requirements.

ELECTRIC SPECIALTY COMPANY
225 South Street **STAMFORD, CONN., U. S. A.**
Pioneers in developing High Voltage Apparatus

Tell them that you saw it in RADIO

KGO

Continued from page 11

Both of these stages are resistance coupled and use UV-203A tubes with a plate potential of 750 volts. The filaments are lighted by batteries. The plate potential of all the tubes is supplied from a generator in the generator room after being properly smoothed and filtered to eliminate any commutator ripple. The third stage amplifier contains a gain control for regulating the output of the control room amplifiers. The output is coupled by means of a transformer to any one of twelve pairs of lines which connect the control room and the power station.

The control panel contains a radio receiver by means of which the senior operator monitors the radio output. If the pick-up has been incorrectly located and the amplifying equipment will not compensate for it, he signals to the director by means of small electric lights placed on the director's table whether the trouble is in respect to the soloist or accompanist. If possible, the director then makes the necessary change.

The control circuits for the remote control of the plate generator and the batteries are also located on this board, as well as a time signal receiver for re-radiating the government time signals, a small radio oscillator for test purposes, a radio receiver and amplifier for operating a loud-speaking device, and no-click and interlocking relays for both studios with test switches in parallel with the director's control switch.

The no-click relays prevents the usual click heard in shifting from one pick-up device to another or in disconnecting a microphone from the circuit from appearing in the output. The interlocking relays prevent the use of more than one studio at a time.

Three operators are on duty in the control room during all programs. The senior operator controls the grouping of the amplifiers, operates the gain control, and monitors the radio output. The second man takes the various meter readings at the beginning of each selection and records them in the log. He also assists the senior operator when necessary. The third man listens-in on a wavelength of 600 meters and keeps a log of ship and shore stations, continually on the lookout for a distress call, in which event the station would close down. He is also in control of a 500-watt transmitter adjusted for telegraph operation on 300 or 600 meters located in the power station.

THE power station is a one-story stucco building 71 by 32 ft. placed directly beneath one downlead of the multiple-tuned antenna. It is connected to the control room electrically by means of two six-pair lead-covered cables running in metal conduit. These wires

terminate in jacks in the operator's control unit on the control table.

The power supply of the station is 2300 volt, 3 phase, 60 cycle alternating current. By means of transformers this is changed to 110 and 220 volts for distribution.

The generator room of the power station contains nine motor-generator sets. These supply current for heating the filaments of the tubes, plate potential for the power amplifiers and the 600 meter commercial transmitter, bias potential for the amplifier and modulator tubes, and excitation for the various generators. These machines are all in duplicate, thus assuring a continuous program even though a machine should break down. This room also contains the automatic compensators for starting the alternating current motors that drive the generators and the transformers that supply the a.c. plate potential to the rectifier unit. These transformers contain, besides the high potential windings, a smoothing reactor for smoothing the direct current output of the rectifier, a transformer for supplying filament voltage to the kenetron rectifier, and an interphase reactor which will be described later. The transformers are in duplicate and a switching arrangement makes possible the use of either one at a moment's notice.

Two complete transmitters for broadcasting as well as a commercial transmitter adjusted for 300 or 600 meters are in the operating room. A large switchboard is at one end of the room. The controls for starting the machines in the generator room are located on this board, as well as the distribution of the output of the generators. Meters are provided for reading the filament and plate potentials and currents and watt-hour meters for recording the filament life of the tubes.

The output of the control room amplifiers is plugged through the operator's control unit to either power amplifier for the fourth stage of amplification. This amplifier is also resistance coupled and uses either one or two UV-204A tubes in parallel. The plate potential of the amplifier is from 1500 to 2000 volts depending upon the tube characteristics. The bias potential is between 15 and 30 volts. In case four stages of amplification are not sufficient to operate the grid of the modulator tube properly a stage of either one or two UV-203A tubes in parallel can be inserted ahead of the power stage by throwing a three-pole switch in the proper position.

The output of the power amplifier is coupled to the grid of the modulator tube, which is a water-cooled tube of recent design. The modulation system utilized is that commonly known as the plate method of modulation. The bias potential for both the amplifier and the

modulator tubes is supplied by a generator in the generator room.

The oscillator which generates the radio-frequency also utilizes one of the water-cooled tubes operating at reduced output. Separate units tune both the grid and plate of the oscillator tube. A tank or dummy circuit is utilized to compensate for the variation in the antenna constants due to a swaying of the antenna. The antenna is loosely coupled to this tank circuit.

The direct current plate potential of both the oscillator and the modulator tubes is obtained from the kenetron rectifier unit. For the plate potential of this rectifier an auto-transformer varies the supply voltage between 40 and 220 volts, 3 phase, for supply to the delta-connected primary of the transformer. The high tension windings of the transformer are connected to form two Y's 180 degrees out of phase. Each Y with its kenetron is thus a half wave rectifier so 6 phase full wave rectification is obtained. The midpoints of the Y's are connected through an interphase transformer which aids the efficiency of the rectifier. The direct current component of the current delivered by each of the Y's is one-half the total direct current, so each tube only has to pass one-half the maximum value of current required per tube in the ordinary 3-phase full wave rectifier. The tube equipment consists of six UV-219 kenetrons.

By means of a smoothing reactor and smoothing condensers which are in duplicate, the direct current delivered by the rectifier has less than one-tenth of one per cent ripple. The rectifier is capable of delivering 15,000 volts direct current. Only 8000 volts are used on the plates of the oscillator and the modulator tubes.

By working tubes much below their rating, their life is prolonged, the chance of distortion is very much less, and hence the quality of the transmission is improved.

On the operator's control unit there is a switch that controls a contactor that lights the filaments of the oscillator, modulator and amplifier tubes, starts the cooling systems for the oscillator and modulator tubes, and starts the generator that furnishes bias for the modulator and amplifier tubes. Another switch places plate voltage on the amplifier tube or the commercial transmitter and a third switch, through a contactor, lights the filaments and places plate voltage on the kenetron rectifier unit. The rectifier unit can also be controlled from either oscillator tuning unit or the power distribution board.

A dummy antenna unit having the same constants as the antenna is utilized so that testing can be carried on without putting the radio-frequency into the air.

Continued on page 74

The AFRICAN "Drum talk" of TODAY

BOOM! BOOM! BOOM! BOOM!

THUS the drum talk of the natives of Africa broadcasts to a radius of fifty or sixty miles the departure of white men leaving one village for another. To the weird Boom! Boom! of the huge drums, the travelers with their porters commence the perilous journey, knowing that their arrival is expected at the next village.

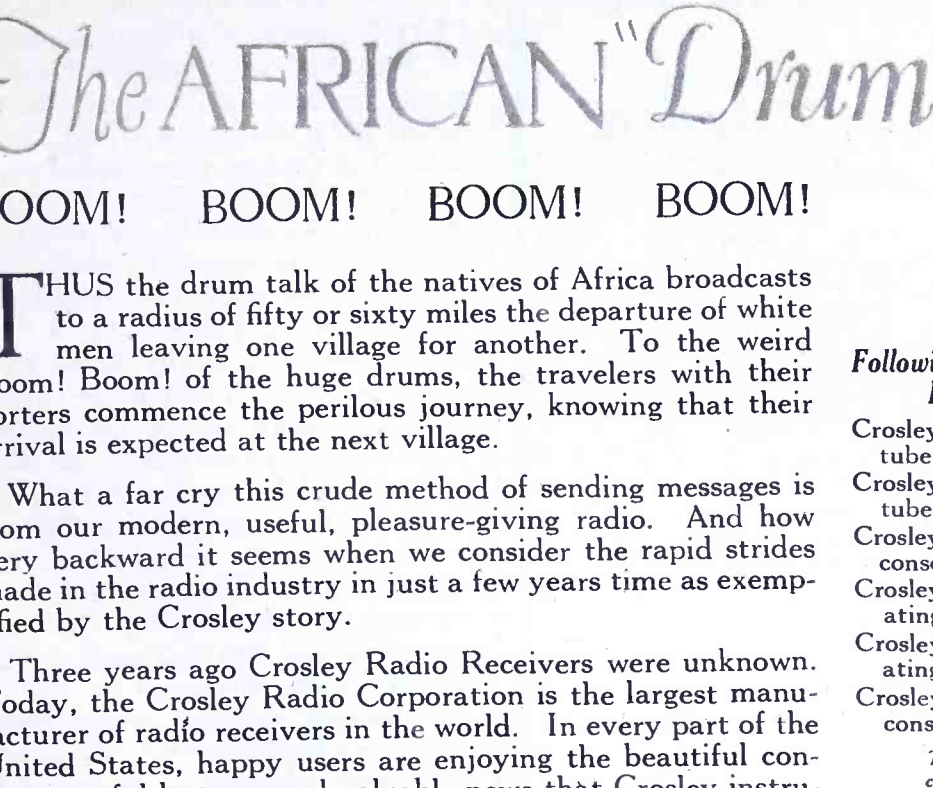
What a far cry this crude method of sending messages is from our modern, useful, pleasure-giving radio. And how very backward it seems when we consider the rapid strides made in the radio industry in just a few years time as exemplified by the Crosley story.

Three years ago Crosley Radio Receivers were unknown. Today, the Crosley Radio Corporation is the largest manufacturer of radio receivers in the world. In every part of the United States, happy users are enjoying the beautiful concerts, useful lectures and valuable news that Crosley instruments unfailingly bring from the distant points desired.

Real merit at moderate prices has brought about this Crosley popularity. Crosley engineers have continually kept abreast and perhaps a little ahead of the rapid advancement that radio has made.

We firmly believe that Crosley Radio Receivers are the best that have ever been offered to the public.

Insist upon Crosley Radio Apparatus
For Sale by Good Dealers Everywhere



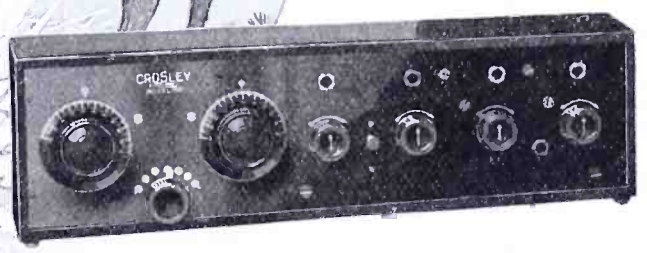
Following is a list of the Most Popular Crosley Receiving Sets with Their Prices

Crosley Type V (formerly Ace) one tube regenerative	$ 16.00
Crosley Type 3-B (formerly Ace) three tube regenerative	42.00
Crosley Type 3-C (formerly Ace) consolette model	110.00
Crosley Model VI, two tube incorporating radio frequency	24.00
Crosley Model X-J, four tube, incorporating radio frequency	55.00
Crosley Model X-L, four tube consolette	120.00

The Crosley regenerative receivers formerly called Ace, listed above are licensed under the Armstrong U. S. Patent No. 1,113,149

The Crosley Radio Corporation owns and operates Broadcasting Station WLW

CROSLEY
Better-Cost Less
Radio Products



CROSLEY MODEL X-J—PRICE $65

A 4-tube radio frequency set combining one stage of Tuned Radio Frequency Amplification, a Detector, and two stages of Audio Frequency Amplification. A jack to plug in on three tubes for head phones, the four tubes being otherwise connected to the loud speaker, new Crosley multistat, universal rheostats for all makes of tubes for dry cells or storage batteries, new condenser with molded plates, filament switch and other refinements add to its performance and beauty.

We believe that for bringing in distant stations it cannot be equalled.

COST OF NECESSARY ACCESSORIES FROM $40 UP.

MAIL THIS COUPON TODAY

The Crosley Radio Corporation,
319 Alfred Street, Cincinnati, Ohio

Gentlemen:—Please mail me free of charge your complete catalog of Crosley instruments and parts.

Name .....

Address .....

THE CROSLEY RADIO CORPORATION
Powel Crosley Jr., President

Formerly
The Precision Equipment Co. and Crosley Manufacturing Co.

319 Alfred St. Cincinnati, Ohio

Tell them that you saw it in RADIO

Continued from page 72

THE antenna is of the multiple tuned type with two tuning points and is strung between two towers, 150 ft. in height and 250 ft. apart. A small house beneath the second downlead houses the tuning for that section of the antenna. Beneath the antenna is the counterpoise consisting of twelve wires parallel to the antenna, 15 ft. above the ground, covering an area of 150 by 300 ft. This counterpoise is carefully tuned so that the current in each wire is the same.

Both transmitters are kept in readiness so that in case one set or part of one set breaks down the other one can be immediately brought into the circuit.

Two operators are on duty during all programs. The senior operator supervises the operation of the power equipment and sees that each set is resonated to the frequency of 960 kilocycles before the start of the program. This is accomplished by means of a fixed wavemeter which is calibrated and set at this frequency. Very careful watch of this indicator is maintained during the program to make sure that the frequency is constant, for constancy of frequency and continuity of the program are the two vital points in radio broadcasting. The senior operator listens to the output of a radio receiver and also watches the voice wave in an oscillograph. This wave is obtained by means of a small rectifier unit that rectifies radio-frequency picked up from the antenna circuit. The small amount of direct current thus obtained is put through an oscillograph vibrator, which is in a strong magnetic field. By means of a source of light and reflecting prisms, a small mirror on the vibrator deflects light onto a ground glass plate in the front of the oscillograph in proportion to the movement of the vibrator caused by the varying direct current flowing through the magnetic field. A revolving mirror in front of the ground glass plate shows the actual wave. By watching the voice wave, the percentage of modulation is maintained at the proper point. Should the modulation become too high the operator flashes a signal to the control room operator, who reduces the output of the amplifiers by means of the gain control. Should the percentage of modulation be too low the operator would flash another signal and the output of the amplifiers would be increased. Thus the modulation of KGO is maintained at approximately the same level throughout the program without destroying the delicate shading that an artist or artists give to each selection.

The junior operator records all meter readings in the log at the beginning of each selection. He also watches the motor-generators for hot bearings or sparking brushes and keeps the set resonated by the fixed wavemeter. In the event of a long selection, readings are taken every ten minutes.

KGO is operating at a power of 1000 watts, although for purposes of testing and experiment this power can be increased.

KGO will not be limited entirely to its own studio for programs, for, by means of pick-up circuits, church services, dance orchestras, important public gatherings, and theatre productions, as well as athletic contests, can be broadcast. An operator carefully places the different pick-up devices needed and, during the program or service, switches from one to the other as necessity demands. He controls the output of his one or two stages of amplification which are required to compensate for the losses in the line between the pick-up device and the control room.

Martin P. Rice, director of broadcasting for the General Electric Company, has charge of the new station, as well as WGY at Schenectady and the proposed Denver station. J. A. Cranston, Pacific Coast manager of the General Electric Company, has direct supervision of KGO.

DISTORTIONLESS AMPLIFICATION

Continued from page 24

acteristic curves, without causing distortion.

This elimination of distortion can be understood by referring to Fig. 2 and 3. As explained above, a voltage wave *A* in Fig. 3 impressed across the primary of the transformer T_2 in Fig. 7, will be reproduced as the distorted full line plate current wave *B* in Fig. 3, due to the bend in the characteristic curve shown in Fig. 2. Assuming that this current wave *B* represents the current flowing in the upper part of the primary winding of the transformer T_3, the full line current wave *C* will represent the current in the lower part of the primary winding.

The distorted wave *B* may be thought of as being made up of two other waves *F* and *H*, known as a fundamental and a harmonic of the fundamental. It is very evident that by adding or subtracting these two waves according to their position above or below the horizontal line, that the resultant is the wave *B*. It will also be noted that the wave *F* is exactly similar to the wave *A*. Wave *C* may also be resolved into a fundamental and a harmonic as shown, the dotted line representing the fundamental and the dashed line representing the harmonic. By noting the position of the two fundamentals and the two harmonics, it can be seen that the fundamentals will add and that the harmonics will cancel each other, leaving a resultant exactly similar in shape to the impressed wave *A*. This pure wave will be reproduced in the secondary of the transformer T_3 as shown in Fig. 7 and hence distortion has been eliminated.

Fig. 7 shows how the "push-pull" circuit can be added to a one or two stage amplifier, the only special apparatus necessary being the two middle tapped transformers T_2 and T_3. This figure also shows two methods by which the grid can be given a negative bias. The first method, that of connecting the filament rheostat *R* in series with the negative filament lead is usually sufficient for plate voltages up to 45 volts. The second method, that of connecting a battery *C*, in the grid circuit, should be used when the plate voltage exceeds 45 volts. The positive side of the *C* battery should be connected to the filament lead, as shown.

To summarize briefly: As a general rule, low turn ratio transformers are preferable. Builders of amplifiers should follow the manufacturers' recommendation regarding *C* battery voltages, and should use high plate battery voltages whenever possible. Audio frequency amplifiers should be limited to three stages. "Push-pull" amplifiers eliminate certain detrimental harmonics and may be overloaded without seriously impairing the quality of the reproduction. In addition, there is no alternating current flow in the plate battery supply leads of such an amplifier.

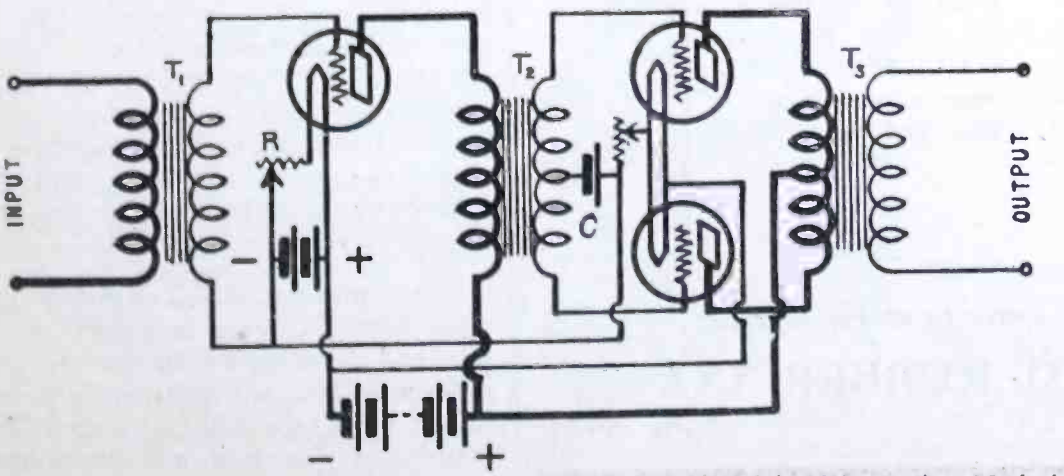


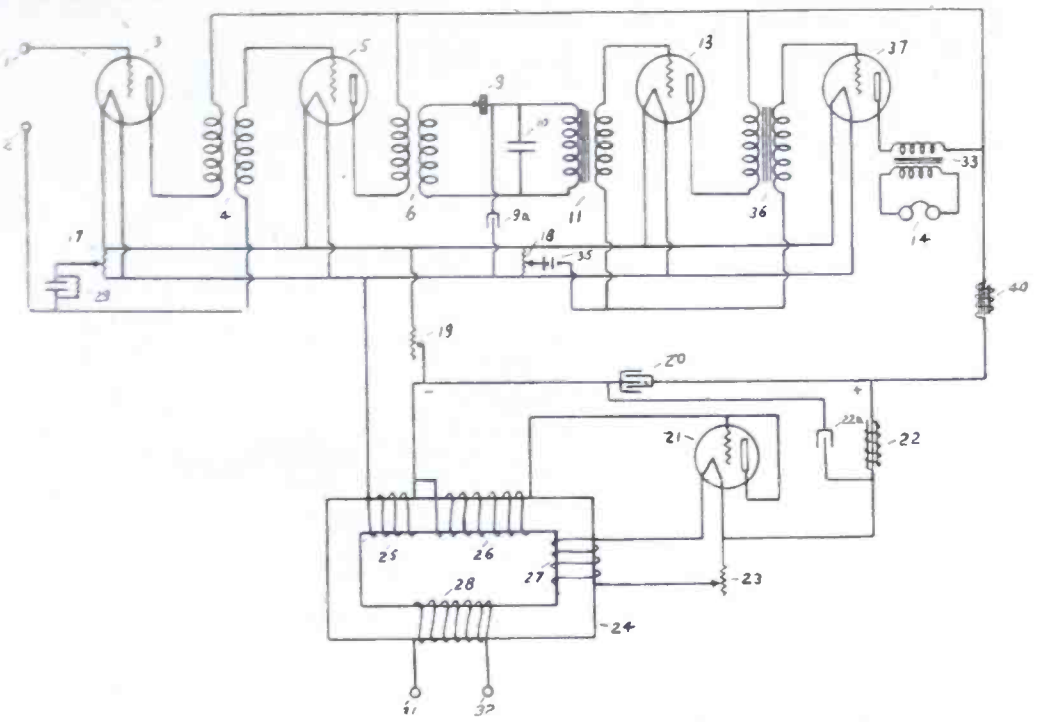
Fig. 7. Push-Pull Amplifier Circuit as Second Stage of Amplification, Illustrating Methods of Giving the Grid a Negative Bias

RADIO POWER FROM LIGHTING CIRCUIT

Continued from page 33

The receiving unit developed in the Radio Laboratory of the Bureau of Standards by P. D. Lowell and F. W. Dunmore, consists of two stages of radio-frequency amplification, two stages of audio-frequency amplification, and a crystal detector. The crystal reduces the a.c. hum. The residual hum in the phones is further minimized by voltage dividers and other devices.

The 110-volt alternating current supplied to the primary of a transformer is stepped down in the secondary windings to a proper voltage for plate and filament supply and is then rectified by a two-element tube. A 10-volt dry cell gives grid biasing voltage. The entire equipment with tuner is mounted in a portable cabinet. The experimental unit operates over a band of 200-750 meters.



Hook-up for Set Using Lighting Circuit Current Supply

RADIO PRINTING

Continued from page 12

The printer telegraph machine has already been applied to radio-printing telegraphy between ground wireless stations and flying aircraft, and also between moving ships. Notably, for instance, one of these machines was installed in San Diego, California, and another in Washington, D. C., and by controlling the arc-transmitting apparatus at NSS, the powerful radio-telegraph station of the United States Navy Department at Greenbury Point, or Annapolis, Maryland, messages were sent and received in typewritten form across the continent.

More recently, however, at the annual convention of the Association of Railway Electrical Engineers, 300 members of which assembled in Chicago, an exhibition was given to determine the secrecy of this method of communication. A message transmitted from a broadcast station five miles from the auditorium was typed in the convention room on a "stock-ticker" device at a rate of thirty words a minute. The privacy of this message was insured by placing the wires of the transmitting typewriter keyboard in improper relationships with the broadcasting pulsator. Then, by arranging the same order of pulsations at the selected receiving station, secret communication is possible. That is to say, the purposely jumbled connections in the sending and receiving outfits, which were co-ordinated with respect to the two particular stations conducting the test, were recorded on other receiving apparatus in a form akin to a Chinese puzzle. The signals in the latter case consisted of meaningless letters, figures and punctuation marks, and they were recorded without spacing between the lines. On the other hand, the same signals were received intelligibly and typed in the auditorium where the engineers had assembled.

However, the transmission of secret communications by this system is not necessarily restricted to traffic between two stations. Broadcasting may be resorted to and in that case the dispatches, where newspapers are concerned, are rendered available to many receiving stations at the same time, these stations being adjusted in co-ordination with the particular transmitting station. Also, if we are to accept the claims that privacy in radio communication has been accomplished, this system will not only be extended to press dispatches, but will comprehend traffic in both private and commercial intelligence.

If the filament of a Tungar, or Rectigon battery charger is opened, on one side, and the charging current permitted to keep the filament emission up to brilliancy, your tube will last a great deal longer than otherwise, and the charging current will not be greatly reduced.

CALLS HEARD

Continued from page 48

By 2CPQ, J. C. Phipps, 407 E. 18th St., Brooklyn, N. Y.

1st dist.—aar, adr, af, agb, agi, (agk), akd, ask, awk, bdi, bdu, bec, bgk, bke, bpi, brb, bry, byf, (cac), caz, cmp, cxl, (er), gk, gs, (kc), lr, sn, yb, ze.

3rd dist.—aa, ab, adm, adn, aja, aur, ba, bar, bdo, ber, bfq, blc, bnj, bp, btw, bwz, cbz, cdn, cel, (chg), cjn, cua, gf, hk, ir, jc, jy, kg, kn, lg, nf, ok, qs, rk, tj, (tr), vo, yo, yp.

4th dist.—cl, gf, jk, uy, xm.

5th dist.—agj, amh, cn, gq, hl, qf, sr, zg.

6th dist—ard, bd, bdw, bmr, cgg, lv.

7th dist.—rt, sc.

8th dist.—aa, aah, aaj, ab, ac, acn, ads, agp, aig, ajh, ajn, (alf), anl, anr, apt, aur, (avd), az, bbu, bci, bda, bdi, bdm, bdu, bf, bgp, bka, bnh, bnn, bny, bq, bqi, bqu, br, btr, bxx, byo, bzc, bzi, bzr, ccq, cdd, cej, cop, cwp, (dae), dal, dcd, dd, dda, dg, (dkl), do, dp, dtk, dzc, fm, gu, gz, (hj), jd, lr, mz, oe, re, rv, ue, ug, un, wy, xg.

9th dist.—aad, ahr, aon, aqd, ba, bch, rip, bpd, bsz, cfz, chi, do, cfz, eq, fp, lp, mc, zt. Will qsl crd for above. Pse qsl card qrk? All cards answd.

By 6BPQ, Milton Smith, 326 E. Stocker St., Glendale, Calif.

Can.: 5ah, 5cn, 5go.

U. S.: 4cl, 4cs, 5ado, 5ahr, 5air, 5aiu, 5akf, 5akn, 5aky, 5ama, 5cn, 5ek, 5fh, 5fv, 5fx, 5gf, 5gj, 5gu, 5ht, 5hz, 5in, 5ka, 5kg, 5lg, 5lr, 5mn, 5nk, 5on, 5ph, 5qq, 5qx, 5uo, 5vc, 5xap, 5xd, 5yw, 5zav, 5zax, 5zb, 6's too numerous, but will give those out of Calif—6aru, 6asa, 6bbh, 6bdt, 6bip, 6bnf, 6bpm, 6buf, 6buh, 6bui, 6cbu, 6cca, 6cek, 6ceu, 6cjb, 6pe, 6zo, 6zz, 7abb, 7abh, 7adf, 7adp, 7aea, 7afk, 7age, 7agf, 7agv, 7ahi, 7bj, 7br, 7cf, 7co, 7cv, 7ek, 7em, 7eo, 7ey, 7fl, 7go, 7gq, 7hg, 7hz, 7if, 7ih, 7io, 7iw, 7je, 7jw, 7ks, 7lr, 7lu, 7ms, 7mv, 7nz, 7ob, 7oh, 7ot, 7pj, 7qd, 7qj, 7rp, 7sc, 7sf, 7sh, 7so, 7tg, 7to, 7uc, 7vn, 7we, 7wm, 7ws, 7ya, 7yl, 7zd, 7ze, 7zu, 8acy, 8aig, 8bda evry nite, 8bvk, 8fu, 8oa, 8zy, 9anq, 9aod, 9aou, 9apf, 9apu, 9azg, 9bgj, 9bji, 9bjk, 9bly, 9bp, 9bri, 9btt, 9bun, 9bzi, 9caa, 9ccs, 9cet, 9cjy, 9ctq, 9cvc, 9cyf, 9czw, 9dbk, 9dfh, 9dhb, 9dky, 9doe, 9dpx, 9dyl, 9edb, 9eky, 9elv, 9mc, 9qe, 9uh, 9vm, 9xaq, 9yy, 9zg, 9zt, 9zy.

By 8CP, Orlo Palmer, East 11th St., Holland, Mich.

(Can. 4co), (Can. 5cn), (Can. 5go), 5za, 6ahp, 6ajh, 6aly, 6ani, 6aos, 6avv, 6awt, (6bbw), 6bic, 6bnc, 6bnt, 6bqz, 6cbu, (6cbw), 6ccp, 6ccr (qra Hawaii), 6cdg, 6chu, 6ckr, 6cns, 6bm, 6cp, 6fy, 6gr, 6ic, 6mg, 6mh, 6pl, 6ve, (6zar), 6zb, 6ze, 6zh, 7akh, 7gv, (7ks), 7pf, 7qv, (7sc), 7sh, 7ze, 9amb, (9apf), 9auw, 9bxq, 9cfy.

By 9BJI, Denver, Colo.

C. W.: 1aiv, 1apc, 1aqm, 1ary, 1aw, 1bcp, 1bep, 1bes, 1bdi, 1bgn, 1bwj, 1cao, 1cmp, 1crw, 1fd, 1ho, 1pa, 1sn, 1xm, 1xx, 1yb, 2aay, 2ayv, 2bnk, 2bqh, 2brb, 2by, 2cei, (2cfb), 2crp, 2cxl, 2qm, 2rb, 2wa, 2xq, 3aao, 3aln, 3as, 3asz, 3ban, 3bdo, 3bgt, 3bn, 3bnu, 3btl, 3bvn, 3bwt, 3chr, (3hg), 3jy, 3me, 3su, 3tr, 3zm, 4ag, 4db, (4eb), 4el, 4eq, 4ft, 4gx, 4hr, 4hs, 4jk, 4kc, 4mb, 4oa, 4qf, 4rh, 4za, 6ceu, 8aa, 8aaj, 8acn, 8acy, 8adg, 8ag, 8agp, 8aib, 8aig, 8aih, 8aim, 8aio, 8ajh, 8al, 8am, 8ame, 8amm, 8anb,8apn, 8ard, 8asv, 8atc, 8atn, 8aus, 8avd, 8awt, 8axc, 8axz, 8azh, 8azo, 8bbw, 8bci, 8bcp, 8bcu, 8bda, 8bfd, 8bfm, 8bfq, 8bfr, 8bge, (8bhf), 8bhn, 8bjv, 8bjy, 8bky, 8bmb, 8bmg, 8bnh, 8bnn, 8bob, 8bp, 8btj, 8bxh, 8bym, 8byw, 8bzc, 8cb, 8cci, 8cdd, 8cdc, 8ced, 8cia, (8cjd), 8cjp, 8ckt, 8ckw, 8con, 8cpy, 8cqh, 8crn, 8crw, 8cvo, 8ctp, 8cwk, 8cwl, 8cwr, 8cwu, 8cxw, 8cyt, 8czz, 8cz, 8dat, 8daw, 8dbl, 8dcb, 8dcz, 8ddq, 8dgo, 8dil, 8djp, 8dle, 8dlh, 8ef, 8eo, 8er, 8dx, 8fi, 8fu, 8gt, (8gz), (8jj), 8hn, (8nb), 8mt, 8pl, 8pd. 8qn, 8px, (8tr), 8ua, 8ue, 8uf, 8ve, 8vt, 8wx, 8xe, 8yn, 8zw, 8zz.

Can. C. W.: 1ar, 2be, 3eak, 3co, 3dc, 3de, 3he, 3ir, 3jt, 3ni, 3oj, 3sp, 3tb, 3ws, 4aw, 4cl, 4cr, 4cw, 4cn, 4dy, 4hf, 4hh, 5cn, 5ct, 9bj, 9bx

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By 9DAW, C. M. Braum, 3832 Elliot Ave., Minneapolis, Minn.

1afb, 1avc, 1aw, 1apc, (1bcg), (1boq), 1cit, 1er, 1gs, 1hx, 1il, 1kc, 1my, 1sn, 1xam, 1yb, 1yk, 2acg, 2afp, 2agb, 2ami, 2ajf, 2bgi, 2bnl, 2brb, 2bwr, 2by, 2bzv, 2cee, (2cfb), 2clj, (2cjr), 2cnh, 2cqn, 2cqz, 2crq, 2cxd, 2cxl, 2gk, 2kf, 2ts, 2za, 3ahp, 3aln, 3bdo, 3bgt, 3bji, 3bm, 3bnu, (3btl), 3buc, 3buv, 3bwt, 3hg, 3hk, (3oq),3pz, 3te, 3tr, 3ud, 3vo,4bf, 4bq, 4eq, 4jh, 4ku, 4lj, 4mb, 4nv, 4rr,(6aak), 6acm, 6ahp, 6ajd, 6ajj, 6alv, (6aoi), 6arb, (6aru), (6avv), 6awt, 8bcl, 6beo, 6bih, 6bjq, 6bpz, 6brf, 6brk, 6bui, 6buo, 6bvg, (6cdg), 6cek, (6cgw), 6chu, 6ckr, 6cnl, 6ft, 6fy, 6nx, 6wt, 6zah. 6zau, (7abb), 7aci, 7adr, 7agr, 7aea, 7fd, 7fl, 7hw, 7ih, 7it, 7jd, 7je, 7lr, (7ly), 7oh, 7pj, (7sc), (7to), (7uu), 7ya.

Can.: 2cg, 3bp, 3jt, 3kg, 3ko, 3oh, 3om, 4dy, 5cn, (5go).

Would appreciate reports on my sigs, all cards answered.

Tell them that you saw it in RADIO

At 5ADB, El Paso, Tex.

C. W.: 1apc, 1ary, 1asv, 1bbo, 1bes, 1bhk, 1bkq, 1bqd, 1cmp, 1cpa, 1cpn, 1fv, 1hx, 1oj, 1ow, 1vv, 1wo, 1xm, 1yb, 1zi, 2afp, 2bjx, 2brb, 2bxy, 2by, 2bzv, 2cbg, 2clu, 2csr, 2cwj, 2dac, 2gk, 2kf, 2lv, 2rb, 2ubw, 3ajd, 3as, 3atb, 3bdo, 3bdq, 3bgi, 3bnu, 3bof, 3bjn, 3cm, 3cok, 3hk, 3jj, 3su, 3tr, 3yo, 3zl, 3zm, 3zt, 4bx, 4el, 4fa, 4ft, 4hr, 4ku, 4qf, 4rh, (4aat), 4acr, 5ae, 4aee, 5agi, (5ahr), 5aib, (5aiu), (6ajj), (5ama), 5ana, 5au, (5bx), 5ce, 5cv, 5ez, (5fa), 5fj, 5ft, (5gi), 5hq, 5if, (5in), (5li), (5lr), (5lg), 5nh, (5nk), (5nn), (5nr), 5ok, (5ov), (5pb), 5qq, 5qr, 5qw, 5rm, (5sd), 5up, 5zax, 5zb, (6ahp), (6ajd), (6ajh), (6asa), 6bcs, (6bfg), (6bjq), (6beq), (6bqe), (6bra), (6bsg, (6bts), 6bvg, 6cbb, (6cfz), (6cga), (6cgg), (6cgw), (6cmu), (6cu), (6fp), 6km, (6nb), 6su, (6ua), 6xad, 6zx, (6zau), 7abb, 7abg, 7adq, 7agr, 7bj, 8bo, 7em, 7hw, 7ks, 7lu, 7ob, 7ly, 7qj, 7ws, 7zd, 7zo, 7zu, 7zz, 8aaj, 8aam, 8ab, 8acy, 7adg, 8afd, 8afn, 8ag, 8aih, 8ajh, 8amd, 8amm, 8atc, 8axz, 8bbf, 8bcp, 8bda, 8bdu, 8bjv, 8bnh, 8bob, 8byn, 8ced, 8cei, 7cgj, 8cp, 8cwu, 8cyz, 8czd, 8dat, 8daw, 8djf, 8fu, 8hn, 8kj, 8pd, 8pk, 8pl, 8se, 8sp, 8uf, 8wa, 8wx, 8xe, 8cz, 8zz, 9ad, 9aec, 9aed, (9aim), (9amb), 9aod, 9aon, (9apf), 9arz, 9ava, 9avs, 9baf, 9bal, 9bbw, 9bdu, (9bds), (9bhz), 9bkm, 8bly, 8bsv, 9bsz, 9bvo, (9ccv), 9ccz, 9cdo, 9cfi, (9cfj), 9cga, (9cgu), 9chd, 9chg, 9cin, 9cje, 9cjy, 9clj, 9clq, 9cpb, 9cr, 9cte, 9czw, 9dkw, 9dky, 9dll, 9dmn, 9dsw, (9dte), 9duq, 9dwx, 9dxc, 9dxn, (9dxu), 9dzy, 9eak, 9ei, 9eiz, 9ekt, 9eq, 9fg, 9jcs (qra?), 9mc, 9na, 9nr, 9ss, 9ti, 9vl, 9vm, 9pw, 9qr, 9yu, 9yy, 9zt.

Can.: 2am, 2cg, 3bp, 3co, 3he, 3hs, 3ni, 3qs, 3tb, 4cn, 4dy, 5cn, 9bx, 9bp.

Mex: (bx).

Spark: 5bv, 9bof, army wui, wzb.

Will appreciate qsls on our sigs. The above calls qsl'd if requested.

By 9CKM, A. E. Meditz, 623 Sandusky Ave., Kansas City, Kans.

1jv, 1yb, 2rk, 2xq, 3ce, 3jy, 3tr, 3auw, (3bgg), 3btl, 4ai, 4cr, (4db), 4mi, 5fv, 5gf, 5gn, (5ht), 5je, (5lr), 5ml, (5pa), 5ph, (5ql), 5sq, 5tj, (5aiv), (5ama), (5akn), 5zav, 6fp, 6cgw, 7zu, (8aa), 8fm, 8fu, 8kg, (8tr), 8vy, 8wa, (8aco), 8anl, 8axz, 8bmg, 8bxh, 8clc, (8cpy), 8cvg, 8cwy, (8ddq), 8adl, 9dc, 9dg, (9vm), 9abp, 9aeb, (9afy), (9aom), (9arb), 9bhl, (9bly), (9bmv), (9bmx), 9bof, 9bqj, 9bri, 9bsm, (9bwv), (9bzs), 9cga, (9cgu), (9cvo), 9ddp, (9ddu), (9dhg), 9dpx, (9dro), (9dso), (9dvm), (9dvw), 9dxu, 9dxy, 9dyy, 9eea, (9elv).

Can.: 3co, 3xn, 4fd. All cards answered, using 5 watts here.

By D. E. Huntington, Kalama, Wash.

5abb, 5adb, 5ahr, 5ama, 5amb, 5ax, 5be, 5fa, 5go, 5gw, 5lr, 5ov, 5pb, 5qq, 6bbw, 6bcr, 6bec, 6beh, 6beo, 6bez, 6bfg, 6bic, 6bjj, 6bks, 6bmn, 6bmy, 6bpz, 6bra, 6brf, 6bsg, 6buf, 6buh, 6buo, 6buy, 6cbb, 6cbd, 6cbu, 6cbw, 6ccu, 6cde, 6cej, 6cfm, 6cfz, 6cgd, 6cgg, 6chc, 6cix, 6cje, 6cjj, 6cju, 6ckh, 6ckv, 6cll, 6cmi, 6cmu, 6aaj, 6acb, 6act, 6acx, 6adm, 6afg, 6agj, 6aja, 6ak, 6akz, 6anb, 6aqq, 6aqu, 6atz, 6ea, 6fy, 6kj, 6lv, 6pe, 6pl, 6ts, 6ua, 6wv, 6xad, 6zau, 6zav, 6zx, 6ceu, qra? 8aa, 8ab, 8ame, 8bf, 8bda, 8bfm, 8bzc, 8cjd, 8es, 8jj, 8pu, 8vy, 8xe, 9aau, 9anb, 9ami, 9amk, 9aon, 9ap, 9ape, 9apf, 9aua, 9aus, 9auw, 9avu, 9bab, 9bed, 9bik, 8bji, 9bjk, 9bly, 9boo, 9bqj, 9btt, 9bzi, 9caa, 9caj, 9cbj, 9cfy, 9cgu, 9cly, 9cr, 9cvo, 9cvs, 9daw, 9dfh, 9djb,9dkb, 9dsw, 9dte, 9dzy, 9ebt, 9edb, 9eet, 9elv, 9eky, 9ig, 9mc, 9ss, 9vm, 9xaq, 9xi, 9yy, 9zt.

Can.: 3ni, 4cb, 4cl, 4cn, 4cw, 4dq, 4dy, 4er, 4hh, 4hl, 5ah, 5cq, 5ct, 5eb, 5hg, 9bp, 9bx.

Fone all C. W.

By 8CJD and 8CGJ, St. Johns, Michigan

(5afs), (5alj), (5ana), (5ams), (5ac), (5gn), (5in), (5nj), 5nr (fone), (5up) (5uk), (5vf), 5za, 6adl, 6afq, 6aiy, 6ajf, 6ajh, 6ajj, 6ahu, 6alv, 6amh, 6anb, 6aoi, 6asx, 6aup, 6auy, 6avv, 6bar, 6bbu, 6bcj, 6bcl, 6beo, 6bic, 6bih, 6bis, 6blg (qra?), 6bnc, 6bqc, 6bua, 6buo, 6buy, 6buz, 6bve, 6bwe, 6cbi, 6ccd, 6cci, 6cdg, 6cfz, 6cgw, 6chl, 6chu, 6ckp, 6cnc, 6bk, 6ce, 6cc, 6ce, 6cf, 6fp, 6fy, 6js, 6ka, 6lj, 6mh, 6pl, 6tu, 6tv, 6zh, 6zq, 6zo, 6zr, 6zt, 6xb, 6xwi, (6xad), (6zah), 6zar, 7abb, 7aga, 7ate, 7em, 7gh, 7io, 7lh, 7lu, 7no, (7sf), 7vr, 7wm, 7zd, 7ze, 7zo, 7zr, (7zt), 7zu, 9amb, (9avs), (9bji), 9caa.

Can.: 1ar, 1dd, 1hv, 2cg, (4cn), 5cn, 5go, 9bx.

Wl qsl all crds.

By 6OF or 6AIQ, 3419 So. Hope St., Los Angeles, Calif.

2ts, 2cxl, Can. 2cl, 3co, 4fu, 4fa, 4el Can., 4cl, 5adb, 5ahr, 5ajj, 5hz, 5kc, 5lg, 5lr, 5tj, 5za, 5zav Can., 5cn Can., 5go, 6's too numerous, 7ac, 7aci, 7adr, 7ads, 7aea, 7ael, 7alk, 7asf, 7bj, 7em, 7ft, 7gq, 7jd, 7lh, 7en, 7ob, 7ot, 7px, 7qj, 7qt, 7qy, 7rp, 7sf, 7to, 7ya, 7zd, 7zu, 8ahn, 8amm, 8bda, 8bdu, 8cgj, 8cqh, 8dat, 8vd, 8zz, 9aau, 9aim, 9amb, 9anq, 9apf, 9avu, 9auw, 9avs, 9bew, 9bji, 9bjk, 9bxq, 9bzi, 9caa, 9ccz, 9cgj, 9cks, 9cvc, 9czq, 9dfh, 9dow, 9dyr, 9eae, 9eky, 9yu, 9zt. Anyone hearing my cw pse qsl. All cards answered.

By Frank Stansel, 140 Parkwood Blvd., Schenectady, N. Y.

4eb, 4gx, 4jk, 4kb, 4me, 4ud, 5hl, 5ny, 5tn, 5vr, 7fl, 8af, 8aid, 8anm, 8bz, 8cou, 8dqi, 8drm, 8gz, 8hn,8jj, 8kr, 8lk, 9aad, 9aar, 9aaw, 9agd, 9agi, 9aen, 9aon, 9ar, 9arh, 9ark, 9avn, 9ayb, 9bak, 9bgc, 9bhh, 9bkb, 9bsa,9bsr, 9cav, 9cci, 9chw, 9cnv, 9ctb, 9ctu, 9cv, 9cx, 9cyk, 9dgi, 9dgn, 9di, 9dku, 9dnx, 9don, 9dqn, 9dr, 9dtt, 9ej, 9elv, 9ep, 9eq, 9es, 9fu, 9mc, 9rk, 9st, 9um, 9vc, 9xa, 9zr, 9st.
Can.: 4tz.

By 3KY, J. S. Hayden and D. A. Troy, "Peddie," Hightstown, N. J.

4bq, 4el, 4ep, 4ft, 4gx, 4hr, 4kc, 4lj, 4mb, 5aiu, 5up, 5afa, 5ags, 5bwc, 6fp, 6ajj, 6bic, 6cgw, 7sc, 9bj, 9zg, 9zt, 9zy, 9afp, 9aps, 9avj, 9ccz, 9ddu, 9dpc, 9dvm, 9egp, 9elv. Anyone hearing our 5-watter pse qsl via crd.

By 3BVA-8BOY, 40 S. Beaver St., York, Pa.

U. S. C. W.:4ai, 4bk, 4bq, 4db, 4dc, 4eb, 4kl, 4qf, 4rh, 5aby, 5acm, 5adh, 5bm, 5et, 5hl, 5kh, 5mi, 5ov, 5pb, 5qe, 5qw, 5vv, 5wo, 5ws, 5xac, 5za, 6acm, 6age, 6agj, 6ajd, 6ajj, 6aoi, 6aos, 6arb, 6asu, 6avv, 6awq, 6awt, 6bcj, 6beg, 6bhr, 6bic, 6bih, 6biq, 6bjp, 6blg, 6bm, 6bmn, 6bnc, 6bpv, 6bpz, 6bqe, 6brf, 6brk, 6bry, 6bua, 6buh, 6bve, 6bvf, 6cbu, 6cbw, 6cdg, 6cek, 6cfz, 6cgw, 6chu, 6ckl, 6cmr, 6cnh, 6eo, 6fy, 6gr, 6gx, 6jx, 6km, 6lv, 6mh, 6pl, 6ti, 6vd, 6wt, 6xad, 6xf, 6zah, 6zar, 6zau, 6zh, 6zw, 6zx, 7aci, 7aek, 7ael, 7agr, 7aiy, 7akv, 7asu, 7fd, 7jd, 7kr, 7lu, 7qc, 7qd, 7qf, 7sc, 7sf, 7sh, 7ve, 7vq, 7wm, 7ws, 7wx, 7ze, 7zf, 7zu, 7zt, 7zo, 7zx, 7zd, 9akm, 9ahy, 9ahz, 9amb, 9amu, 9asv, 9auw, 9avu, 9ayf, 9ayp, 9awd, 9bak, 9bep, 9bff, 9bji, 9bjk, 9bmo, 9bmx, 9bpv, 9bri, 9brt, 9bxq, 9byx, 9bwv, 9ccs, 9ccz, 9cfi, 9cga, 9cgu, 9ckw, 9cld, 9cvc, 9cvv, 9cra, 9czg, 9dbn, 9dcr, 9ddu, 9dfh, 9dkk, 9dhy, 9dky, 9dgi, 9dmn, 9dvw, 9dtt, 9dsq, 9eeg, 9egh, 9kd, 9pb, 9yu, Ex 8cof.
Can. C. W.: 1ar, 2bg, 2bn, 2cg, 2ic, 3afp, 3aec, 3ni, 4cw, 4dy, 4er, 4bb, 4ja(?), 5go, 5bx(!).
English C. W.: 6ni. All inquiries regarding reception answered.

By 8CCI, James C. Lisk, 902 S. Elizabeth St., Lima, Ohio

1aw, 1er, (1ez), 1yb, 1aao, (1adn), 1afa, 1bes?, (1bgk), (1btt), 1bgg, 2gk, 2boo, (2bgi), (2bjx), (2bqh), 2bjo, (2ccd), 2cla, (2cwj), (3gk), (3qf), (3tr), (3ur), (3ajd), 3bdo, (3bnu), (3bgo), (3abw), (3cah), (3ckj), 4gw, 4na, (4ft), 4ku, 4on, (5gj), (5gm), 5hr, 5lr, 5ma, 5mn, (5mm), 5kn, 5ov, 5pr, (5qf), (5aat), (5abt), (5aiu), 5amh, 5amu, 5zas, 5zav, 6lv, 6xp, 6awt, 6bik, 6auy, 6cdg, 6cgw, 6arb, 6bua, 6xad, 7wp, 7vw, 9ig, 9ape, (9apf), (9avn), (9bep), (9bhi), (9bkc), 9bhq, (9bmu), (9bof), 9bze, (9btt), 9caa, (9cee), (9clq), (9dan), (9dzy), (9cpt), (9dch), (9dmj), (9eck), (9eak).
Can.: (2cg), 2bn, 3dp, (3ni), 3pg, 3zl, 4ci, 9ce. Qra? my 10-watt C. W. and fone. All crds answered.

By 9CTE, South Bend, Ind.

7ad, 7afn, 7agk, 7agr, 7ei, 7gh, 7hg, 7ih, 7ks, 7lw, 7ot, 7pj, 7qc, (7qj), 7sc, 7sf, 7uk, 7zd, (6aak), 6acm, 6afh, 6afq, 6afu, 6agk, 6aic, 6ajd, 6ajh, 6ak, 6alv, 6ani, (6avv), 6baa, 6bbw, 6bch, 6bck, 6bcl, 6beo, 6bff, 6bgy, (6bh), (6bic), 6bih, 6bm, 6bja, 6bmy, 6brf, 6bsj, 6buo, 6bve, (6bvg), 6bwe, 6cbd, 6cbu, 6cc, 6cdg, 6cec, 6cfz, 6cgw, 6chu, 6chz, 6ckp, 6ckr, 6cmi, 6cmr, 6cnh, 6eb, 6fh, (6fy), 6hp, 6lu, 6mh, 6pe, 6ts, 6pl, 6xad-6zw, 6zh, 6za, 6zah, (5za), 5adb. Above stations worked in three hours. Qsl crd to any.

By 3AKR, Lansdowne, Pa,

C. W.—4ag, 4eb, 4er, 4fa, 4hh, 4hr, 4jk, 4ky, 4mb, 4na, 4qw, 4ru, 5acm, 5akn, 5da, 5db, 5eq, 5hr, 5ht, 5mo, 5nj, 5nn, 5uk, 5up, 5za, 6ajj, 6bic, 6zz, 7agr, 7sc, 9aid, 9aek qra?, 9ahy, 9aon, 9aps, 9ark, 9awv, 9axh, 9baz, 9bdh, 9bji, 9bp, 9bri, 9bsh, 9ccs, 9ckw, 9cnb, 9cpt, 9cvs, 9dcp, 9dfh, 9dhr, 9djm, 9dkw, 9dkx, 9doe, 9drw, 9eba, 9ep, 9gs, 9pb, 9pf, 9ss, 9uz, 9vm, 9vo, 9xk, 9zt.
Can.: 1ar, 2bg, 2bn, 2ic, 3adn, 3adu, 3afp, 3ba, 3cf, 3cg, 3de, 3he, 3jt, 3nf, 3pr, 3xi, 3yh, wx5 qra?

By L. Wheitsel, 6325 Beechwood St., Philadelphia, Pa.

1aok, 1ary, 1bnl, 1bom, 1boq, 1er, 1gb, 1ii, 1ij, 1xu, 1yb, 2aay, 2bem, 2bta, 2crq, 2rk, 4hr, 4ku, 5lr, 5qi, 5up, 8abl, 8act, 8af, 8ajh, 8avd, 8azh, 8bbi, 8bci, 8bff, 8bfi, 8bhf, 8boe, 8bos, 8bt, 8bvu, 8byn, 8cc, 8cej, 8ceo, 8cjd, 8cjh, 8ckn, 8cpq, 8ctn, 8cux, 8cwk, 8dcd, 8dcz, 8dkl, 8dla, 8gz, 8nb, 8om, 8te, 8uf, 8tr, 8ve, 8vt, 8wa, 8xa, 8yg, 9aap, 9aic, 9amu, 9aod, 9aog, 9aqx, 9arh, 9arp, 9bak, 9bed, 9bff, 9bp, 9buj, 9bwa, 9bwp, 9cas, 9cck, 9cnj, 9cnv, 9co, 9ctb, 9cyw, 9dct, 9dhg, 9dhq, 9dkx, 9dlw, 9dqu, 9dtt, 9dwk, 9dzs, 9dzy, 9ebo, 9edo, 9ehi, 9ei, 9elv, 9er, 9hk, 9ox, 9qr, 9ru, 9ub, 9vm, 9vz, 9zt, 9zy.
Phone: 1bbo, 8kg.

By 9DJB, 3808 Wyoming St., Kansas City, Mo.

1aez, 1afa, 1ajx, 1ali, 1alj, 1apc, (1aqi), 1ary, 1bcu, 1bhk, 1bom, (1boq), (1bwj), 1cab, (1cmp) ,1cpn, 1csw, 1aw, 1er, 1fm, (1hk), (1hx), 1ii, 1il, 1mo, 1pa, 1qp, 1rv, 1sn, 1ts, 1vv, 1yb, 1yk, 2aay, 2agb, 2ana, 2ayw, 2bmq, 2bqb, 2brb, 2bwr, (2bxp), 2bxw, 2byg, 2cdm, 2cjr, (2cpa), 2cpq, 2cqn, 2cqz, 2crq, 2cvj, 2cxd, 2cxf, 2cxl, 2cxy, 2an, 2ax, 2by, 2ds, (2ku), 2rb, 2rk, 2rm, 2sq, (2ts), 2wr, 2xab, 2xq, 3aao, 3abw, 3acy, 3adb, 3adp, 3ady, 3aec, 3aek, 3ahp, 3ajd, 3aln, 3alr, 3atb, (3bei), 3bji, 3bnu, 3bof, 3bsb, 3bss, 3bva, 3bwt, 3cbl, 3cel, 3cfv, 3chg, 3cjn, 3cjw, 3as, 3ca, 3hh, 3jj, 3jy, 3kq, 3ll, (3oq), 3pz, (3tr), 3yp, 3zm, 6aak, 6abx, (6acm), 6adh, 6afh, 6afq, 6age, 6ahf, 6ahp, 6ahu, 6aja, 6ajd, 6ajh, 6alo, (6alv), 6anb, 6ani, 6aoi, 6aos, 6aou, 6arb, 6aru, 6atg, 6aup, 6avv, 6awq, 6aws, 6awt, 6awx, 6bbc, 6bcl, 6bcs, 6bdr, 6beo, 6beq, 6bfg, 6bic, (6bih), 6bik, 6biq, 6bjj, 6bjq, 6bkx, 6blg, 6bnc, 6bnt, 6bpf, 6bpz, 6bqb, (6bqe), (6bql), 6brf, 6brk, 6buo, 6bvg, 6bwe, 6cae, 6cbd, 6cbk, 6cbu, 6cbw, 6cej, 6cek, 6cfz, 6cgd, 6cgl, 6cgw, 6chu, 6cia, 6cid, 6ckh, 6ckp, (6ckr), (6cmr), 6cnh, 6cnl, 6ak, 6bh, 6bm, (6dd), 6ea, 6eb, 6ej, 6fh, 6fp, (6fy), 6gr, 6hp , 6jx, 6ka, 6li, 6lv, 6mg, 6mh, 6ms, 6nx, 6ol, 6pl, 6rm, 6ua, 6vd, 6vf, 6wt, (6xad), 6xl, 6zah, 6zar, (6zau), 6zh, 6zq, 6zr, 7abb, 7aby, 7adg, (7aea), 7aez, 7afn, 7ahi, 7ak, 7go, 7hg, 7ih, (7it) !, 7iw, 7jd, 7ks, (7ly), 7nn, 7ot, 7qc, 7qj, (7qt), 7qu, 7qy, (7sc), 7sf, (7to), (7ws), 7zd, 7zo, 7zu, 7zy.

Can.: 2bn, 2cg, 2ic, 3aa, 3ba, 3bp, 3bq, 3gk, 3ia, 3jt, 3ni. 3oh, 3om, 3pg, 3si, 3tf, 3xi, 3zs, 3adh, 3aec, 4dy, 4hh, (5cn), 5go. The above heard on detector and one step a.f., with bad power line qrm most of time.

By 7LH, Junction City, Wash.

2aay, 2bqh, 3ab, 3co, 4hs, 5aai, 5abb, 5adh, 5adv, 5agj, 5ahr, 5aij, 5aiv, 5ajj, 5alr, 5ama, 5anc, 5dr, 5ek, 5gf, (5ht), 5hz, 5in, 5kc, 5lr, 5nn, 5ov, 5qi, 5qq, 5qw, 5ua, 5uk, 5vf, 5xv, 5za, 5zav, (6aak), 6ac, 6afy, (6afz), (6agj fone), (6agk), 6agt, 6ahd, (6ahp), (6aib), 6ajf, (6ajp), 6ame, 6amg, (6ams), (6anb), (6aoh), (6aoi), 6aos, (6asx fone), 6atc, 6aty, (6atz), 6aup, 6auu, (6avu), 6awt, (6bcj), 6bcl, (6beh), 6bfg, (6bhk), 6bic, (6bih), 6biq, 6bjc, 6bnt, (6bon fone), 6bou, (6bpl), 6bqe, (6brf), (6bsj), (6bso), (6buf), (6bur), (6bur), 6buy, 6cbu, 6ccy, (6cdg), 6cee, 6cej, 6cfz, 6cgg, (6cgl), 6cgw, (6chc), (6che), 6chj, 6cia, (6cib), (6cid), 6cie, (6cjb), (6cjj), (6cjl), (6cjo), (6ckh), 6ckr, (6cku), 6clr, 6cml, (6cmm), 6cmn, 6cmr, (6cmu), 6cng, (6cnl), (6et), (6fh), 6ii, (6ik), 6js, 6km, (6kw), (6li), (6lu fone), (6nx), 6pe, 6wr, 6zh, 6zx, (6zau) qra?, 8ada, 8afd, 8amf, 8bz, 8ced, 8cmu, 8coj, 8ctp, 8dac, 8dgo, 8do, 8er, 8gz, 8kh, 8kj, 8nf, 8qn, 8yn, 9aau, (9ack), 9ady, 9aec, 9aen, 9agl, 9ahg, 9ait, 9amb, 9amd, 9aou, 9apf, 9aps, 9asf, 9atp, 9avn, (9avu), 9azg, 9bdr, 9beb, (9bey), 9bez, 9bfb, (9bgi), 9bhd, 9bis, 9bji, 9bjk, 9blg, 9bly, 9bmq, 9bnk, 9bpn, 9bun, 9ccs, (9ccv), 9ccz, (9ceh), 9chc, 9cjy, 9cmk, 9cnb, 9cqw, 9cr, 9ctq, 9ctr, 9cuq, 9cyw, 9czw, 9daw, 9day, 9dcj, 9dct, 9dcw, 9des, 9dfh, 9dj, (9dkb), (9dlf), 9dlw, 9dqu, 9dro, 9dsw, 9dte, 9dvg, 9dxc, 9dxn, 9eae, 9eak, 9ee, 9efj, 9ei, 9eky, 9elv, 9nr, 9qr, 9zt.

Can.: (4aj), 4ax, 4cl, 4cw, 4dy, 4fn, 4hf, 5cn, (5eb), (5ef), 5go, 9bp.

Spk.: 5hd (Can.), 6azu, 6ts. Wud appreciate reports on my 10-watt C. W.

At Canadian 3TB, 300 Wolfe St., London, Ontario

1abc, 1afa, (1ahz), 1alj, (1all), (1ary), (1avl), (1aw), (1bgc), 1bgf, (1bqd), (1bqm), 1boa, 1bwj, (1caz), 1cmp, (1cpc), 1hx, (1er), 1mq, (1oz), (1wo), (1xam), 1yb, 1ze, 2ami, (2awf), 2bbn, 2bjo, (2bqh), 2bls, 2bum, (2buy), (2bxp), (2cee), 2cel, (2ccd), (2cgb), (2cpa), (cnh), (2cqi), (2cxd), (2cxl), 2cva, (2fz), (2iw), 2kf, (2ku), (2lv), 2rk, 2rm, 2ts, 2wa, 2wf, (2wr), (2xq), 3ahp, 3aic, 3arm, (3bbp), (3bdo), 3blp, 3bml, (3buc), 3buv, (3bsb), (3caz), (3cgm), (3cjn), 3chp, (3cbl), (3ckd), 3cc, 3hh, 3jv, 3jj, 3pz, (3tr), 3su, (3uz), 3yp, 4ay, (4eb), (4ft), 4jk, 4mi, 4bk, 4mb, (5abh), (5ago), (5air), 5aiu, (5ahr), 5afq, 5ama, (5amh), 5akn, 5ac, (5be), 5ht, 5qf, (5qq), 5nn, 5mi, 5oo, 5uk, 5up, 5vv, 5xa, 6acm, 6aos, 6arb, 6avv, 6bcs, 6beo, 6bic, 6bih, 6blm, 6bnc, 6bwp, 6cbd, 6cc, 6cgw, 6chu, 6ckp, 6ckr, 6ea, 6et, 6fp, 6lv, 6ts, 6su, 6vd, 6zau, 6zh, 6zz, 7adr, 7sc, 7afn, 7zu, (8ab), 9aal, (9aap), 9adp, aem, (9afy), 9ahq, 9ahy, (9ahz), 9aim, (9ajv), (9ami), 9amb, (9amu), 9aod, 9aon, 9apf, 9aps, 9arc, 9arf, 9arh, 9avn, 9aus, 9auu, 9awg, 9awp, 9awv, 9axa, (9ayj), 9avn, 9bas, (9bbw), (9bcf), 9bdr, (9bez), 9bfi, 9bff, 9bji, (9bak), (9bjr), 9blg, (9bly),9bpd, 9bpn, 9bqj, (9bsh), 9bsp, 9btl, 9bun, 9bxq, 9caa, 9cah, 9cao, 9ccz, (9ceb), (9ceh), 9cgu, (9chd), 9cho, 9cja, 9cjc, 9cjs, 9ckp, 9ctb, 9ctr, 9cvc, 9cyq, 9czo, 9czw, 9daj, 9dct, 9deq, 9dhg, 9dkw, 9dky, (9dpx), 9dsl, 9dsm, 9dso, 9dwa, 9dwk, 9dxy, (9dyt), 9dyy, 9dzy, 9edo, 9eea, 9egh, (9ehi), 9efj, (9eld), 9elv, (9eky), 9ekc, 9dc, (9eg), 9qr, 9qw, (9mc), 9ub, 9vc, 9zg, 9zt.

Can.: 1ar, 1dd, 1de, (2bn), 2cg, (2am), 2be, (2ic), (3aa), (3ni), (3ws), (5cn), 5go, 9ce. Above stns. heard on detector only. All reports on our 50-watt R.A.C. C. W. Sigs appreciated.

By 5HT ex-5PX, 200 Oark Ave., Fort Worth, Texas

1ajx, 1ary, 1awe, 1bcg, (1boq), 1bqd, 1cab, (1cmp), 1cpn, 1er, 1gv, (1hx), 1sn, 1yb, 2aay, 2bwr, 2brb, 2by, 2cei, (2cfb), (2cpa), 2crp, 2cxd, 2kf, (2rk), 2ts, 2wa, 3ab, 3ahp, 3atb, 3bij, 3bwt, (3hg), (3hs), 3jy, 3me, 3pz, (3vo), 3yp, 4ag, (4db), 4el, 4fg, 4ft, 4hr, 4hs, (4jh), 4jk, 4jz, 4mb, 4ob, 4on, (4na), (4pd), 4pv, (6aak), 6aam, (6acb), 6age, (6ajd), 6ajj, (6ahu), (6ak), 6alv, 6alk, 6ane, 6ani, 6aoi, (6aos), (6arb), 6aur, 6aup, 6avv, 6awt, 6bah, 6bcj, (6bcl), 6beg, 6beh, 6bih, (6bjj), (6bkx), 6bmn, (6bnt), 6bpz, 6bqe, (6bql), (6brf), (6brk), 6bsv, 6bua, 6bve, (6cbd), 6cdg, 6cfy, 6cgg, (6cgw), 6cjl, 6cmr, (6cnh), (6cnl), 6cu, (6eb), (6et), (6fp), (6fy), 6jm, 6mh, (6od), 6pe, (6pl), 6ux, 6vf, 6wt, (6zah), 6zar, 6zx, 6zh, 6biq, (7abb), 7abh, (7adg), 7adr, 7ads, 7ahi, 7akh, 7fd, 7hw, (7ih), (7iw), (7lh), 7ln, (7lr), (7ly), 7qd, (7qj), 7rc, (7sf), (7sc), 7sh, (7to), 7zu. Too many 5's, 8's and 9's.

Can.: 2bn, (2cg), 3jl, 3ko, 3kp, 3nf, 3oe, (3oh), 3si, 3zt, (4cl), (4cn), 4cr, (4fn), (5cn), (5go).

Mexico: (bx).

By 9FM, Dr. S. J. Blum, 6320 Main St., Kansas City, Mo.

6fp, 6fy, 6gr, 6lh, 6lv, 6mh, 6oh, 6pe, 6pl, 6ts, 6yc, 6zh, 6zu, 6lu, 6aos, 6alv, 6ajj, 6ajd, 6agk, 6asx, 6akz, 6awt, 6bhr, 6bic, 6brf, 6buh, 6bnc, 6blg, 6buo, 6bbh, 6brk, 6bjj, 6ckr, 6chu, 6cek, 6cnh, 6cfz, 6cbu, 6cgw, 6cbb, 6cgi, 6cbd, 6cfz, 6cmr, 6zah, 7fd, 7ge, 7no, 7sh, 7sc, 7sf, 7yl, 7zd, 7zo, 7zu, 7zx, 7wm, 7agr, 7adf, 7afn, 7ads, 7aif, 7abb, 7aiy, 7sh. Cards if requested. Anyone hearing my C. W. pse qsl.

Tell them that you saw it in RADIO

By 3AGF, Bridgeton, N. J.

5abd, (5ahd), 5aiu, 5akn, 5cf, 5gf, 5gj, 5gp, 5je, 5lr, 5nn, 5ov, 5qi, 5qt, 5tm, 5uk, 5vf, 5vv, 5ws, 6acz, 6ajp, 6akz, 6alt, 6aol, 6arb, 6awt, 6bcl, 6beo, 6bih, 6buo, 6chv, 6cnl, 6lv, 6rn, 6xad, 6zah, 6zar, 6zw, 7abb, 7aea, 7co, 7fq, 7mp, 7wp, 7zu, 9aar, 9aav, 9ady, 9aec, 9aep, 9ahq, 9ahy, 9aim, (9amk), 9amo, 9and, 9aou, 9apf, 9apr, 9aps, 9arf, 9ase, (9ato), 9atx, 9aus, 9awf, 9awg, 9axh, 9ayx, 9azg, (9azp), 9bak, 9bbi, 9bbw, 9bcb, 9bda, 9bed, 9bff, 9bis, 9bjl, 9bmu, 9bpv, 9bsg, 9bvn, 9bwf, 9bwv, 9byc, 9ccm, 9ccs, 9ccw, 9cdo, 9cdv, (9ceh), 9cfk, 9cgn, 9cgu, (9cip), (9cja), 9cjc, 9cji, 9clz, 9coc, 9con, 9cow, 9cte, 9cvc, 9cvi, 9cvo, 9cwl, 9cyd, 9czl, 9day, 9dcw, 9dcy, 9dge, 9dhr, 9dip, 9djz, 9dkx, (9dmj), 9dpc, 9dqu, 9dsg, (9dsw), 9dxs, 9dyr, 9dyy, 9eak, 9ees, 9efu, 9ehi, 9eja, 9ejz, 9eky, 9ae, 9ap, 9bg, 9cp, 9dd, (9er), (9ir), 9kd, (9mm), 9oy, 9ru, 9st, 9vm, 9vz, 9wn, 9yy, 9zt.

Fone: 5amf, (9dlo).

Wud appreciate a crd fm anyone hearing my 10 watt C.W. All crds qsl'd.

By 8BCU, Rochester, Mich. (near Detroit)

4ag, (4lj), (5afq fone), 5aiu, 5akn, 5aom, (5ek), 5kc, 5ov, 5pa, 5nn, 5tj, 5xd, 6aiv, 6alk, 6alv, 6aoi, 6aos, (6avv), (6bcl), 6beh, 6beo, 6bpf, 6bpz, 6bug, 6bur, 6bve, (6bvg), 6chl, 6chv, 6cng, 6xad, (6zau), 6nb, 6vf, (7abb), 7ge, 7hg, 7iw, 7ot, (7se), 7to, (9apf), 9ayu.

Can.: 2ic, (3gg fone), (3wg), (3ni), 4ca, 4cw, (5cn), 5go.

By 7IW, Eugene, Oregon

1cmp, 1er, 1rv, 2rk, 2afp, 2cpa, 3hs, 3bva, 3hg, 3bn, 3gg, 4hg, 4el, 4ft, 4hv, 4ea, 4cs, 4fn, (5aiu), 5ajj, 5abb, 5chl, 5hq, 5qq, (5ahr), (5ht), 5ph, 5akn, 5gg, 5lr, (5za), 5ef, (5zav), (5xd), 5ov, 5vm, (5hk), (6ceu), 7mn, 8wx, 8zc, 8ab, (8aa), (8bxx), (8bda), 8bhn, 8bfh, 8aib, 8anm, 8ada, 8bfm, 8czz, 8com, (8dhq), 8jy, 8bk, 8ef, 8apt, 8yh, 8vy, 8aqv, 8pl, 8rj, 8ban, 8aid, 9vm, 9afm, 9mc, 9dyr, 9apw, (9apf), 9cbj, 9bly, 9azg, 9lz, 9aic, 9aac, 9btt, 9qr, 9bjk, 9dhz, 9bzi, 9dwn, 9bji, 9aou, 9asn, 9doe, 9bhf, 9cjy, 9vy, 9atn, 9zy, 9dli, 9bhx, 9cgz, 9ash, 9amb, 9afy, 9ccv, 9awp, (9ctr), (9dsw), 9dug, (9dkb), 9dte, 9cvs, 9brk, 9dqw, 9apt, 9cdo, 9dyr, 9zt, 9cip, 9bed, 9cgu, (9bdz), 9aec, 9cip, 9cdv, 9aec.

By 2BQC, Franklin A. Korn, 330 So. Park St., Elizabeth, N. J.

4ag, 4ai, 4ay, 4by, 4cs, (4db), 4eb, 4io, 4ku, 4mb, 4me, 4rh, 5abd, 5aiu, 5akn, 5ek, 5fv, 5gt, 5ht, 5lr, 5mo, 5up, 5ws, 5zav, 5zb, 6awt, 6bcl, 6xad, 6zh, 7co, 7lu, 7sc, 8ab, 8aam, 8acy, 8adk, 8aex, 8afn, 8agd, 8ago, 8agp, 8aje, 8apt, 8atn, 8awj, 8ba, 8bbw, 8bda, 8bdu, 8bf, 8bfu, 8bia, 8bjv, 8bjy, 8blb, 8bmb, 8bnh, 8bnz, 8boa, 8bqi, 8brc, 8bvt, 8cfx, 8cgn, 8ckn, 8coj, 8con, 8cwp, 8czz, 8daw, 8dcg, 8dcy, 8dfb, 8dkj, 8dlm, 8dp, 8er, 8fc, 8fu, 8gz, 8hn, 8ij, 8jj, 8jq, 8nz, 8om, 8pl, 8rm, 8tt, 8uf, 8vy, 8zab, 9aa, 9aad, 9aau, 9aaw, 9aep, 9afy, 9ahy, 9aic, 9aim, 9an, 9anq, 9aqd, 9arf, 9arp, 9arr, 9ase, 9asv, 9asw, 9awd, 9awf, 9awv, 9axx, 9ayp, 9azg, 9bak, 9bbi, 9bdb, 9bdy, 9bed, 9bjr, 9bki, 9bnb, 9boz, 9bry, 9bsg, 9btt, 9buh, 9bva, 9ccs, 9ccv, 9cdo, 9cgb, 9ckw, 9cmc, 9cmk, 9cra, 9csy, 9cpb, 9cui, 9cvs, 9cyw, 9daj, 9ddj, 9dhs, 9dkk, 9dky, 9dqu, 9dro, 9dvw, 9dxs, 9dyy, 9dzs, 9ecv, 9eer, (9eja), 9ejz, 9eky, 9ell, 9elv, 9le, 9mc, 9mf, 9ss, 9ur, 9vc, 9vm, 9wc, 9zt.

Can.—2be, 2bg, 2bn, 2dn, 2ic, 3ko, (3tb), 4ea, 4cl, 9bp. Will qsl to any of above on request. Wud appreciate a crd on my sigs.

By 9TH, 419 Livingston Ave., St. Paul, Minn.

C. W.: 1aw, 1ci, 1jt, 1mo, 1uj, 1wi, 1xm, 1xw, 1yb, 1zi, 1aol, 1avk, 1cki, 1caz, 2be, 2dh, 2gk, 2hm, 2wb, 2ana, 2bms, 2blp, 2bte, 2cjr, 2cpa, 2crp, 2cwp, 2cxl, 2czr, 3iw, 3ov, 3lg, 3tf, 3wx, 3xi, 3yv, 3ahp, 3arm, 3avm, 3bar, 3bdo, 3bei, 3bgg, 3bji, 3bqp, 3bti, 3bva, 3bwt, 3caq, 3ccv, 3cfv, 3chh, 3cia, 4bk, 4cs, 4cr, 4ea, 4fv, 4gx, 4jh, 4on, 4qf, 4qw, 4adn, 5ek, 5fx, 5gg, 5hg, 5in, 5io, 5kc, 5lr, 5ml, 5mo, 5ny, 5qr, 5qw, 5rg, 5rh, 5ti, 5uk, 5up, 5wp, 5xv, 5zg, 5aac, 5adc, 5ado, 5agj, 5ahr, 5air, 5aiu, 5akj, 5amu, 5zas, 5bm, 6dd, 6ik, 6jj, 6ls, 6lu, 6lv, 6mh, 6pl, 6qg, 6vu, 6wt, 6xa, 6zb, 6zs, 6acm, 6ahz, 6aoi, 6auu, 6auy, 6bbe, 6bcl, 6bfh, 6bic, 6bih, 6biq, 6bjj, 6blg, 6bnc, 6brf, 6bsj, 6bua, 6buh, 6bve, 6cbw, 6cfy, 6cfz, 6cgd, 6cgw, 6cjb, 6ckp, 6cuz, 6zar, 7aa, 7co, 7du, 7hw, 7it, 7ob, 7qc, 7qj, 7ra, 7sc, 7sh, 7to, 7tw, 7zx, 7adh, 7adr, 7aea, 7aiy, 7ajy, 7akh, 8ap, 8bd, 8do, 8dh, 8es, 8ld, 8nz, 8pu, 8tt, 8rj, 8uf, 8wc, 8wy, 8zz, 8aag, 8aaj, 8acm, 8act, 8aeg, 8aex, 8afg, 8agl, 8aih, 8alt, 8anb, 8apn, 8atl, 8axc, 8azh, 8bay, 8bci, 8bda, 8bfh, 8bfw, 8bgz, 8bjv, 8bma, 8boa, 8boy, 8bum, 8bvu, 8bwk, 8cap, 8ccr, 8cdz, 8cgm, 8cgx, 8cko, 8cmu, 8cnw, 8coj, 8con, 8cqi, 8cqx, 8crf, 8crn, 8crw, 8cuv, 8cux, 8dac, 8dcy, 8des, 8dfo, 8dga, 8dgl, 8dhn, 8die, 8dif, 8dkz, 8dok, 8zag.

Can.—2ac, 2bn, 2cg, 2dn, 2ei, 2ic, 3ar, 3ba, 3fc, 3if, 3ir, 3jt, 3nf, 3om, 3ph, 3tb, 3tf, 3ws, 3xi, 4uv, 9cd. Will qsl crd to any of the above if requested. We would appreciate crds from those hearing our 5-watt C. W.

By 3CKF, Aubrey C. Birch, 2050 Wis. Ave., N. W., Washington, D. C.

1ajt, 1ajx, 1alj, 1all, 1anf, 1aol, 1apg, 1apj, 1ar, 1asn, 1asu, 1aur, 1aw, 1bcr, 1bgn, 1bhk, 1bsd, 1bst, 1chi, 1ci, 1ckf, 1cmp, 1cqp, 1cri, 1gv, 1iv, 1iz, 1ml, 1pj, 1qi, 1rr, 1sj, 1ts, 1va, 1vk, 1xm, 2ad, 2ai, 2al, 2asu, 2aws, 2az, 2be, 2bn, 2bna, 2br, 2cg, 2cgj, 2cp, 2cpa, 2cqb, 2cwj, 2cwq, 2cxt, 2im, 2yb, 3's too numerous, 4ai, 4ay, 4bx, 4by, 4el, 4fb, 4ft, 4hw, 4hz, 4jk, 4mi, 4na, 4da, 4su, 4wk?, 4za, 5ag, 5air, 5ajp, 5amw, 5kh, 5lr, 5ma, 5mo, 5qw, 5rk, 5rv, 5sz, 5uk, 5xk?, 5xj?, 5za, 5zb, 6ack, 6buo, 6ckp, 6du, 6fa, 6fp, 6my, 6xc? 7alr, 7co, 7gs, 8aaj, 8abh, 8abz, 8ack, 8acm, 8afo, 8aln, 8alj, 8anb, 8apn, 8apt, 8atp, 8atr, 8avt, 8azh, 8ban, 8bce, 8bcu, 8bda, 8bhf, 8bho, 8biz, 8bjr, 8bm, 8bmb, 8boa, 8boy, 8bpm, 8bvu, 8bx, 8cbw, 8cfu, 8ckn, 8clm, 8com, 8cpu, 8crn, 8crm, 8cuo, 8cve, 8daw, 8dcg, 8dcz, 8dda, 8dgj, 8dhn, 8diz, 8djd, 8dl, 8dyj, 8do, 8gz, 8hj, 8hq, 8jj, 8kh, 8kj, 8mt, 8pz, 8rh, 8rj, 8tm, 8uf, 9aad, 9aau, 9acq, 9aeq, 9afy, 9ahm, 9aio, 9aku, 9amb, 9amk, 9amn, 9amt, 9anp, 9ans, 9apw, 9aqb, 9aqp, 9arf, 9ars, 9aru, 9ase, 9asm, 9asv, 9auw, 9bbu, 9bcp, 9bed, 9bgz, 9bfn, 9bgc, 9bgn, 9bhd, 9bhi, 9bib, 9bmf, 9bmp, 9bnh, 9bqy, 9bu, 9bvw, 9byw, 9cah, 9cd, 9ccz, 9cga, 9che, 9cji, 9ckc, 9cmc, 9cmk, 9cmt, 9cra, 9ctc, 9cte, 9ctg, 9cwf, 9cyf, 9cyw, 9czs, 9dct, 9dcz, 9ddu, 9dfh, 9dgc, 9dhr, 9dlw, 9dnn, 9dnx, 9dqu, 9dro, 9dtt, 9dxy, 9ea, 9eer, 9ej, 9ekc, 9ekf, 9ela, 9eld, 9ell, 9ely, 9le, 9oa, 9qr, 9ub, 9ur, 9us, 9vk, 9vm, 9wc, 9zt, 9zy.

Can.—1ckp, 2ic, 2bn, 3iv, 3kp, 3nf, 3tb, 3tf, 3xi, 3xs, 3zl. Will appreciate qsl's on mi 5-watt I. C. W. The above calls qsl'd if requested.

By 8BNH, 142 S. Union St., Akron, Ohio.

6aak, 6acm, 6agj, 6ajh, 6ajj, (6aos), 6avv, (6bcl), 6bcs, 6beq, 6bic, (6bih), 6bnc, 6bpz, 6bqe, 6bua, 6cbb, 6cbw, 6cgw, (6chl), 6ckr, 6cnh. (6cmr), 6ak, 6cc, 6fp, 6lv, 6mh, 6pl, (6xad), 6zah, 6zar, 6zau, 6zh, 7acs, 7adh, (7abb), 7sc, 7sf, 7lu, 9amb,(9apf), (9azg), 9bji, 9bxq, 9caa, 9cjy. Can. 5cn, 5go.

By 4PV, L. H. Leathers, 148 Avant St., Spartanburg, S. C.

(1amf), 1bck, 1bgq, (1bvb), 1cgo, 1er, (1zd), (2aay), (2apd), (2bir), 2bm, 2buy, (2ccd-qra?), 2cee, 2cjr, 3afs, 3ahp, (3aqr), (3bei), 3bgo, 3bgj, 3bmn, 3bpf, 3bva, (3bvl), (3cel), 3cia, 3lg, 3oh, (5acm), 5afq, 5agj, 5amh, (5ek), 5ht, 5kc, (5kr), (5lr), (5nn), (5ov), 5ql, 5rg, 5uk, (5xk-qra?), 8aex, 8age, 8ahj, 8ard, 8bbf, 8bch, 8bdm, 8bf, (8biq), 8bjv, (8bnh), (8boa), (8ccq), (8cko), (8con), 8cus, (8cuv), 8djp, 8dxs, 8nd, 8pl, 8rj, 8rm, 8sf, 8ve, 8xw, (8yae), 8zc, (9ady), 9aic (C. W. and fone), (9amt), 9amz, 9aps, (9awf), (9ayl), (9bak), 9bly, 9bmu, 9boe, 9bry, (9bxt), 9ckw, 9cmm, 9czm, 9dek, (9dhr), 9dkx, 9dnd, 9ehm, 9ei, 9ejz, (9eld), 9elq, 9elv, 9ep, 9zt.

Can.—(3kg), 3mn. The above heard on 3-circuit tuner with two stages A.F.; will qsl to those making request by card. All reports on sigs of 4PV are greatly appreciated and promptly qsl'd.

By 2BY, Schenectady, N. Y.

C. W.: 4ab, 4af, 4ai, 4ay, (4bx), 4by, 4db, (4dw), (4ea), (4eb), (4el), 4fn, (4ft), dalite-C. W. and fone, 4fz, 4gx, (4hr), (4hs), (4jk), 4ku, (4lu), 4mi, 4my, 4oa, (4pk), (4qw), 4sh, (5ago), 5aic, (5air), 5aiu, 5akn, 5amf C. W. and fone, 5amh, 5arb, 5bm, 5ek, 5er, 5fv, 5gm, (5hl), 5kc, 5lr, (5nn), 5nz, 5qi, (5ql), 5qw, 5qy, (5uk), 5we, (5xv), 5za, (5zav), 5zax, 6aak, 6ajh, 6awi, (6bcl), 6bic, 6bm, (6bpz), 6bvg, 6cgw, 6crz, 6fp, 6ka, 6lv, 6mt, 6nl, 6pf, 6pl, 6xad, 6zah, 6zbc, 6zh, 6zz, (7abb), 7aby, 7adh qra?, 7co, 7em, 7fd, (7ih), 7qc, 7sc, 7zd, 7zu, (9aad), (9aag), 9aau, 9aci, 9acq, 9ady, 9aed, 9amb, 9anb, (9aou), (9aox), 9ape, 9apf, 9asn, (9atn), 9aus, (9avt), (9awf), 9axd, (9azg), (9bak), (9bed), (9bfb), 9bg, 9bgh, 9bkp, 9bmz, 9bof, (9brk), 9bry, 9bto, 9bun, (9bwb), 9bzi, 9cbj, 9ccs, (9ccz), 9cea, 9cfz, 9che, (9cki), (9clq), 9co, 9cra, (9ctb), (9cvv), 9cyw, 9czg, (9czw), 9day, (9dds), (9dkv), 9dli, (9doe), 9don, (9dsw), (9dxs), (9eeg), 9ehi, 9eil, 9ekf, (9eky), 9ela, (9ely), (9elq), (9ep), (9eq), 9fm, (9mc), (9yy).

Can.—5go, 5cn, 5ct. English—2kl, wnp Dec. 18th. If u havn't already qsl'd our sigs, we wud appreciate ur crd.

By 6AMM Rt. 2, Bx. 124, San Jose, Calif.

1ze, 3co, 4ab, 4cl, 4cw, 4oa, 4oi, 5ado, 5aig, 5ajp, 5ak, 5amf, 5cd, 5cg, 5cn, 5ef, 5ek, 5go, 5lo, 5lr, 5nn, 5ra, 5za fone, 5zav, 5zb, 6adm, 6adt, 6aff, 6afg, 6ahv, 6aru, 6asa, 6atq, 6bbh, 6bbq, 6bcj, 6bdt, 6be, 6beg, 6beh, 6bis, 6bjj, 6bjv, 6bjy, 6blg, 6blh, 6bpz, 6bra, 6bsc, 6bsu, 6buh, 6buo, 6bvz, 6bwe, 6cag, 6cbg, 6cbu, 6cdd, 6cff, 6cfl, 6cfm, 6cfy, 6cgw, 6chv, 6chw, 6cu, 6et, 6hj, 6mi, 6ms, 6od, 6pe, 6tn, 7ab, 7acg, 7aci, 7ads, 7afe, 7ahx, 7ahz, 7ajd, 7ajy, 7ca, 7cb, 7co, 7ez, 7fl, 7fv, 7go, 7gu, 7hg, 7hj, 7hw, 7io, 7it, 7iy, 7jr, 7kr, 7lh, 7lr, 7ls, 7ly, 7mp, 7nt, 7ob, 7oh, 7op, 7ot, 7pj, 7pz, 7qj, 7rd, 7rj, 7rp, 7sc, 7sl, 7sy, 7to, 7vc, 7ve, 7vn, 7wa, 7wp, 7yi, 7yl, 7zf, 7zu, 8ame, 8bda, 8bu, 8caj, 8cdg, 8cgj, 8cpp, 8crm, 8jj, 8tv, 8vj, 8wx, 8yn, 8azl, 9aff, 9aim, 9amb, 9apf, 9aps, 9avn, 9avs, 9azg, 9bak, 9beo, 9bjk, 9bly, 9bob, 9bol, 9bou, 9bri, 9bsi, 9bsp, 9bun, 9bwa, 9bxq, 9bzi, 9caa, 9cag, 9cjh, 9clg, 9cpo, 9cpu, 9cr, 9cvh, 9day, 9det, 9dfh, 9djb, 9dkp, 9dly, 9dn, 9dte, 9dvw, 9eer, 9eky, 9ic, 9yy, 9zt.

Can.—4cl, 4cw, 5at, 5ct, 5go.

5cd and 9an, U. S. stns., heard three hours after daylight.

By Herbert B. Drake, 6VD, Anaheim, Calif.

2rk, 2xq, 4ay, 4eq, 4gx, 5adb, 5ado, 5be, 5de, 5hl, 5ht, 5hz, 5lg, 5lr, 5nn, 5tj, 5za, 5zav, 6ceu, 6cbu, 6rm, 7abb, 7adf, 7adr, 7ads, 7aea, 7aek, 7ael, 7aez, 7age, 7agv, 7aiy, 7akn, 7arv, 7bj, 7cf, 7dc, 7ei, 7fl, 7gi, 7gq, 7ih, 7iy, 7ks, 7ln, 7lo, 7lw, 7oh, 7ot, 7qd, 7qj, 7ql, 7rx, 7sc, 7sf, 7sz, 7to, 7ws, 7xy, 7ya, 7zd, 7ze, 7zi, 7zo, 7zt, 7zx, 7zz, 8bbi, 8bda, 8bfm, 8dat, 8ef, 8pd, 8vy, 8vq, 8yn, 8xe, 8zz, 9aim, 9amb, 9apf, 9awv, 9bed, 9bez, 9bji, 9bjk, 9bly, 9bun, 9ccz, 9cfy, 9cjy, 9cns, 9cvs, 9czg, 9dfh, 9dte, 9dxy, 9eae, 9ecz, 9eea, 9eht, 9ekf, 9eky, 9eq, 9rc, 9ss, 9vm, 9yy, 9zt.

Can.—3co, 4cb, 4cl, 4fn, 5cn, 5go. Also na (qra?).

At 8YAE-8ZE, Oberlin College, Oberlin, Ohio

(1ajx), (1aqi), (1aze), (1bhk), (1biz), (1cki), (1il), (1ju), (1mp), (1zd), (2aco), (2anm), (2auy), (2ax), (2beo), (2bgd), (2bmr), (2bqh), (2cfb), (2cqd), (2chq), (2cvj), (2cwj), (2cxl), (3ajg), (3bfs), (3bva), (3blc), (3cbl), (3cbv), (3cg), (3cn), (3sp), (3wf), (4eb), (4hs), (4jk), (4mi), (4mv), (5amh), (5gj), (5in), (5nl), (5uk), (6xb), (5zav), 6bm, 6ec, 6ez, 6gt, 6gr, 6if, 6ii, 6ka, 6kg, 6lv, 6sk, 6zh, 6zw, 6zv, 6aak, 6afq, 6akz, 6alk, 6aos, 6apw, 6arb, 6aru, 6avv, 6awt, 6bbc, 6bcl, 6bck, 6bic, 6biz, 6bkx, 6bmc, 6bnc, 6bnt, 6boe, 6bqb, 6bua, 6buo, 6bum, 6bve, 6bvg, 6cbw, 6cdg, 6cgd, 6cfm, 6cgw, 6chl, 6cib, 6ckp, 6ckr, 6cmh, 6cmr, 6dlf, 6xad, 6zar, (x 6tv), 6zba, (x 6cfi), 7abb, 7adr, 7afo, 7bj, 7co, 7hg, 7it, 7iw, 7ot, 7px, 7zg, 7zu, (9aav), (9adw), (9amz), (9ape), 9apf, (9aps), 9avs, (9awk), (9ayp), (9bav), (9baz), (9bgi), (9bfi), (9bhn), (9bkb), 9bji, (9bjl), 9bjk, (9brk), (9brt), 9bto, (9cbn), (9clq), (9crx), (9cyf), (9daw), (9dc), (9dkv), (9dky), 9dqh, (9dxl), (9eak), (9ebt), (9ehm), (9ej), (9elq), (9mf), (ft), (9ot), (9zt).

Can.—(2bn), (2cg), (3ia), (3xn), (3bm), (3om), 5cn, 5go. Glad to qsl to any of above, and would appreciate reports on our sigs from western states.

By Ray Groebe, Elizabeth, N. J.

4ai, 4aq, 4ay, 4db, 4eq, 4hs, 4ja, 4jz, 4ob, 5aac, 5adh, 5ahj, 5aiu, 5ama, 5amh, 5bm, 5cek, 5er, 5ht, 5iu, 5kr, 5lr, 5na, 5nn, 5ov, 5qd, 5qw, 5vv, 5xk, 5xas, 6ajr, 6aol, 6avv, 6bfg, 6bqb, 6bua, 6bvs, 6cfz, 6cgw, 6chl, 6cmr, 6cnl, 6fp, 6lv, 6zh, 6zz, 7adh, 7bj, 7co, 7lu, 7zd, 7zu, 9aar, 9apf, 9aqb, 9avf, 9avn, 9awd, 9bji, 9blg, 9boo, 9bri, 9bto, 9bzg, 9ccn, 9ccs, 9ccz, 9cga, 9ckm, 9cmk, 9czg, 9daw, 9dfh, 9dgi, 9did, 9dlm, 9dlw, 9dof, 9dqu, 9ear, 9eac, 9eea.

Can.—1dd, 2am, 2be, 2bg, 2bn, 3adn, 3nf, 3ni, 3xi, 4cl.

At 9CA, Dwight, Ill.

C. W. unless otherwise marked: 1aac, 1adn, 1afp, 1agi, 1akz, (1arf), 1ary, 1avl, 1aw, 1bbe, 1bvr, 1bdi, 1bqm, 1cpc, 1cpn, 1ly spk, 1oa, 1uo, 1va, 1yb, 6acm, 6adm, 6ajh, 6akz, 6alk, 6als, 6aoc, 6apt, 6avy, 6awt, 6beh, 6beo, 6bfg, 6bie, 6biq, 6bkx, 6bm, 6brf, 6bsx, 6buo, 6bur, 6buy, 6bvg, 6bwp, 6bwz, 6caw, 6cbb, 6cbw, 6cdg, 6cfy, 6cfz, 6cgd, 6cgw, 6chl, 6cjb, 6cuy, 6ea, 6ec, 6fp, 6kw, 6lv, 6mh, 6pe, 6pl, 6vf, 6wt, 6xad, 6zah, 6zam, 6zaw, 6zb, 6zba, 6zw, 7abb, 7co, 7ln, 7mp, 7ny, 7ob, 7oh, 7sc, 7yl, 7zd, 7zu.

Fone: 5ana, 5amf, 5lj, 8dat, 8kg, 9abx, 9ahj, 9aic, 9ash, 9aw, 9az, 9ccm, 9cls, (OW announcer), 9cfl, 9cwl, 9dfc, 9dfu, 9dlo, 9dyh, 9dyt.

Can.—2ad, 2dn, (3bg spk), 3bp, 3cn, 3fo spk, 3kq, 3ly, 4cl, 4hh, 6nx. French—8ab. Also station using uz as intermittent calling 6awt on Dec. 22 at 8:18 p.m. CST believed to be zuf or ufz. Most complete log in U. S. A crd gives all dope on ur sigs.

By 7HG, 3569 East K St., Tacoma, Wash.

(1ajx), 1cmp, 1er, 1kc, 2bxw, 2cpa, 3btl, (3hs), 3oh, 4ay, 4dk, 4ic, 4mr, 4qv, 5ado, 5agj, 5ahr, 5aiu, 5ajj, 5amh, 5akn, 5be, 5ek, 5ga, (5gj), 5ht, 5in, 5kn, 5mt, 5nk (spk), 5ph, 5sk, 5tj, 5tm, 5to, 5uk, 5vf, 5vm, 5za, 5zav, 5zw, 5zy, (6ceu), 8aa, 8ame, 8anm, 8avt, 8bci, 8bda, 8bdu, 8bf, 8bfm, 8bfn, 8bjy, 8brc, 8brm, 8bxx, 8cdz, 8crn, 8ctp, 8czz, 8dhq, 8ef, 8fu, (8jj), 8jy, (8pl), 8rv, 8vq, 8wx, 8wy, 8zz, 9adf, 9ady, 9aep, 9af, 9afm, 9afy, 9ahb, 9aic, 9aim, 9ajv, 9amb, 9amt, 9aon, 9aou, 9apf, 9ase, 9asn, 9atn, 9aue, 9awv, 9axx, 9ayp, 9azg, 9bab, (9bed), 9bhd, 9bis, 9bji, 9bjk, 9bkx, 9bly, (9bmx), 9bof, 9bqj, 9bqy, 9bri, 9brk, 9caa, 9ccs, 9cdo, 9cfy, 9cip, 9cjc, 9clq, 9cly, 9cpu, (9ctr), 9cvc, 9czm, 9daw, 9day, 9dek, 9dge, 9djb, 9dkb, 9dkq, 9dky, (9dlf), 9dli, 9doe, 9dpx, 9dsw, 9dug, 9dyr, 9dyz, 9eer, 9ehk, (9ei), 9ekf, 9eky, 9elv, 9ep, 9eq, 9fm, 9gk, (9mc), 9rc, 9vc, 9vk, (9vm), 9xaq, 9zt, 9zy.

Can.—(1ac), 3gk, 3oe. Pse notice qra, not correct in call books.

By 8RY, Sullivan, Ohio

Q6kw-fone, C2be, C2cq, C3co, C3kg, C3nf, C3si, C5cn, C5go.

1er 1sq, 1va, 1zd, 1afa, 1ajx, 1aol, 1aqm, 1oja, 1ckr, 1cpn, 2iu, 2atf-icw, 2bsg, 2cee, 3lg, 3vo, 3vw, 3yo, 3ahp, 4ay, 4dx, 4el, 4ft, 4gz, 4hz, 4io, 4il, 4mo, 4qf, 5om, 5fv, 5ht, 5in, 5nn, 5ov, 5pe, 5qi, 5ql, 5tj, 5vm, 5xap, 5za, 5abh, 5adc-qra?, 5aic, 5akn, 6jx, 6zar, 6acm, 6adm, 6ajp, 6auu, 6ayv, 6bbc, 6bcl, 6bic, 6bsj, 6buo, 6cbo, 6cgw, 7co, 7yl, 9ub, 9vm, 9aav, 9ajv, 9ali, 9amu, 9arp, 9ase, 9atn, 9auw, 9awv, 9ayl, 9bcx, 9bga, 9bhd, 9boe, 9bvn, 9cah, 9cdo, 9cji, 9dkx, 9dli, 9dyz, 9edb, 9eek, 9ekf, 9eky, 9eld.

At 6BUI, 711 N. 11 West, Provo, Utah

1cmp, 1yb, 1zi, 2aay, 2bqb, 2bxw, 2rk, 2xq, 3btl, 3ni, 4cl, 4jk, 4ku, 5aic, 5aij, 5air, 5aiu, 5ahd, 5adb, 5ahn, 5amu, 5anc, 5akr, 5bm, 5fj, 5fm, 5gi, 5hq, 5ht, 5in, 5jc, 5lw, 5mm, 5ql, (5qq), 5rw, 5sj, 5xd, 5zav, (6aed), (6afz), (6ahp), (6ajp), (6ap), (6ani), (6amg), (6aos), (6awx), (6bbw), (6beh), (6beq), (6bdi), (6bql), (6bkx), (6blm), (6bmm), (6bon), (6brf), (6bso), (6bur), (6bwd), (6cbb), (6cbu), (6cgd), (6cix), (6cgg), (6cmm), (6et), (6pe), (6wt), (6yb), (6zh), (6zau), (7adf), (7af), (7adr), (7ahn), 7aif, 7aiy, (7aic), 7cb, (7co), 7dc, (7eb), 7eo, 7gi, 7ih, 7hi, (7io), 7qj, 7qt, (7lu), (7lh), 7qd, (7no), (7ob), (7os), (7mp), (7rd), 7ru, 7sh, 7td, (7to), 7uu, 7wm, 7zu, 8agc, 8aki, 8bob, 8bzt, 8cnu, 8ddt, 8dgo, 8dhq, 8jj, 8kh, 8sw, 8tr, 8xan, 8xe, 8zz, (9ack), 9adp, 9ae, 9aec, 9afn, 9afr, 9ahq, 9aht, (9aim), (9amb), 9and, 9aod, 9aou, 9auw, 9avs, (9avu), 9avz, 9awv, 9ayp, (9azg), 9bak, 9bed, (9bey), 9bfi, 9bjg, 9bhx, (9bjk), 9bk, 9bmx, (9bri), 9btl, 9bxq, (9caa), 9cao, 9ccs, (9ccz), 9ce, 9cei, 9cfp, (9cga), 9cgl, 9chw, (9chd), 9cip, 9cjc, 9cji, 9clq, 9cmk, 9cpb, 9cpo, 9cpk, 9cpu, (9csy), 9ctg, 9cvc, 9cxr, (9daw), 9day, 9ddf, 9dfh, 9dhw, 9djp, 9dky, (9dms), 9doe, 9dpp, 9dpx, 9dqe, (9drf), 9drt, (9dsw), (9dun), 9dwk, 9dyz, 9ear, 9ee, 9eer, 9efa, 9eht, 9eiq, 9emc, 9ejz, (9jf), (9mc), 9qe, 9qk, 9qw, 9qy, 9ss, 9vm, 9vz, 9xaq, 9xy, 9zt.

Can.—4cn, 4er, 4ew, 4fn, 4gh, 4gl, 5cn, (5go).
Fone: 6bgd, (6brf), 6cbb, 6cgg, 9cvc.

By 6BWE, 3081 West Pico St., Los Angeles

U. S.—1bwj, 1yb, (2rk), 4ft, 4ku, (5gj), (5lr), 5ht, 5mn, 5ql, (5qq), (5aij), 5akn, 5aky, 5za, (5zav), 5adh, 5adh, (8gz), (8bci), 8bda, (8bdt), 8bfh, (8cgj), 8dig, 8zz, 8zy, (9apf), (9azg), (9bji), (9bsg), (9ccs), (9ccv), (9dun), (9zy).

Can.—3bp, 3co, (4cl), 4fn, (5cn), (5go), 9bp, (9bx).

By H. L. Smith, 711 D St., Oxnard, Calif.

C. W.: 5ado, 5akf, 5fv, 5lg, 5ql, 5ui, 5vp, 5za, 6ceu (Hawaii), other 6's too numerous, 7acq, 7ald, 7co, 7du, 7em, 7ez, 7hg, 7hw, 7it, 7kk, 7pe, 7qd, 7qt, 7sc, 7vn, 7we, 7zr, 7zu, 8bxx, 8cpp, 8jj, 8jy, 9aau, 9aep, 9aia, 9aim, 9amb, 9auw, 9avu, 9bed, 9bez, 9bji, 9bjk, 9bsg, 9byx, 9bzi, 9caa, 9cfy, 9cld, 9daw, 9dkq, 9dte, 9dun, 9dyr, 9eky, 9elv, 9eq, 9xaq. If ani of above want checks on sigs drop a crd and I wl qsl promptly. All copied on one tube.

By 6EU-6ZT-6XBE, Box 772, Salt Lake City, Utah

Can.: 4cl, 4cn, 4er, 4fn, 5ct, 5go.

U. S.: 2cjx, 2rk, 4ag, 4ft, 5ahd, 5ahr, 5aiu, 5aky, 5fx, 5hq, 5vf, 5vm, 5za, 5zah, 5zav, 5zb, 5zj, 6aed, 6afz, 6agj, 6ahf, 6ahp, 6aht, 6aib, 6aic, 6ajh, 6aju, 6alk, 6aoi, 6aos, 6auu, 6auy, 6awt, 6bbq, 6bic, 6bih, 6biq, 6bjj, 6bmn, 6bnc, 6bon, 6brk, 6bsx, 6buo, 6bur, 6bve, 6bvg, 6cae, 6cbd, 6cbk, 6cdg, 6cfz, 6cgw, 6chu, 6chz, 6ckr, 6cmi, 6cmu, 6dd, 6eb, 6fh, 6fy, 6gr, 6hp, 6ka, 6mr, 6nf, 6nx, 6of, 6oh, 6tc, 6ts, 6vd, 6xad, 6xbj, 6xl, 6zah, 6zbn, 6zh, 6zo, 6zq, 6zu, 7abb, 7aci, 7adk, 7af, 7afk, 7afn, 7bj, 7co, 7ew, 7hw, 7io, 7iw, 7ix, 7nn, 7ob, 7ot, 7qd, 7qj, 7qt, 7sc, 7to, 7ur, 7we, 7ze, 7zo, 7zu, 8aih, 9ac, 9aec, 9afm, 9aim, 9amb, 9amk, 9aml, 9apf, 9avw, 9avs, 9awv, 9azg, 9bdm, 9bed, 9blk, 9bly, 9bof, 9bzi, 9ccs, 9ccz, 9cdi, 9cdq, 9cjs, 9cjx, 9cr, 9cvc, 9czg, 9czw, 9dkb, 9dlm, 9dqe, 9dsw, 9dug, 9dvb, 9dxy, 9dyr, 9eae, 9ebd, 9eea, 9fm, 9mc, 9uh, 9vm, 9xaq, 9xy, 9yy, 9zg, 9zt.

By 6CLZ, 2131 Grant St., Berkeley, Calif.

C. W.: 2aay, 2kf, 4cs, 4ku, 5abb, 5ahr, 5aiu, 5akn, 5ama, 5ek, 5fv, 5gj, 5ht, 5kc, 5lr, 5nk, 5qy, 5tj, 5xd, 5yw, 5za, 5zav, 5zb, 5zh, 6ahf, 6aja, 6ajp, 6aru, 6atq, 6awx, 6bts, 6bui, 6ceu, 6cjb, 6pe, 6rm, 6yb, 6zh, 7abb, 7acg, 7aci, 7adr, 7adf, 7ads, 7aea, 7aek, 7ael, 7afn, 7agf, 7agv, 7ahn, 7ahx, 7aiy, 7ajy, 7akh, 7ald, 7bj, 7br, 7ca, 7cf, 7dc, 7du, 7ei, 7em, 7ez, 7fd, 7fq, 7fy, 7ge, 7gs, 7hg, 7hi, 7io, 7iw, 7iy, 7kk, 7ks, 7lh, 7ln, 7mp, 7no, 7nt, 7ob, 7oj, 7oo, 7ot, 7pj, 7qc, 7qd, 7qj, 7qt, 7ra, 7rc, 7rd, 7sc, 7sf, 7sh, 7so, 7tb, 7to, 7tt, 7ve, 7vn, 7wa, 7we, 7wm, 7ws, 7yl, 7zd, 7ze, 7zr, 7zt, 7zu, 8aa, 8abm, 8ajh, 8ame, 8asv, 8bbi, 8bci, 8bda, 8bfm, 8bmb, 8bmg, 8bqi, 8bvt, 8czz, 8dat, 8er, 8fu, 8ij, 8jj, 8kg, 8mz, 8pd, 8wx, 8xe, 8yn, 8zz, 9aau, 9aaw, 9ahq, 9aim, 9aku, 9an, 9anb, 9aps, 9avn, 9awm, 9awv, 9azg, 9bak, 9bav, 9bed, 9bex, 9bez, 9bg, 9bhd, 9blt, 9bly, 9bof, 9boz, 9bp, 9bqy, 9bri, 9bsp, 9bun, 8bzi, 9cbj, 9ccn, 9ccv, 9ccz, 9cga, 9chc, 9clq. 9cly, 9cr, 9ctk, 9cvc, 9cvv, 9czg, 9czw, 9daw, 9day, 9dfx, 9dge, 9dkb, 9dkq, 9dsw, 9dui, 9dwn, 9dxy, 9dyr, 9edb, 9ee, 9eer, 9egu, 9eky, 9ell, 9elv, 9mc, 9ss, 9th, 9vm, 9xaq, 9yy, 9zt.

Can.—C. W.: 3bp, 3oq, 4cb, 4cl, 4cw, 5ah, 5bq, 5cn, 5ct, 5ej, 5go. All stns. hrd on Reinartz det. only. All crds answered promptly. Qrk 6CLZ—5 watts a.c. C. W.? All over 500 miles.

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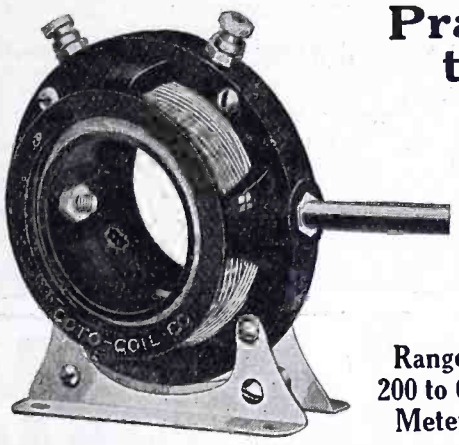

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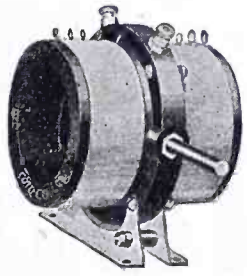

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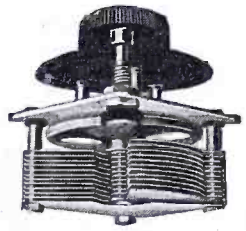
Companion piece of the Variometer. With eight taps for use with primary Condenser. Base or panel mounting. Type 9000. $5.50.



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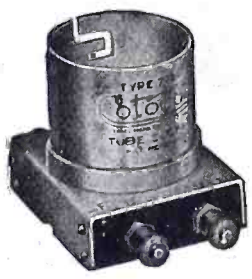
Especially designed and rigidly tested for electrical efficiency. Stops all leaks of antenna energy. Silver plated copper plates soldered in place. .001 Mfd. $6; .0005 Mfd. $5; .00025 Mfd. $4.50.



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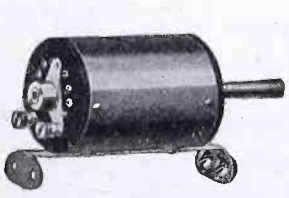
Coto Apparatus is designed and made to give the best possible results in standard radio circuits.

Its national reputation for excellence is based on good honest performance under all conditions.

So we guarantee each Coto Radio Part to the limit, authorizing all dealers to replace without question for any defect.



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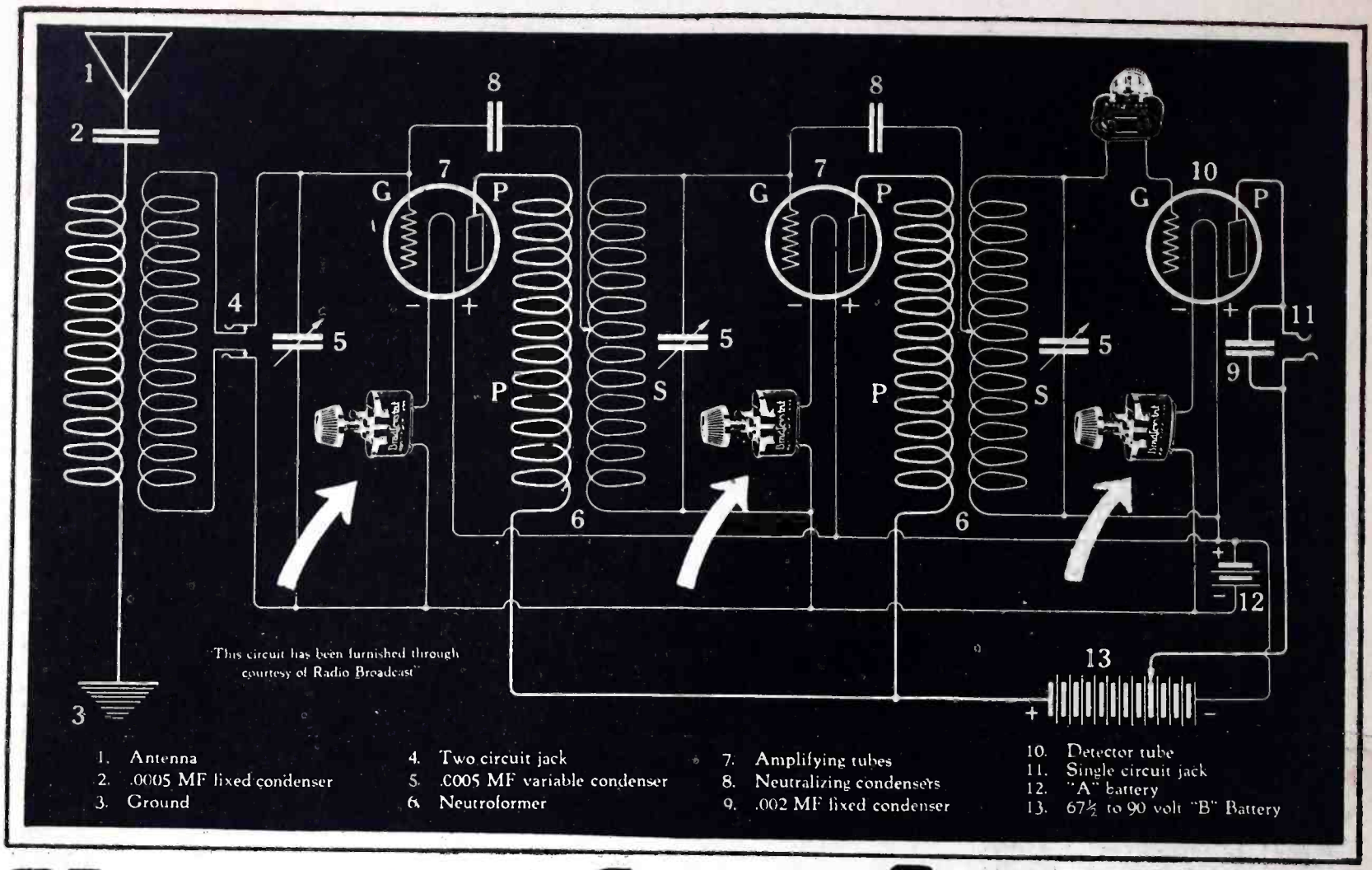

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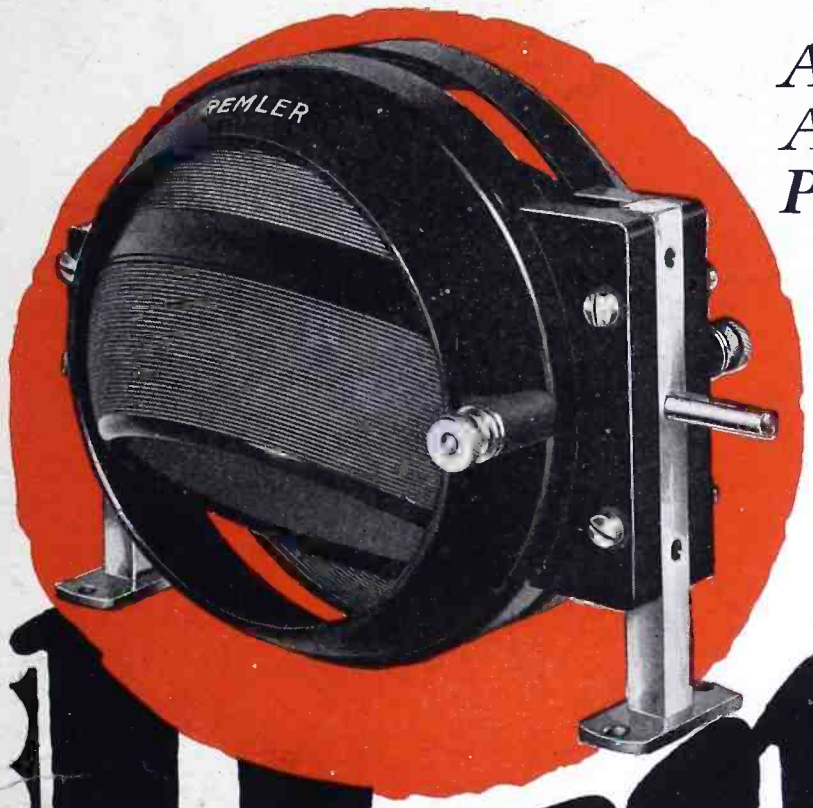

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