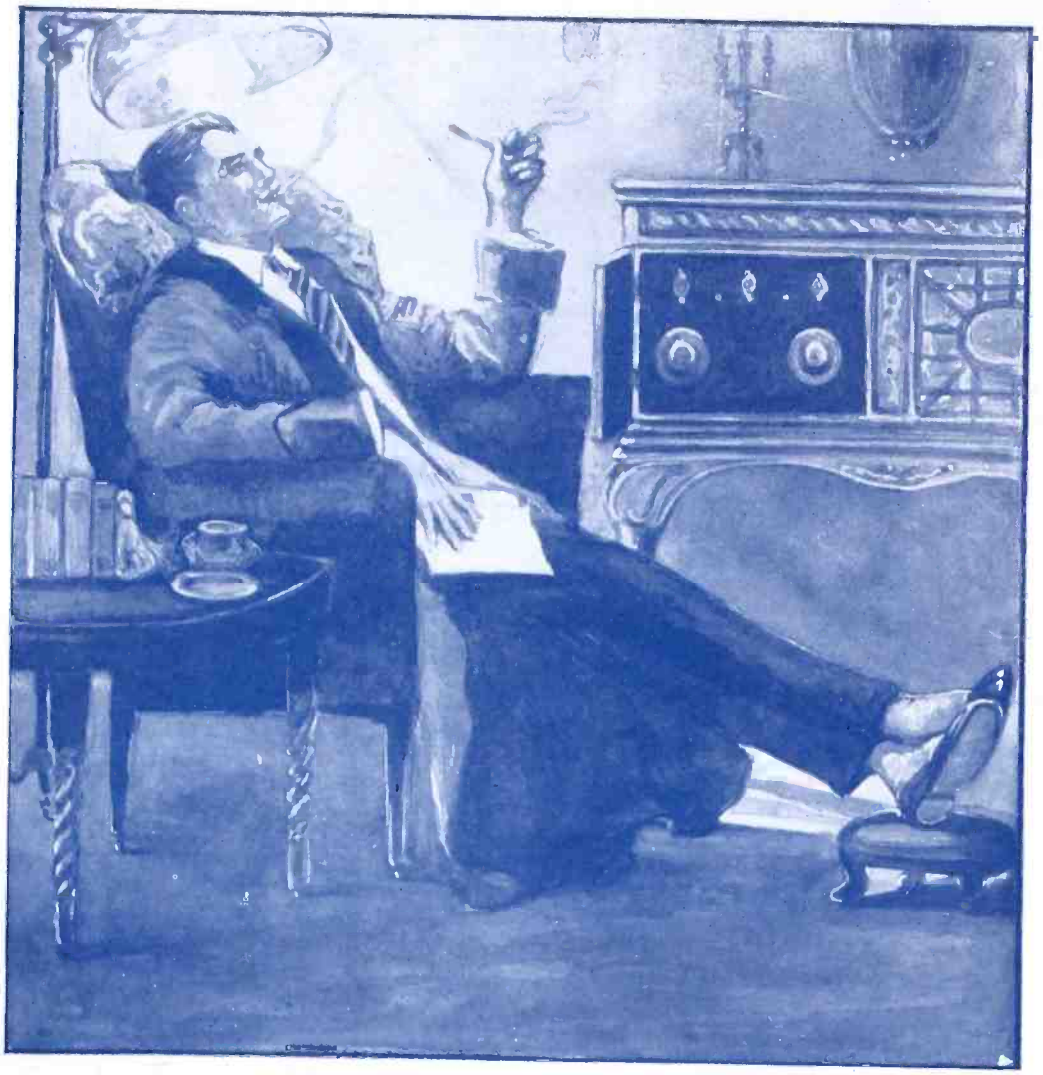
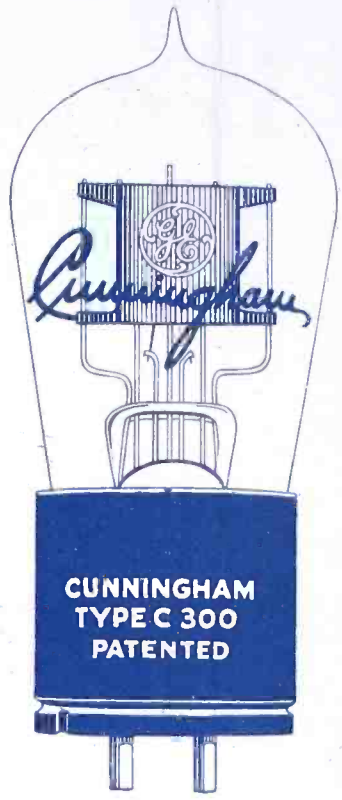
January, 1923 25 Cents

RADIO

An Independent Magazine Serving the Needs of the Radio Amateur and the Commercial Operator





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AS IT
DETECTS

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Cunningham Tubes used in any standard receiving set will enable you and your friends to listen to news reports at breakfast, stock market quotations at lunch, and in the evening sit in your comfortable living-room by the fireside and enjoy the finest music and entertainment of the day.

Send 5c for new 32-page Cunningham Tube catalog, containing detailed instruction for the operation of Cunningham Tubes as well as numerous circuit diagrams and graphic illustrations of tube action.

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

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TYPE C-300
Super-Sensitive
DETECTOR
$5.00

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Distortionless
AMPLIFIER
$6.50

The trade mark GE is the guarantee of these quality tubes. Each tube is built to most rigid specifications.

RADIO

Established 1917 as Pacific Radio News

Volume V *for* JANUARY, 1923 *Number 1*

CONTENTS *for* JANUARY, 1923

RADIO is Published Monthly by the
Pacific Radio Publishing Co., Inc.,
Pacific Building, San Francisco, Calif.
ARTHUR H. HALLORAN, *Editor.*
LAWRENCE MOTT. *Associate Editor.*
LOUIS TREVISO, *Art Editor*
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Advertising Forms Close on the First of the Month Preceding Date of Issue

Issued Monthly, 25c a copy. Subscription price $2.50 per year in the U. S., $3.00 per year elsewhere. Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

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

Forecast for February Issue

V. Ford Greaves, engineer with the Federal Telegraph Co., has attained remarkable success with a one-tube modification of the Armstrong super-regenerative circuit. He has described his very compact and simple set for the readers of February RADIO. With his improved loop antenna this is the best yet for operation in an automobile.

Those who have missed the excellent articles by B. F. McNamee since he became engineer with the Colin B. Kennedy Co. at St. Louis, will welcome the news that he has made time to write an article about "Reading Wavelengths in the Receiving Set." This includes directions for making a wave meter.

Volney G. Mathison will have two articles: One, the "Operator's Audion," concludes his series on the Professional Radio Operator. The other describes "Multiplex Arc Radio" whereby the Federal Telegraph Co. maintains overland domestic telegraph service. The diagrams and pictures are especially interesting.

H. Mac D. Hassell, senior operator on the *H. F. Alexander,* the man on the job in the picture in this issue, has a short story on "Preserving Your Ear." He tells how co-ordination improves your copying.

S. P. Wright, whose narrative about "Wildcat's" building a tuner appears in this issue, comes again with "Sparks" and "Bozo Make A Call" in the next. Therein is told how to prevent an electrolytic rectifier from drying up and ruining the plates.

Stuart A. Hendrick, 2BJG, presents construction data whereby an amateur can make a tungar rectifier for charging storage batteries. Complete details as to core and coil construction are given for a 2-ampere and a 6-ampere charger.

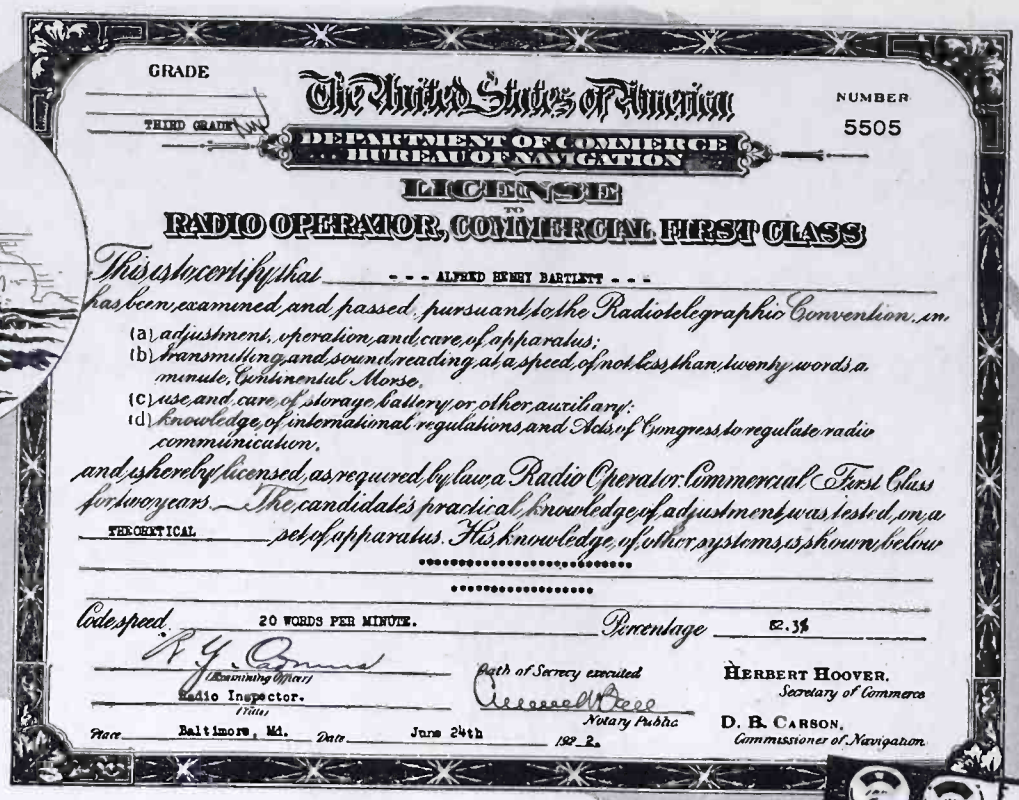
Major Lawrence Mott, 6XAD, has contributed another of his fine radio tales entitled "Worth," wherein a man's loyalty and gratitude is richly repaid. 'Tis well worth the reading.

Assignments Nos. 9 and 10 in the U. C. Correspondence Course on Elementary Radio by Ellery W. Stone are concerned with the action of the vacuum tube as a detector and as an amplifier. These assignments may be profitably read without reference to what has preceded or will succeed them.

Gerald M. Best is building a small radio telephone transmitter employing ordinary amplifying tubes,—an outfit good for several miles. He promises to have a complete description ready for February RADIO so that any amateur may duplicate the set. This will be in addition to Mr. Best's regular answers to queries.

As a constructional kink Arthur Gordon will tell how to make a vernier blade for your condenser. Francis J. Andrews will give some facts about antennas. Several other good articles are in preparation but cannot be definitely announced yet. 'Tis a joy to the editor to be able to give advance announcement about the remarkable material told of in these brief paragraphs. February RADIO will be a humdinger!

Occasionally one of the great leaders in electrical thought takes time to enlighten the other workers in the field about the nature of the things with which they are working. This has been done for our next issue by Samuel G. McMeen, a great telephone engineer and incidentally an enthusiastic radio operator, in an interesting story on "The Versatile Vacuum Tube."



Get This First Class Radio License

You Can Earn Big Money With It

THE best paid positions in Radio go to the men who hold the Government's Commercial License. The radio men on every ship, in every land commercial station, in every broadcasting station, must have one of these licenses. Every radio inspector must pass the first-class license examinations. Engineers, mechanics, installation and maintenance experts must all of them own a Government First-Class Commercial License. It is every radio man's ambition to get a license, not only because it is the highest mark of honor he can get but because it also opens to him all the wonderful opportunities in this great profession.

Edward L. Powell, expert radio aide at the Washington Navy Yard gets $2600 a year. George Staffa is making $125 a month with all expenses paid. Read in the panel of the fine salaries paid in all the wonderful positions open to you as soon as you get the Government First-Class License.

Win Your First Class Government License This New, Easy Way

The National Radio Institute, America's first and largest Radio School, has devised a remarkable new method that makes it easy for you to win your license. No previous experience in electricity or radio is necessary. Lessons, so fascinating they read like an interesting romance, take you step by step through the whole wonderful science of radio. Spare time study at home prepares you in an amazingly short time to pass the government examinations, so you can get one of the fine jobs waiting in this great field. Prominent radio experts give you personal instruction and advice. They grade your papers, answer your questions, give you every help you want so you can qualify quickly. The diploma we give you upon completion of the course, counts for 5 to 10 credits on all government license examinations.

The most important requirements for a commercial license is a knowledge of the Radio Code. One of the most extraordinary features of the Institute's comprehensive course is the four patented instruments, invented and owned by the National Radio Institute, give you the practical training in radio operation, installation, maintenance and repair which you *must* have to become an expert.

Four Radio Instruments Free

Among these instruments is the wonderful Natrometer, said by experts to be the most perfect device ever invented to teach the Radio Code. With this amazing machine you quickly learn how to send and receive code with all the speed, the accuracy and precision of a trained expert operator. No extra equipment is necessary. Simply connect a dry cell, adjust the head-phone, wind the motor, and for twenty minutes you can listen to a reproduction of the code-work of two of the most expert trans-Atlantic operators.

Interesting Book on Radio Free

Get into this fascinating profession now. The field is wide open; thousands of positions are open. Find out at once *your* opportunities in radio. Send for the interesting free book. "How To Learn Radio at Home," which gives complete details of the plan by which the National Radio Institute qualifies you quickly in your spare time at home for a Government Commercial License. If you are sincerely ambitious to win success and wealth in radio, send the coupon, or a post card, now.

National Radio Institute Dept. 10-B Washington, D. C.

Send me your free book, "How to Learn Radio at Home," with full particulars about the opportunities in radio, and how you will quickly train me in my spare time at home to win a Government First-Class Commercial License. Also tell me how your free Employment Service will help me to a position.

Name..... Age.....

Street.....

City..... State.....

Pick Out The Job You Want We Will Help You Get It

This is a brief list of the positions in the Radio field today, and the salaries paid:

Radio Mechanic, $1,500 to $2,000 a year.
Radio Inspector, $1,800 to $3,000 a year.
Radio Auditor, $1,200 to $1,800 a year.
Radio Salesman, $2,000 to $5,000 a year.
Radio Engineer, $3,500 a year and up.
Radio Executive, up to $10,000 a year.
Radio Aid, $6 to $10 a day.
Radio Draftsman, $7 to $10 a day.
First Class Ship Operator, $105 a month, all expenses paid.
Commercial Land Station Operator, $150 a month and up.
Broadcasting Station Operator, $125 to $250 a month.

MAKES MONEY MANUFACTURING SETS

The sudden demand for radiophones and receivers has created a fascinating, good-paying job for me. I have built one large receiver and two small ones, and am getting more. I am the first amateur to hold a license in this vicinity.
E. E. MAHACEK,
Route No. 1, Crete, Nebr.

GETS $165 A MONTH

I am the only operator on board the "Lake Tulare" and receive a salary of $125 a month, with an additional $3 a day food-allowance while in port, totaling a cash pay of approximately $165 a month.
LEO. A. GOLDBLATT, Baltimore, Md.

STARTED ME IN BUSINESS

I know you will be glad to hear from me again and that I am getting along fine in the Radio game. I am now an instructor in Radio for a local institution and the rest of the time I am installing sets, selling and operating sets as well. There is no limit to the amount of business one can do. You certainly got me started in a coming business all right.
HARRY E. WATERMAN,
Box 642, Spokane, Wash.

EASY TO GET GOOD JOB

Only a short letter to let you know that I am still on board and waiting for the ship to sail. Tell your students for me that a man with a license has no trouble obtaining a good position. Believe me, a job like this is worth a good deal of studying.
L. M. WARING, JR.,
S.S. Lake Farney, Norfolk, Va.

$7.00 A DAY AS OPERATOR

Just sailed this morning for Norfolk, where we are to get a load of coal. I haven't much to do on board, and when in port not that much. I get $7.00 a day when in port, and can sleep on the ship. Not bad at all.
REVERE B. GURLEY,
On board S. S. "Lake Figart."

NATIONAL RADIO INSTITUTE
DEPT. 10-B 1345 Pennsylvania Ave., N. W. Washington, D. C.

Tell them that you saw it in RADIO

MAGNAVOX—pioneers in the RADIO field

IT was in 1913 that the Magnavox electro-dynamic receiver made its first public demonstration, when telephone communication was held between Denver and New York — a revolutionary advance.

The rise of Radio Broadcasting found Magnavox apparatus already fully developed to make possible the reproduction of wireless music and speech in ample volume and marvelous clearness.

R-2 Magnavox Radio with 18-inch horn

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

Price **$85.00**

R-3 Magnavox Radio with 14-inch horn

(as illustrated)

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

Price **$45.00**

Model C Magnavox Power Amplifier

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

2-stage **$ 80.00**
3-stage **110.00**

The facilities and experience back of each piece of equipment bearing the Magnavox trade mark are unrivaled anywhere in the world.

PALS AGAIN

Never a dull evening in the home

The relaxation, the gayety and the stimulus which all the world is seeking, Magnavox Radio will bring to your own hearth and home.

With the Magnavox Radio, every incoming signal registered by the receiving set is reproduced to the utmost degree of sensitivity and power. This incomparable superiority, based on scientific reasons known to every expert, has by general popular opinion given Magnavox the distinctive title of the *Reproducer Supreme.*

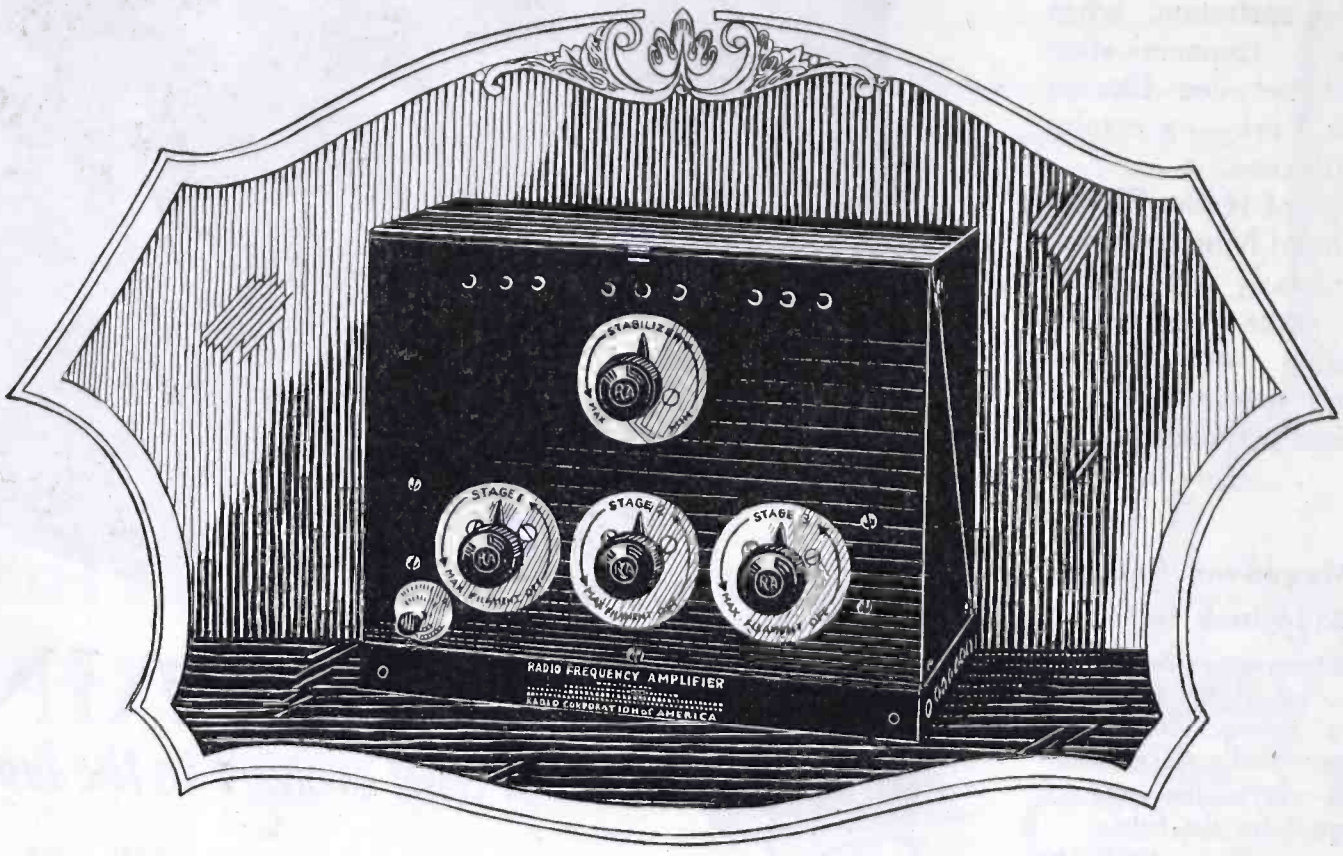
Magnavox Radio and Power Amplifier are readily attached to any good receiving set—no other equipment gives you the uniform enjoyment of radio at its best.

Magnavox Products can be had from good dealers everywhere. Our interesting new booklet (illustrated in three colors) will be sent on request.

The Magnavox Co., Oakland, California
New York: 370 Seventh Avenue

MAGNAVOX
Radio
The Reproducer Supreme

Reach out for GREATER DISTANCE!



JUST as you can command a better view of surrounding country from a lofty tower, so can you select at will from the programs of many broadcasting stations with the new Radiola Model AA-1520, a three-stage, radio-frequency amplifier.

Radiola AA-1520 makes possible excellent reception with nothing more than an indoor loop antenna, a variable condenser for tuning, and the customary detector and two-stage amplifiers. It amplifies the feeble energy received from the distant station so that the addition of the usual detector and two-stage, audio-frequency amplification will allow the use of a loud speaker for local broadcasting stations. And of course, when head telephones are worn, one may listen to stations beyond the "loud speaking" range.

A really handsome receiver can be made up of model AA-1520 in combination with model AA-1400, a companion unit, and the new beautifully finished trays, placed top and bottom which contain the two models as a complete Radiola, attractive enough for the best appointed living room.

Your nearest RCA dealer will be glad to demonstrate.

Price of Radiola AA-1520 three-stage, radio-frequency amplifier — $80.00

No radio enthusiast should be without the book "Radio Enters the Home." Price 35 cents at your dealer or by mail.

Radio Corporation of America

WORLD WIDE WIRELESS

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233 Broadway
New York City

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Chicago, Ill.

RCA

This symbol of quality is your protection

Tell them that you saw it in RADIO

January, 1923 **RADIO** Vol. 5, No. 1

Radiotorial Comment

THE war still rages between the novice concert-listener and the amateur radio operator. Of the many letters that have been received from both sides in this controversy, the few that have been published in these columns have been not as oil on the troubled waves but rather as oil on a fire. When the editorial head has dared poke itself above the observer's dugout, it has been assailed with gas-bombs from both trenches.

Each side is righteously indignant because its so-called rights are being wronged. One middle-westerner with more dollars than sense has even brought suit against the youth who interfered with his enjoyment of the broadcast music. A thousand misguided amateurs are sitting on their keys in retaliation.

While we sympathize with both, we counsel moderation to each. As a matter of fact, neither has an irrevocable right to the air. Americans are so accustomed to consider their privileges as rights that they are prone to overlook the fact that these privileges may be withdrawn at any time, as they were during the great war. In other countries they have been granted to only the most limited extent. Our Government, at its discretion, may decide that all wavelengths are essential to commercial and federal communication and so do away with broadcast and amateur transmission entirely.

The greetings of the New Year to you. May 1923 bring peace to the radio ranks, happiness to amateur and novice alike, and prosperity to all! May your reception become more sensitive, your transmission increase, and your enthusiasm grow none the less.

Thus it behooves the radio family to settle its differences peaceably within its own circle and not to call in the police. The amateur operator, as the original aggressor, has it in his power to make this peace. And right nobly is he rising to the occasion. Recognizing the privileges of others, he is voluntarily restricting his operations during those evening hours when the best broadcasting is done.

This action, which was initiated by Western amateurs under the Pacific Plan, has been approved and is now being urged for general adoption by the American Radio Relay League. As a consequence, there are but few amateurs on the air between 7:30 and 10:00 P.M., and most of these operate continuous wave transmitters which offer but little or no interference to broadcasting,—if each keeps to its proper wavelength.

These C. W. transmitters really offer the best practical solution to the entire problem, not merely of interference with the broadcasting but also among the amateurs themselves. However unpopular and unpalatable may be the suggestion, we venture the assertion that the spark is doomed. Within a few years it will be consigned to the limbo of church bells, midnight milk wagons, and unmuffled automobiles.

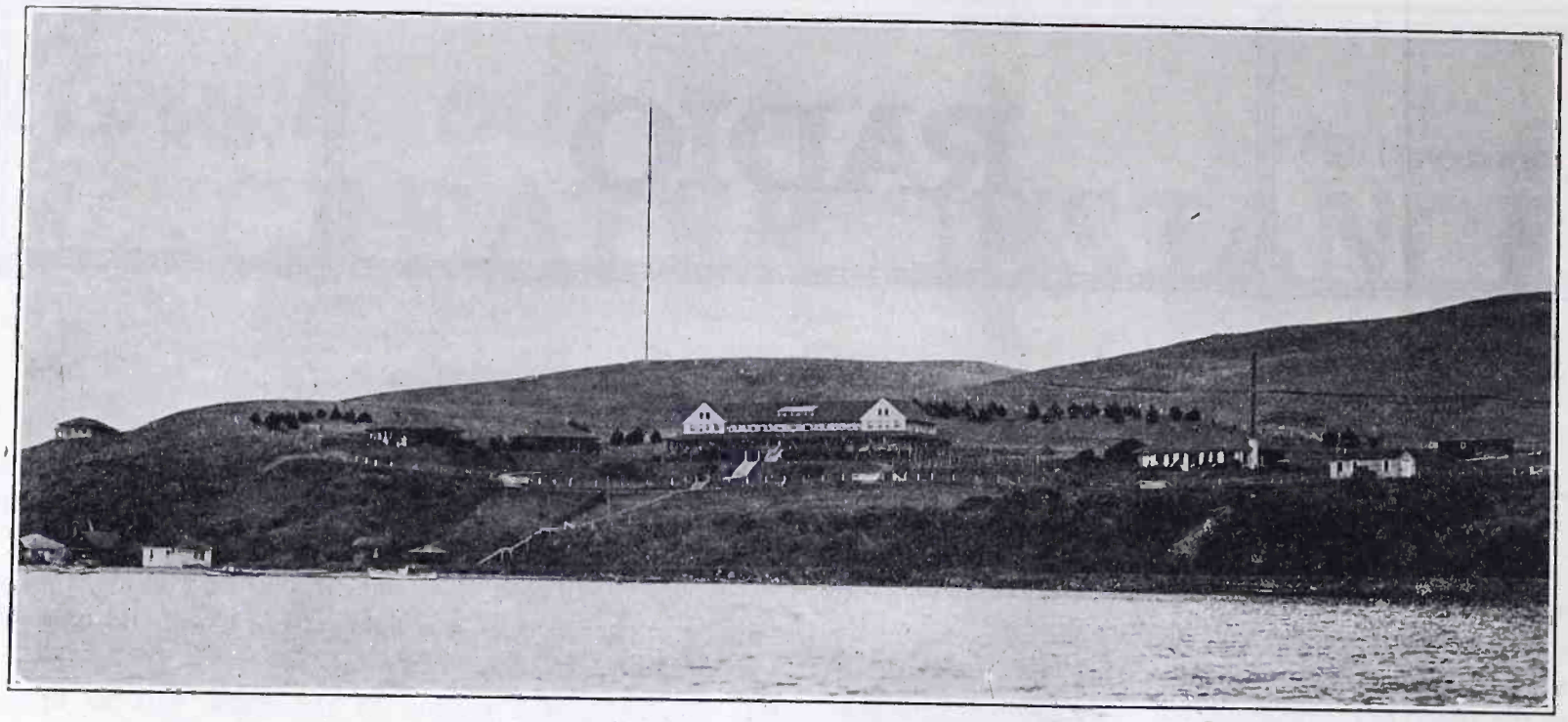
Whether the passing of the spark will be brought about gradually through obsolescence or abruptly by law, it is not for us to prophesy. But it is, in our opinion, as inevitable as the proverbial death and taxes. Progress requires that the old make way for the new.

Such passing will be a source of regret to many. The snap of the spark gives a zest and its broad tuning an ease that cannot be equaled by a tube set. It is simple to understand, cheap to install, and fun to operate. But that is all in its favor for the amateur.

Its noise disturbes the neighbors, its power pull-down causes the electric lights to blink, and its broad wave interferes with the pleasure of hundreds of other people. Its continued use is a mark of selfishness whose stigma no gentleman cares to endure. Furthermore it is a sign of unprogressiveness. There is no more reason for being content with a spark transmitter than with a crystal receiver.

On the other hand, C. W. has none of these drawbacks and has, in addition, many advantages that commend themselves to the progressive amateur. Not only is he reaching out further with less expenditure of power, not only is he able to work with less interference from other amateurs, but also he is utilizing and becoming familiar with the greatest invention of the age—the vacuum tube. Within a few short years the power applications of large vacuum tubes will revolutionize electrical engineering.

Therefore, in the belief that we are helping the man of the future by advising the boy of the present—for ninety and nine of the radio enthusiasts are boys—we suggest that every amateur voluntarily scrap his spark outfit and put in a tube set. The handwriting on the wall is so plain that any may read and it requires no Daniel to interpret: Science hath given a new instrument for man's use; the old is weighed in the balance and found wanting; the spark will pass and the tube will take its place.



General View of KPH Receiving Station at Marshall, California

"KPH"

By David P. Gibbons

Seldom has the human interest side of the commercial radio operator's life been better portrayed than in this breezy description of one link in the great chain of communication maintained by the Radio Corporation of America. "Kaypee Haich" is a typical modern radio station. While the technical details of the installation may hold scant interest for the average reader, many will be glad to know what is behind what he hears.

"BREATHES there a ham with a soul so dead
Who never to himself hath said"

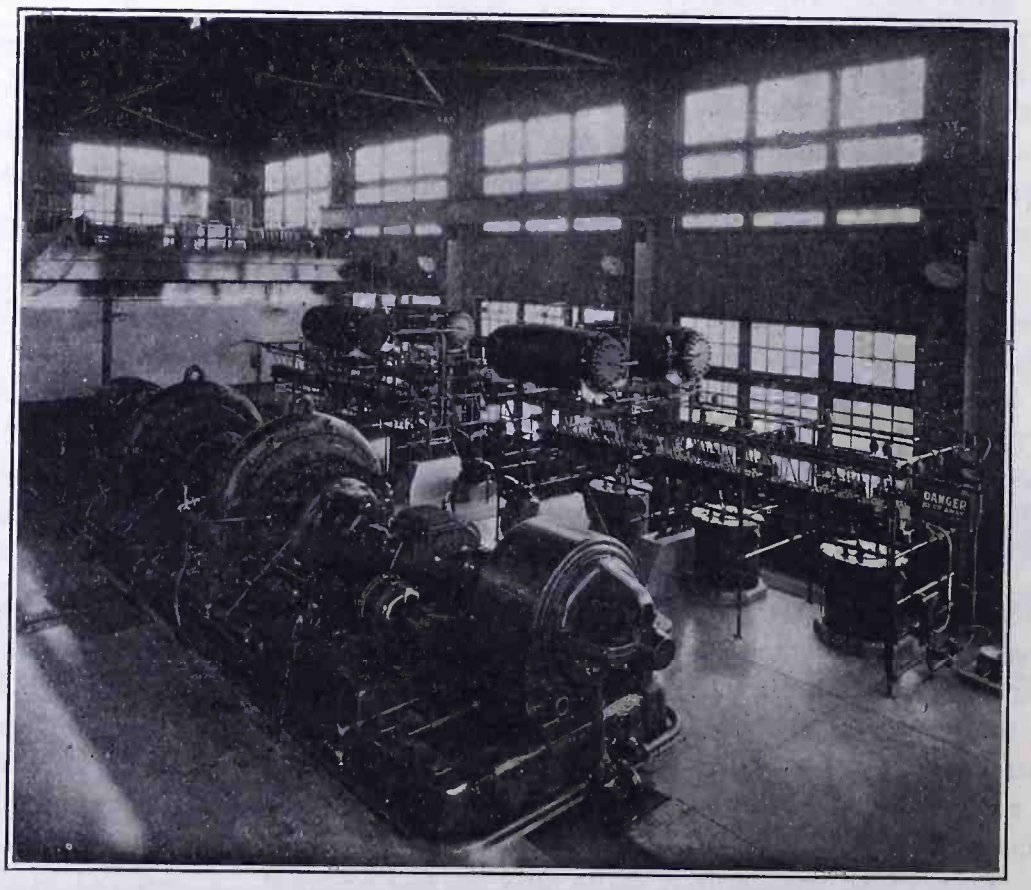
'Gee! but I'd sure like to give this bird KPH the once-over and see what kind of an outfit he's got in his shack! He sure rattles a mean rotary!'

If your aerial is located anywhere between Alaska and Mexico on the sunny side of the Rockies, and if your receiver consists of something just a trifle better than a drug store $1.98 tantalizer, some such thought must have passed through your cranium, when at one time or another, you listened to the deep, steady note of the "big noise of the Pacific." Whether you listen with irritation or admiration depends on whether you are a new recruit or an old-timer in the ranks of the world's most peaceful army.

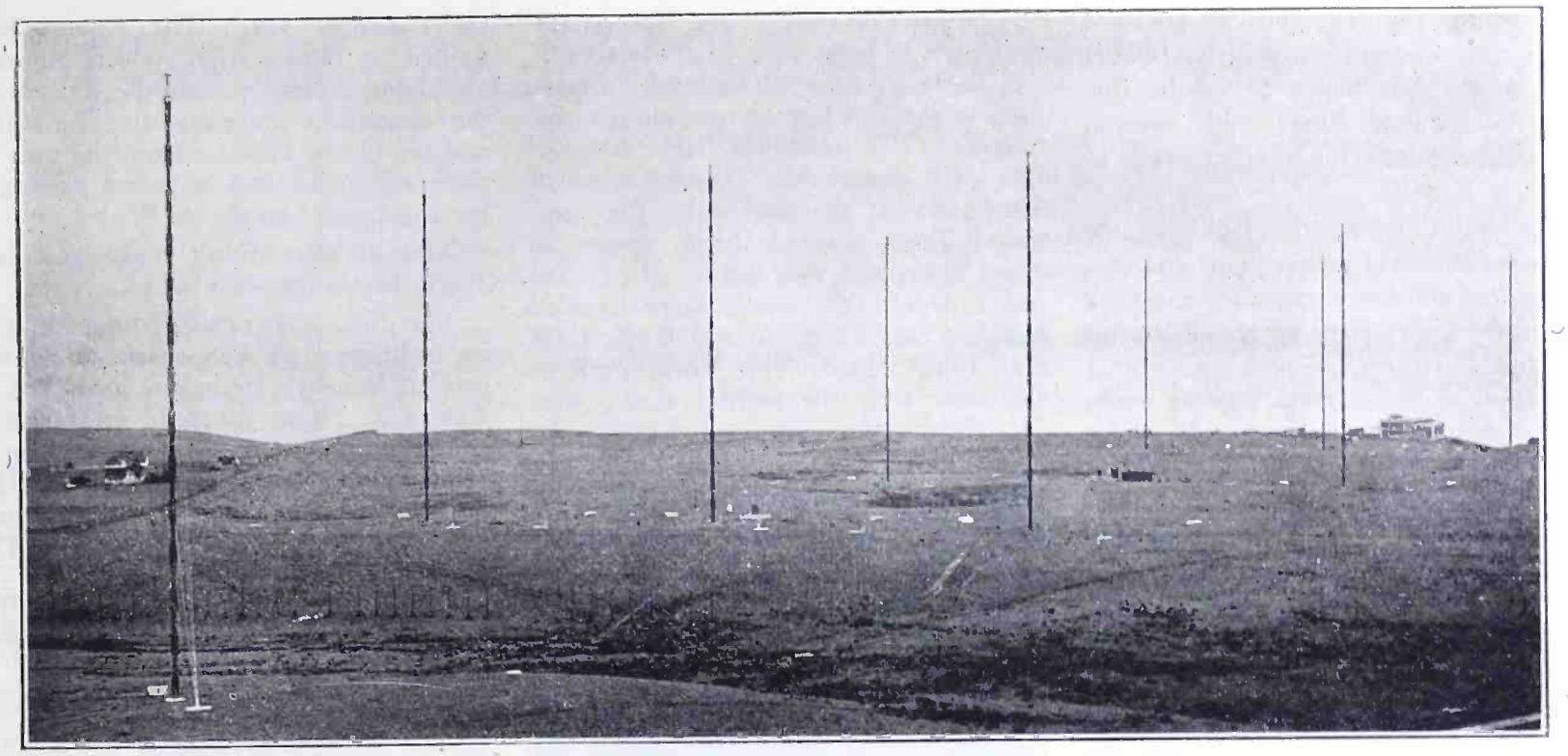
If you have but recently become the proud possessor of a receiving set which tunes a bit broad, or as you probably prefer to express it, not so *very* sharp, you have doubtless been frequently annoyed by the insistent, never-ceasing drone of those dots and dashes, which always seem to break forth into a renewed spasm of activity just at the critical moment when that distant broadcaster starts to announce that "This is the station of the Bluh Blah Company located at Bleh Blaw," or when your favorite tenor is wailing through the weepiest verse of the latest "Daddy" or "Mammy" heart-throbber.

If, on the other hand, you are one of the dyed-in-the-wool fraternity, whose greatest indoor sport is jarring the surrounding atmosphere with your own little pet ether-agitator, you ain't human if you haven't been occasionally filled with curiosity regarding the locality, personality, environment and equipment of that self-same KPH. To satisfy that curiosity to some extent is the object of this article.

The editor suggested that I refrain



Alexanderson High Frequency Alternators in the Interior of the Bolinas Station



Transmitting Antenna System at Bolinas

from highly technical details, but between you and me and the ground-clamp the advice was quite superfluous. Technical data give me a sick headache. Whether the co-efficient of antenna resistance is double nought zero, or whether the internal resistance of a tube varies inversely as the plate current, is about as vitally interesting to the common or garden variety of radiobug as whether a Turkish warrior Mustapha Kemal or a Lucky Strike.

To visit KPH an official pass is necessary. These are issued personally by Mr. A. A. Isbell, the General Superintendent of the Radio Corporation of America at San Francisco. While procuring his, the writer had the pleasure of becoming formally acquainted with this courteous gentleman, than whom there is no whomer in our highest radio circles. When filling out my pass Mr. Isbell wished me a pleasant day and an enjoyable trip. As a well-wishing prognosticator he is certainly the elephant's trunks! Both wishes turned out 100 per cent O.K.

From San Francisco you take the ferry to Sausalito and the train to Point Reyes, where you change to a little dinky railroad that finally lets you off at a station appropriately named Marconi. Least said about these railroads the better, but they surely could stand some radical improvements. The same remark, raised to the n'th power, applies to the roller-coaster tracks which the autos are forced to use in this vicinity. The place is rather remote from "the busy marts of commerce" alright, and at first I wondered a little why some of the boys out there are so completely satisfied to remain permanently. One of the reasons was quickly apparent.

I had arrived in time to meet some of the staff before dinner was announced, and that dinner gave the key to the problem. The motherly lady in charge of the culinary department in the spacious hotel where the staff is housed is just as efficient in her line as the other members are in theirs, and that's saying a mouthful. In other words, she wields a wicked skillet.

A glance at the photograph of the group of buildings, taken from the water on Tomales Bay, only a few miles distant from the ocean, will show several other convincing reasons why a position at KPH is regarded as so desirable. All the buildings are of concrete, finished in the most modern style and equipped with every conceivable improvement. The large one in the center is where the staff lives and is a finer hotel than any railroad publicity expert ever raved about. Just imagine, you sea-going ops who ride the deep in your oderiferous oilcans, imagine having a room 12 feet square all to yourself, with lots of light, steam radiators that actually work, a regular bed to sleep in, and—marvel of marvels—a private bath to every room. Imagine further, wide, carpeted halls, a comfortable library, a fine billiard room with tables that are really on the level, parlors, reception rooms and dining room as well furnished as at the Palace or the Ambassador. Across the entire

Listening-In at KPH

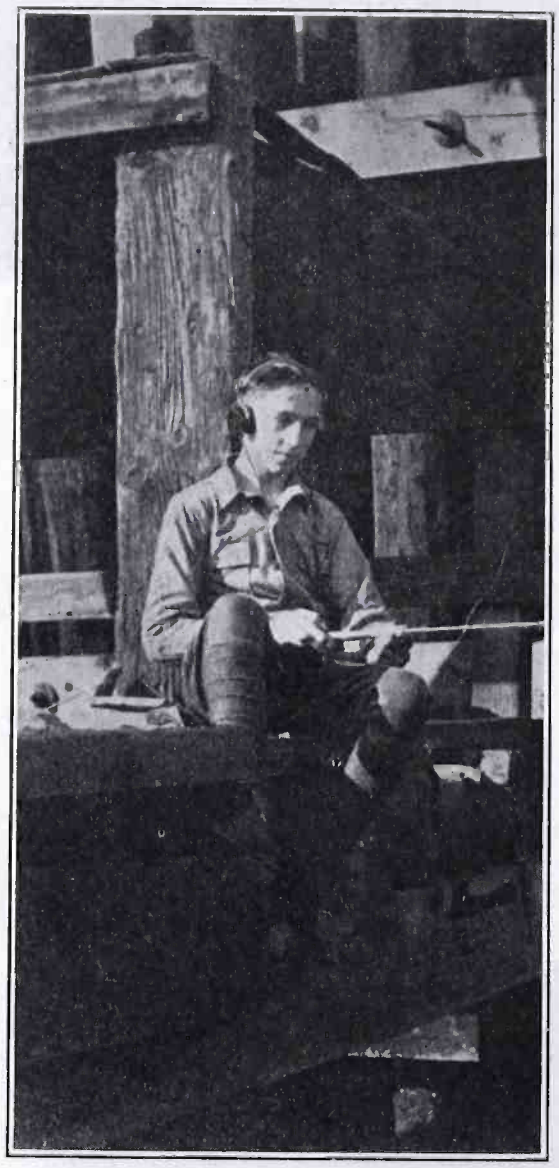
front of the building runs an enclosed concrete veranda, from which you get such magnificent views as would furnish Sir Walter Scott with enough scenic descriptions for another stack of Waverly Novels.

The buildings at the right in the photo are the local power plant and machine shop, and the garages for the flock of autos. Every man at KPH has his own car and the most popular form of relaxation of the various owners seems to be "tearing out the rear end" of his buzz-wagon and endeavoring to put it back in place again.

On one side of the main building is located the tennis court, and on the other the cottages for the married members of the staff. The small building high up on the left of the picture is the receiving station proper, and the tall mast on top of the hill, which is about 600 feet above the water, carries the aerial for the commercial (600 meter) receiving sets. For the long wave, high power receiving, two large rectangular loops, supported on telegraph poles, are used. They are 300 feet long and about 30 feet high, set at right angles to each other, and in addition to these a very novel and efficient form of loop is employed by using the guy wires of the main mast in the shape of two triangular loops, which are also at right angles to each other. Balancing and partial tuning is accomplished by goniometers in series with these loops located inside the building in the high power receiving room. Impulses picked up by these loops from New York, Honolulu or Japan are amplified by two stages of radio frequency, then detected and passed through two stages of audio frequency, and then transmitted to the San Francisco office through what is known as the "tone channel," but which is really nothing more than an extension of the telephone receiver cords. Here they are again stepped up by two stages of audio frequency, whenever necessary, with the result that the strength, clarity and freedom from static of these signals in San Francisco is amazing, and they are copied direct on the mill by skilled high-speed operators. At the same time a perfectly legible copy of every dot and dash is made on an automatic tape recorder in this office. About thirty-five words per is the average speed on this circuit when using hand sending, but using the automatic transmitters and receivers, speeds up to two hundred words a minute are quite frequent.

The receiving operator in the city has direct control of the powerful alternator at Bolinas by means of an ordinary, innocent looking little key on his desk, just as the marine operator at Marshalls (KPH) has control of his spark transmitter also located at Bolinas twenty-eight miles away.

The interior view of the Bolinas station gives a good idea of the elaborate and finely constructed equipment that is used in modern high-power radio transmission. The reliable daylight range of this set is remarkable. During a recent breakdown of the land wires the Associated Press wanted direct service to New York, and they got it. In twelve hours over 6,000 words were handled between San Francisco and Radio Central, Long Island, New York, while at the same time the regular traffic with Honolulu was maintained without the slightest interruption. And talk about speedy service! In a recent Cappy Ricks story, by Peter B. Kyne, the old gent got quite a kick out of his ability to send a message through the R.C.A. to a ship at sea and have it delivered there in *four* minutes, but how about this? The manager of an exporting firm on Montgomery Street sent a radiogram to his branch office in Honolulu and had a reply back on his desk in *thirteen* minutes! When the news of the fire on board the S. S. *City of Honolulu* reached San Francisco the Associated Press asked the R.C.A. if they could procure for them a copy of the passenger list. The request was flashed to Hilo station, which immediately got in touch with the officers of the steamship company in Honolulu, and *thirty-two minutes* from the time of their asking for it a complete passenger list was handed to the A. P.



THE RADIO FISHERMAN

What matter if the Ocean Waves
Bring no fish to me—
The ether waves are teeming with
Sweet strains of melody. —E.J.H.

Now if that didn't make you feel dizzy, here's one that will.

The S.S. *Algonquin,* equipped with an ordinary 1½ kw. spark ship's set, was on her way from San Francisco to Australia. The operator on board—and he certainly was no ordinary ham—kept in daily communication with KPH. On this particular evening his signals were so clear and distinct (on 450 meters) that J. F. Parachini, the receiving operator on watch at KPH, thought that perhaps the folks in San Francisco would like to hear them, so he switched them over to the tone channel and told the operator on the *Algonquin* to go ahead and send some stuff for a test. George E. Baxter, who is city superintendent and a genuine old-timer in the business, thought he could go this one better, so he hooked in two more stages of audio frequency amplification and put it on the Vocaloud. Then they all went halfway down the block on California Street, and could still easily read the messages. The signals they were listening to were coming from a ship which was at that moment exactly 5476 miles away!

The large outdoor picture taken at Bolinas gives an idea of the immense antenna system for the high power work. There are eight masts each 300 feet high, and they support thirty-two stranded phosphor-bronze wires each about as thick as your little finger. The total length of the aerial from the power house to the farthest mast is 2500 feet. Some aerial! The 600 meter transmitting aerial is fastened to one of these masts, and is at right angles to the big fellow, and the spark transmitting equipment is housed in the small building at the right in the picture.

The engineer-in-charge at Marshall, Mr. C. Bailey, very kindly allowed the writer to sit in and listen at KPH, along with the operator on watch, who happened to be D. P. Goodyear, and it is hardly necessary to say that the gentleman who waggles the bug at this station has to be a darn good one. It's emphatically no place for a bird who doesn't possess a steady fist and an equally steady head, and to remark that his time while on watch is fully occupied is putting it very mildly. The one-armed paper-hanger with the hives was a restful individual in comparison.

If the indulgent reader gets even one-half of one per cent of the enjoyment the writer got out of his visit to KPH from this account of it, the latter will feel well satisfied.

Getting and Holding the First Ship

By Volney G. Mathison

Those readers who have been following Mr. Mathison's series on the "Professional Radio Operator" will find this installment at once interesting and helpful. It is eminently human and practical. The next and concluding article in the series will discuss the moot question of the operator's audion. It will appear in February RADIO.

WITH his commercial license stowed safely in his pocket, the newly-fledged operator is at last ready for the realization of what has been his chief desire all along—a ship.

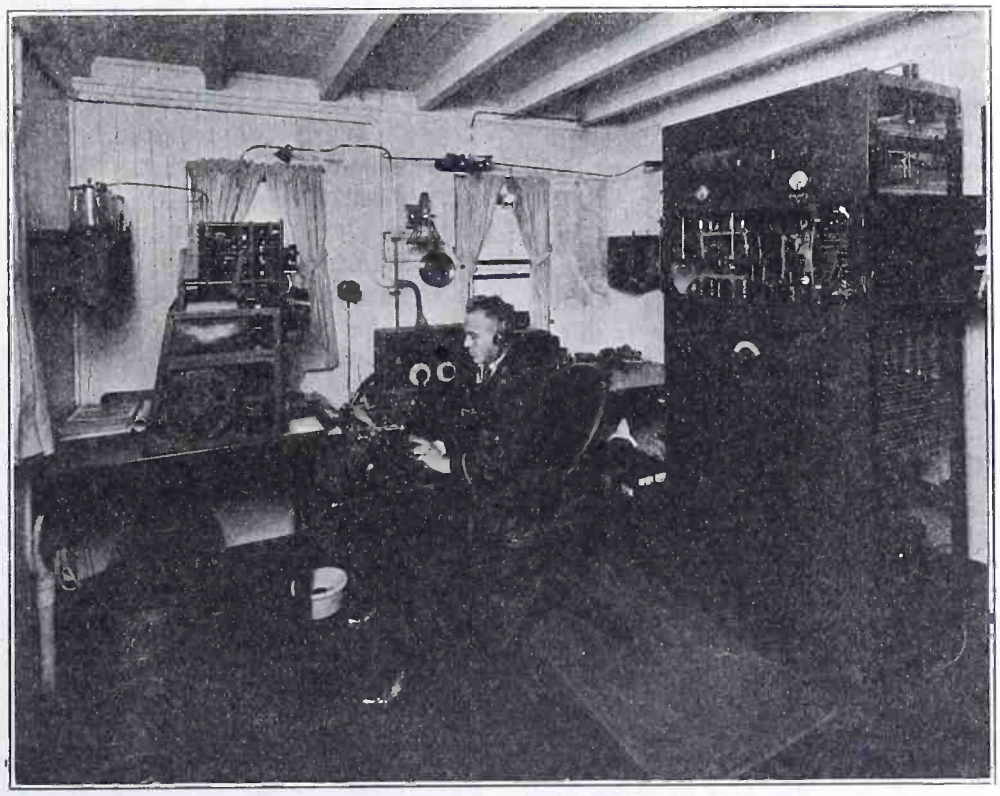
To get a ship is not at present the facile matter that it was during the turbulent days of the war. At that time, the mere appearance on the horizon flying a license-flag was enough to bring a wireless-company tug scurrying out to assist the newcomer into a desirable berth; but in these evil days of cold boilers and rusting paint-work, the arrival upon the scene of a freshly-inked certificate occasions no great enthusiasm anywhere.

From this it is not necessarily to be inferred, however, that the newly-arrived operator need despair of getting an assignment. Owing to the fact that but few radio operators stay in the commercial game for more than two or three years, there cannot but be openings for newcomers. Under present conditions, it is true, these openings are comparatively rather far between; and therefore the inexperienced operator living in the country or in an inland city should not come to a coastal shipping port to look for employment without being prepared to wait from three to six months for an assignment. There is little use, on the other hand, in filing an application for employment with any of the wireless service companies before actually coming to one of the cities where these companies are located; openings almost always come so unexpectedly and must be filled so quickly that no operator can be made use of who can not be immediately reached by telephone and who can not be aboard ship and ready to go to sea, if necessary, two or three hours after receiving his assignment.

Upon coming to a coastal city to get a ship, the operator had best at once join any commercial operators' association that may be functioning in the port. Not only will this bring him into closer relations with other operators, but it also will enable him to obtain much valuable information and assistance, including tips as to where the prospects for an assignment are most favorable. The addresses of the operators' associations may be obtained from almost any experienced operator or from the wireless schools.

After looking up the associations, if there are any in the port, the operator will next go to the officers of the various companies that employ or assign radio operators and file an application for employment with as many concerns as will accept it. There are one or two companies that will not at present accept applications from operators without previous commercial experience, but the most will.

It should be understood that even when the steamship companies own their radio equipment outright, they generally have one of the wireless companies to furnish them with operators; and therefore it is to these wireless companies or "radio service companies," as they are sometimes called, that the operator must go for an assignment—not to the steamship people.



1 KW. Tube Set on S. S. "H. F. Alexander." is also equipped with ½KW. spark set. Tube Set Radiates 19 Amperes on 2100 Meters.

An exception to this rule is seen occasionally, however: sometimes an old operator will apply for employment directly to some steamship company, in whose offices he happens to be acquainted; and once in a while a captain will insist upon bringing his own experienced operator aboard of whatever ship he is in command. Generally speaking, it is best to get all assignments through the radio service companies and not to change from one service company to another unless the operator feels pretty sure that it is to his advantage to do so.

Like the private steamship companies, the United States Shipping Board employ all their operators through the wireless companies, taking a fairly equal number from the Ship Owners' Radio Service, the Radio Corporation of America, and the Independent Wireless Telegraph Company.

On the Pacific coast, the chief seaport is San Francisco. A great many more radio operators are shipped here than in any other western port, not only on vessels running coastwise, but also on ships sailing to distant foreign ports. Seattle is also an important seaport; and a good many operators are shipped here on vessels sailing to Alaska. During the war, a few operators were picked up every week at Portland, Ore., and at San Pedro (Los Angeles); but since the slump in shipping, the employment of operators in these two ports has almost entirely ceased.

So much of the off-shore shipping on the Pacific coast is getting into the hands of Japanese concerns using Japanese ships that all our western ports are becoming seriously affected by it; and this of course also means decreasing prospects for radio operator employment.

The Radio Corporation of America maintains small division offices at San Pedro and Portland; the Ship Owners' Radio Service, the Radio Corporation, and the Independent Wireless Telegraph Company, at Seattle; and at San Francisco in addition to these three are the Federal Telegraph Company (Poul-

sen arc) and the Gray & Danielson Manufacturing Company. This last named concern supplies operators for a large number of ships equipped with privately-owned synchronous spark sets.

On the Atlantic coast, New York, as almost every one is aware, is by far the greatest seaport, with New Orleans, Norfolk, Boston, Baltimore, Philadelphia and Savannah of subordinate importance, about in the order named. There are seven companies in New York employing radio operators, one or two less in New Orleans, and three in each of the remaining ports. A certain number of operators are employed also on steamers plying the Great Lakes, the principal lake ports presumably being Chicago and Cleveland.

After the operator has filed his applications with all the wireless companies that have offices in the port where he has established himself, there is little that he can do but wait. It is advisable, in the case of the operator who has come to the city from some outside point, to stay in a hotel in or near the down-town district, so as to be close at hand when something turns up. A comfortable hotel room will cost about $30 a month in the Pacific coast ports and from $40 to $45 on the Atlantic side. Restaurant meals will cost about $45 a month on either coast; thus, with incidentals, the cost of living in the large seaport cities may be figured at from $80 to $100 a month—though it is true that a good many operators when they are "on the beach" manage to get along with a good deal less than this amount.

The inexperienced operator should, as a rule, accept the first assignment that is offered him. Even though the berth offered him be on a small and undesirable vessel, it is not politic for him to refuse any opportunity to break in. During the war some flippant youngsters bumptiously demanded that they be assigned only to "big Shipping Board ships!" and, in a few instances, they got away with it; but this sort of thing does not happen today.

At the same time, the operator, whether he be cabbage-green or a barnacle-crusted shellback, may rightfully, and should, refuse a certain sort of assignment that has been foisted upon some unfortunate ones lately — the "no-return-transportation" job, this meaning that the operator may be dumped ashore three thousand miles from the place where he started and left to get back home as best he can.

More explicitly, this is an assignment that is sometimes offered on large cargo or passenger steamships which are going to make a voyage to some foreign port, the shipping articles reading that the officers and crew agree to go on the ship to such foreign countries as the articles specify, and thence back to "any American port." As a rule, off-shore shipping articles contain a clause providing that if the ship fails to return to the port from which she originally sailed, the officers and crew (or at least the officers) are to be furnished railroad transportation back to the place where they signed on; but in the no-return-transportation articles, there is no such clause inserted. A good many ships sailing from the Pacific coast for European ports return to the Atlantic coast and tie up there, and likewise some ships sail from the Atlantic coast to the Pacific and stay in the Pacific; whereupon the officers and crews discover that the only way they can get back home is by making a transcontinental railroad trip costing, with sleeper and meals, more than $170.00.

There are of course a great many cases in which the ship *does* return to the port where the crew are signed on; and therefore the operator, before definitely refusing such an assignment, should try to ascertain what probability there is of the vessel eventually returning to the port. This can usually be pretty well determined by asking the captain of the ship, or by inquiring at the office of the company by which the vessel is owned or operated. The radio operator who pays attention to the movement of off-shore shipping will quickly learn to estimate what the chances are either way.

In the case of the Shipping Board ships, the operator may sign the "Any American Port" articles with entire safety. The officials of the Shipping Board have always been very considerate in their dealings with their operators, and if one is discharged at a distant point, they always see to it that he gets another ship back to his home port. The Shipping Board Ships' articles almost always specify a return to the report of signing on.

Where it is pretty certain that the ship is not going to return to the port of departure, the inexperienced operator should not be deceived by any verbal promises of return transportation; unless an agreement to that effect is down in black and white on the ship's articles he may be sure that no transportation will be forthcoming.

I happen to know of a crew being inveigled into signing on a ship at San Francisco through similar promises; and after making a voyage to Europe, the vessel went to Norfolk, Va., where she was decommissioned—and the officers and crew were denied their promised transportation.

Dismayed at the exorbitant railroad fares facing them, eight of the ship's complement jointly purchased a dilapidated second-hand Ford, and started cross-country for San Francisco. This was more than six months ago; and none of them have arrived yet. We have a letter from the ship's cook, however, who was a member of the transcontinental touring party, saying that pieces of the lizzie are scattered all along the road from Norfolk to St. Louis, where, in crossing over a bridge, most of the engine fell down into the Mississippi river, and the auto was necessarily abandoned. According to his epistle, the cook is at present shacking with the Indians in Oklahoma and hopes to get to Frisco some time this fall, provided he has good luck in dodging the railroad brakies.

The only way to get fair shipping agreements is by refusing to sign bad ones.

CONDUCT ABOARD SHIP

AFTER weathering the wait for an assignment, and with his feet safely on a good ship's deck, the holder of a fresh and crinkly license is at last fairly on the way to become a commercial radio operator. I say *become,* because it requires, at the least, one year's experience at sea to make of the average young landman a good seaworthy brass-pounder; and some who have been sailing a good deal longer than a year can not yet be considered as such.

The young operator going aboard his first ship is almost always ignorant of shipboard discipline, etiquette, and customs; and unless he is observing and prudent he is very liable to do something that will bring him into disfavor with the captain and the other officers. The best general advice that can be given the beginner, therefore, is condensed here into three admonitions: First, stay in your own quarters; second, keep an intelligent eye on all the others; and third, adhere to a Scotch-like sparseness of speech until you are sure that you can open your mouth without putting your foot in it.

The first impression of the operator going to sea for the first time is often of a mortifying condescension and sometimes even a cold disregard, not always expressed but nevertheless sensible, in the bearing toward him of the other officers of the vessel. This half-contemptuous attitude of his fellow officers is galling to the finely-strung youth who does not know that he is suffering for the asinine actions of some of his scuttle-brained predecessors. So many small-calibred ninnies with commercial operators' licenses—though not entitled to them—have made downright fools of themselves aboard ship that it has actually come to be so that every new radio operator is looked askance upon until he absolutely proves himself worthy of esteem. As soon as he shows, however, that he is of the right sort and entitled to respect, he is at once accorded it.

The commonest and the worst fault among radio operators is the practice of

Continued on page 50

A Portable Radio Receiver

By D. B. McGown

This constructional article describes the set which was built by the author, who is assistant radio inspector at San Francisco, for use with a 32-volt d.c. power supply such as is found in many country homes. Necessary changes for 6-volt supply are also given.

ALTHOUGH the title may appear somewhat out of place in midwinter, it is thought that many readers will be interested in constructing a receiver which will function well as a portable set, and which, when completed, will also be very handy to use at the home station, during the time the inclement weather prevents the owner from going afield. Although primarily designed as a portable receiver, equally good results will be obtained as a stationary apparatus, and, indeed, the whole instrument cannot be said to be portable, in the fullest sense of the word, as it is rather larger than the usual run of portable equipments.

The instrument is designed to function over a wavelength range of approximately 140 to 5000 meters, minimum and maximum limits, the extreme ranges being well outside the usual ranges needed for a short wave receiver, which generally goes from about 180 to 650 or 700 meters. Inductive coupling is used, owing to its undoubted greater efficiency, selectivity, and freedom from bothersome interference due to impulse excitation of the antenna, which in all single coil apparatus gives a signal, even when detuned, from a nearby station. Tickler feedback for regeneration is used, and a shunt condenser provided for tuning the secondary, while a series capacity is inserted in the antenna circuit, for the purpose of making the necessary resonance adjustments in there. No doubt there is some loss introduced by the addition of the secondary shunt condenser, but it is not great enough to do serious damage, nor to greatly weaken the received signal. For extremely short waves a simple "tuned plate" regeneration system is employed, as the secondary coupling coil *only* is connected in the circuit, without additional loading. The variometer, which ordinarily acts as a tickler, here fills the function of a plate tuning element. This idea, which is decidedly novel, was suggested to the writer by W. W. Lindsay, Jr., 6ZF, and has proven very satisfactory.

The original instrument, as built, was intended to connect direct to the 32 volt farm lighting system, where it was proposed to use the apparatus most of the time, the 32 volt d.c. supply being available in many country homes where no commercial power supply is available. For the benefit of those desiring to use a 6 volt supply, the complete circuit is shown in Fig. 3, where the necessary differences from the original circuit, Fig. 1, are indicated. Western Electric vacuum tubes were employed in this instrument, owing to their wide limits of filament current. Due to their "hardness," no critical adjustment of the detector plate potential will be found necessary. These tubes were purchased on the open market, and are, respectively, VT-1 for detector, and first stage amplifier, and VT-2 for the second stage. By means of the 32 volt system of lighting filaments, and the insertion of proper series resistances, one filament rheostat served to control all the tubes. Furthermore, owing to the voltage drop across the resistances in series, the proper "C," or negative potential was thus impressed on the grids of the amplifier tubes, which obviated the need of external bias batteries. If the 6 volt lighting system is used it will be necessary to add dry cells, of the potential

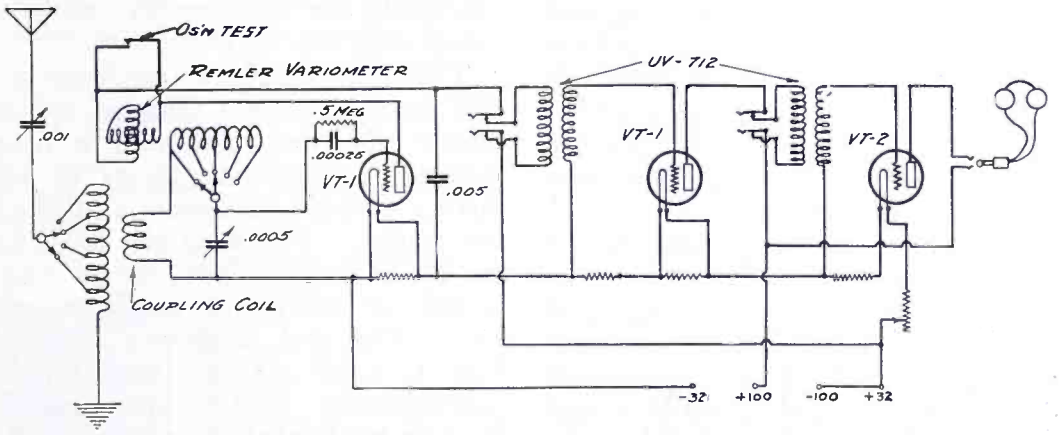
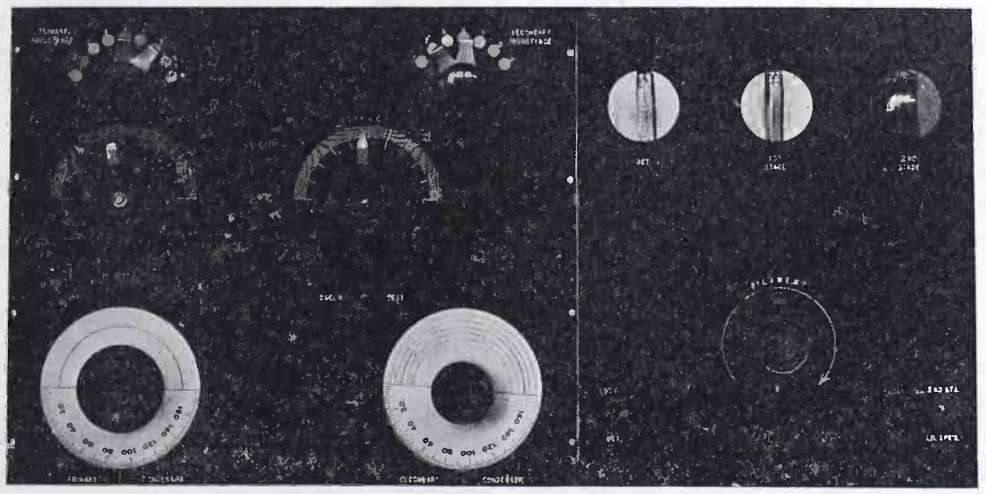
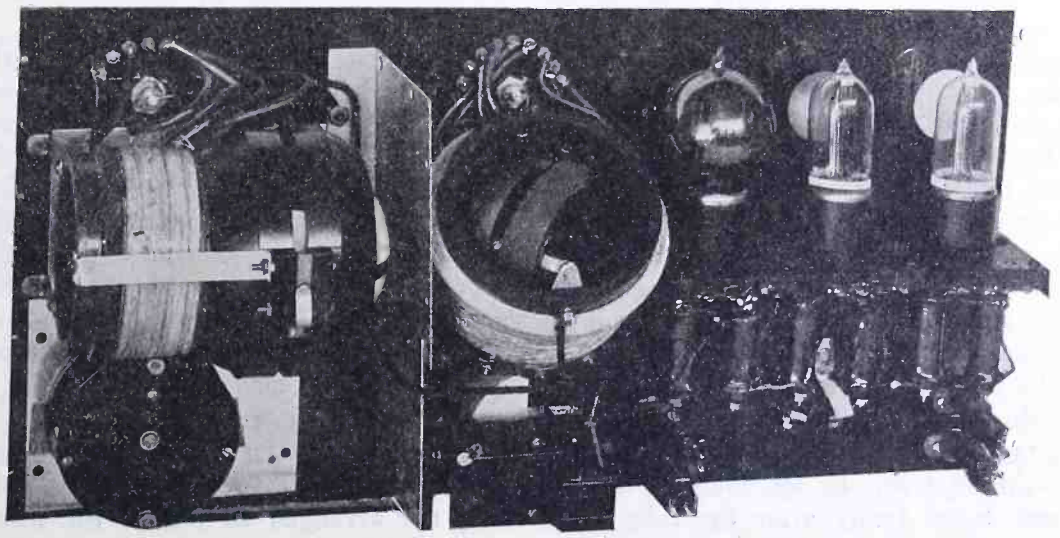


Fig. 1. Complete Diagram Showing 32-volt Filament Supply



Front View of Portable Radio Receiver



Rear View of Portable Radio Receiver

shown, to insure correct operation of the tubes, as may be noted in the grid circuits of the amplifier in Fig. 3.

CONSTRUCTION AND GENERAL DETAILS

The primary inductance is wound on the primary tube of a standard Remler vario-coupler. This consists of a litz winding, of 20-38 silk covered litz. Start ½ in. from the panel end of the primary tube of the vario-coupler, and wind 12 turns, in a double bank winding. Take off a tap here, by looping up about 6 in. of the wire, and winding it with thread, and proceed winding 21 more turns, in a 3-layer bank winding. Now take off another tap, as before, and proceed, winding 28 turns in a 4-bank winding, tap it, wind 40 more turns in a 4-bank winding, and wind 48 more turns also in a 4-bank winding. Now wind 60 turns in a 5-bank winding, and the last 80 turns in a 6-layer-bank winding, and the coil is finished. It may be painted with collodion, or, what is better, a coating of bakelite varnish may be given it, which will effectually fasten the wire into place.

The coupling coil of the vario-coupler should now be wound (of course it is understood that the original winding on the primary and coupling coil were removed before starting any winding at all). The coupling coil should be wound with about 9 turns on each side, or a total of 18 turns of No. 26 DSC wire. This should be fastened in place by varnish, like the primary. As stated above, this coupling coil serves as a secondary alone on very short waves. Connections will be taken off of it, through the bearings, in the usual manner for this type of moving coil, i.e. from the coil ends to the bearing shafts, thence through the springs, to the terminals on the stationary portion of the instrument.

The secondary coil is wound on a short section of bakelite tubing, as shown in Fig. 4. Here we have a piece of bakelite tubing, with ¼ in. wall, of the dimensions shown on the drawing, wound with the complete secondary winding, or as it should be more correctly called, the secondary loading, as it loads the circuit in addition to the coupling coil. One end of this bakelite tube is turned down, with a shoulder, as indicated, and is fitted to the end of a Remler variometer. It will be found that this type of variometer presents a short cylindrical section at the sides of the stators, which can be used effectively to house the end of the inductance. The tubing may be fastened in to the end of the variometer either by bakelite cement or by a couple of small metal pins, which go through both the variometer and inductance coil, as shown in Fig. 4. Care should be taken to see that the variometer turns freely after the tube is in place, as a complete 180 degree rotation of the variometer is necessary in operation.

The inductance itself consists of 18 turns of litz, of the same kind used in the primary, double-bank wound, and tapped at this point. The next tap is taken off, after 33 turns are wound on, in a 3-layer-bank winding; then 64 turns are put on in a 4-layer-bank winding, and finally 100 turns are wound on, in a 5-layer-bank winding. This gives *four* taps available, but actually, the *first* tap on the cylindrical secondary coil connects to the second point on the inductance switch, and so on. This apparent error is due to the fact that the first point on the inductance switch connects with the coupling coil only, the rest of the secondary inductance being cut out.

While the use of litz wire is recommended, it is usually hard to get, and practically the same results can be obtained with No. 24 DCC wire.

The series (primary) condenser is of .001 mfd. maximum capacity, approximately. No particular make is recommended, as there are plenty of satisfactory variable condensers available on the market. The same can be said of the secondary condenser, except that it is only of .0005 mfd. maximum capacity. The grid condenser, shown in Fig. 1, is of ordinary fixed type, of approximately .00025 mfd. capacity. It must be shunted with a grid leak of approximately .5 megohms for best results, althought the actual value depends somewhat on the tubes used for detector, and it may be necessary to use a 1 megohm leak here, instead. This leak may be of any standard type, also, provided it is sealed to prevent changes due to the moisture in the air. The condenser across the telephones or output known as the "bridging condenser" must be of high capacity, approximately .005, mfd. or more, as *if too low the set positively will not oscillate.* The bridging condenser need not be variable, or even adjustable, although sometimes better results can be obtained, if variations of say .0005 mfd. steps can be provided, as slightly different values may be found the best on different wavelengths.

The input transformers between the tubes are the standard R. C. type, UV-712, audio frequency. These are not shown in the picture, as it was desired to show the mountings of the filament resistances, rather than the transformers, which are a standard article. They are mounted on the rear of the amplifier panel, on a frame, or sub-base. Ordinary transformers of other types would doubtless also give satisfaction.

The amplifier end of the panel is fitted with four jacks, set two in each lower corner. These, as in any amplifier, are arranged to permit the insertion of the head-set plug into either the detector, the first, or second stage amplifier. There are two jacks provided in the output of the last tube, connected in series. This arrangement is provided so that a pair of telephones and a loud speaker may be plugged in at the same time, without disturbing either. These jacks may be of any commercial type. The writer used Western Electric, type 118.

Little need be said about the arrangement of the filament circuit for the six volt supply. This is the conventional method in every case. For the 32 volt supply, several important changes are needed, and apparent departures from common practice. The VT-1 tube draws 1.1 amperes, while the VT-2 requires 1.35 amperes for optimum operation. The tubes' life will be greatly lowered if either is overloaded, even a small fraction of an ampere. Thus, it is not practicable to connect these tubes in series, in the ordinary manner. The details of the filament circuit are shown in Fig. 2. The VT-1 detector tube is shunted by a 22 ohm resistance, and between this and the VT-1, 1st stage, two 1.7 ohm resistances are connected, both in series, while another 22 ohm shunt resistance is connected across the 1st stage tube. In series with that, two resistances, of 3.5 ohms each are then connected, and thence to the VT-2 which is the 2nd stage tube. The full current flows through the VT-2 tube, while the 22 ohm resistances in shunt to the VT-1 tubes pass enough current so that just 1.1 amperes flow through them when 1.3 amperes flow through the filament of the VT-2. This is a little lower than the full current that may be used on the VT-2, but sufficient emission will be obtained from the filament for ordinary operation, together with a greatly increased tube life. An ordinary variable series resistance is also provided, to cut down the filament current, when a freshly charged battery is connected to the circuit. The two 1.7 ohm resistances are the so-called "bias" resistances, and there is sufficient potential drop across them to impress the optimum potential on the grid of the VT-1 amplifier. The 3.5 ohm resistors perform the same function for the VT-2. It is, of course, very important that the transformer leads be taken off at the proper points, A and B, as shown, or the function of these resistors will be defeated. A 1.5 ampere fuse is provided, in series with the input of the filament circuit, which will blow if anything happens to be open, or shorted, which may save burning out tubes. A General Radio six ohm filament rheastat was used for control. The series resistors are mounted on the bakelite shelf that supports the tube sockets, brass rods, threaded at each end, being used for the actual supporting members. These are screwed into equidistant

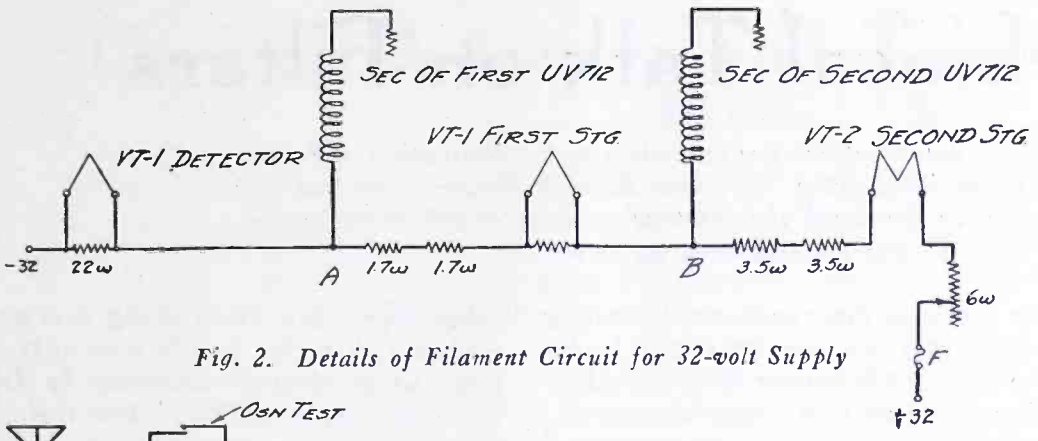


Fig. 2. Details of Filament Circuit for 32-volt Supply

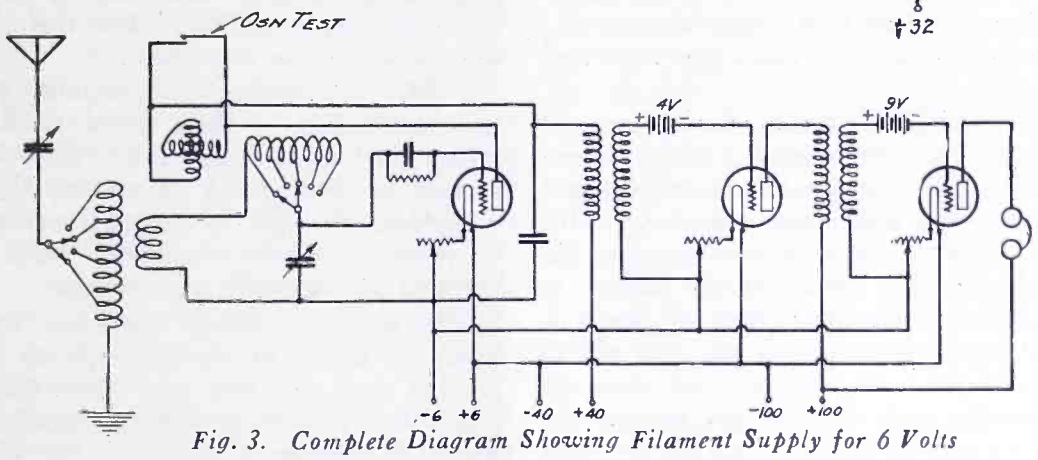


Fig. 3. Complete Diagram Showing Filament Supply for 6 Volts

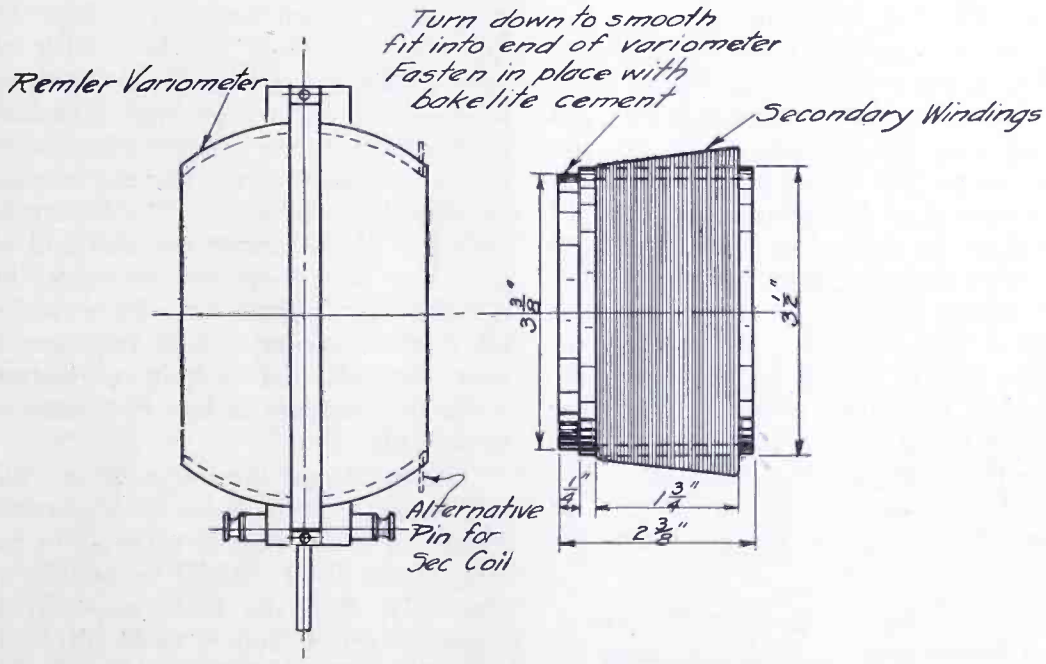


Fig. 4. Secondary Circuit Details

1st Tap—140-350 meters, 18 turns double banked
2nd Tap—174-420 meters, 33 turns 3 layer banked
3rd Tap—375-500 meters, 64 turns 4 layer banked
4th Tap—800-2000 meters, 100 turns 5 layer banked
5th Tap—1800-5000 meters

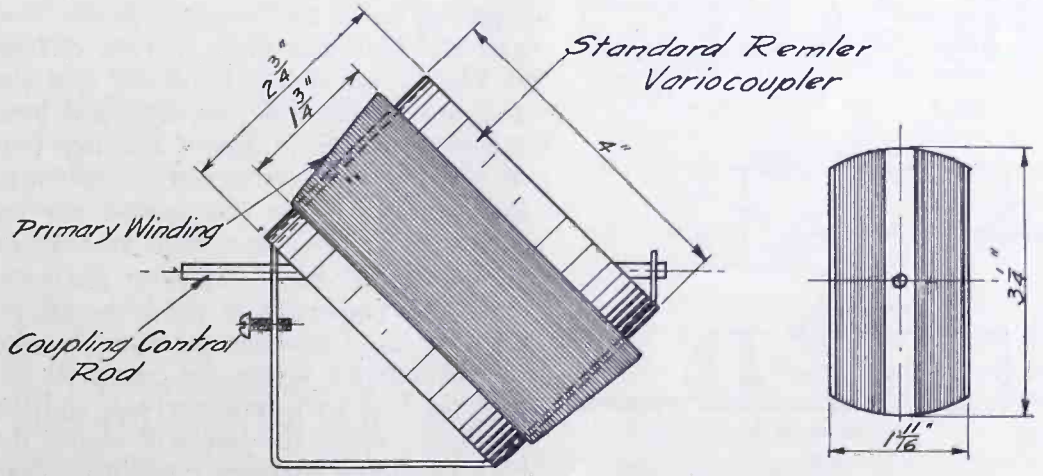


Fig. 5.

PRIMARY COIL
1st Tap—12 turns double banked
2nd Tap—21 turns 3 layer banked
3rd Tap—28 turns 4 layer banked
4th Tap—40 turns 4 layer banked
5th Tap—48 turns 4 layer banked
6th Tap—60 turns 5 layer banked
7th Tap—80 turns 6 layer banked
Total 289 turns

COUPLING COIL
9 turns on each side
Total 18 turns

holes along the shelf, with nuts and washers on the ends, which hold the resistors firmly in place. The resistance units are the standard Ward-Leonard type, and are of known and permanently adjusted value. Being covered with vitreous enamel, they are not subject to changes from oxidation and other deterioration that might be encountered in the common types.

The use of No. 14 soft-drawn copper wire is recommended, and each wire should be covered with the form of empire cloth tubing sold as "spaghetti," which will insure efficient and satisfactory insulation between all parts. This size wire is large enough for the filament circuits, of which the maximum current is about 1.34 amperes. The use of resin, or resin cored solder is advised for all connections, and it *must* be used if litz wire is used on the inductances, as any form of paste will corrode the fine wires and render the set inoperative.

It is desirable, although not essential, to carefully shield the whole apparatus. The author used the "Somerville" dials on the variable condensers. These, being insulated from the shafts and being of metal, can be easily grounded by means of a small spring, and they will then form a fairly effective shield from the effect of the so-called "body-capacity," while tuning. If the maker wishes to go to the trouble, a thin sheet of copper may be fastened to the back of the panel, care being taken to cut it out wherever it would come into contact with any live part of the circuit, and then ground this shield. For most effective shielding, in addition to the above, a copper "box" could be made up, with two compartments. One compartment houses the primary, primary condenser and coupling coil, and the other compartment the secondary and tickler. still another compartment may also be provided for the amplifier, although it will hardly be found necessary.

The mounting of the parts is well shown in the pictures, especially that showing the back view of the outfit. The variable condensers are mounted on the bottom of the panel, and the inductances, with their respective switches, on the top. The tickler and coupling variation is mounted between these two. The amplifier and detector tubes are mounted, as shown, on a small bakelite socket, in the rear of the panel, which is secured thereto by screws which are let into the front of the panel, and pass through holes drilled for them into tapped holes in the shelf. A piece of angle brass would doubtless be a stronger support. Two brass strips, properly bent, are fastened with machine screws to the end of the secondary inductance tube, and support the same at the proper distance from the panel. The

Continued on page 82

A Non-Technical Talk on Filters

This simple explanation of the use of inductance and capacity in eliminating undesired circuits is so good that it is reprinted from "Western Electric News" with but few changes. After getting the idea in the rough the amateur transmitter will better understand the how and why of the coils and condensers in his set.

EVERYBODY is more or less familiar with filters for removing solid matter from liquids. Perhaps the best known is the cheese cloth bag with which the housewife separates the seeds and pulp from the fruit juices of which she expects to make the winter's supply of jellies. Those who were at some time students of chemistry are acquainted with the filter papers—a sort of a blotting paper—used in the laboratories for straining and purifying chemical concoctions. But an electrical filter is something quite different even though it is used for straining "juice."

We, who have been enjoying radio, know that it is only enjoyable when the extraneous noises have been "tuned out" or strained out of the circuit. The "tuned circuit" used for this purpose is a kind of rudimentary filter but, as will be seen later, it does not have the same valuable properties as the complex electrical structure to which the name "filter" has been given. The filter, which is the invention of Dr. G. A. Campbell, research engineer of the American Telephone and Telegraph Company, is one of the most extraordinary of modern electrical devices. The tuned circuit is composed of a coil and a condenser which, for radio purposes, are both valuable. Current passing through this coil creates in its neighborhood a magnetic field, such as we have often seen pictured by means of lines of force. To set up the field requires energy, and as energy cannot be introduced in to any region all at once, but requires some time, this action of the coil causes it to have a retarding effect on the current, just like the inertia of a solid mass. The name inductance has been given to this property of the coil.

The faster we try to set up a current through the coil the greater is the retarding effect which finally means that those currents that alternate slowly may be but little retarded or diminished, while those that alternate rapidly are retarded in proportion to the speed of alternation or frequency.

A condenser acts in a kind of reverse manner to an inductance. It also stores up energy, but in a different form and its action is such that it permits high frequency currents to flow through it readily while it offers greater and greater impedance to lower and lower frequencies. Its action in this respect is measured by its capacity, the greater the capacity the more readily it passes alternating currents. And, of course, it is the action of these parts on alternating currents that we are interested in because as is well known it is the alternating currents that carry sounds and also radio signals and the "carrier" messages.

A special feature of the actions of coils and of condensers is that the retarding effect of the coil is positive and that of the condenser negative. This is the same thing as ascribing to the condenser an accelerating effect as against the retarding effect of the coil. The opposite nature of the two effects permits them to be combined so as to neutralize each other at one chosen frequency and in this way we get the well known effect of resonance.

Now, if we have a circuit as shown in Fig. 1, over which four different tones are being received at as many different frequencies, by placing a "tuned circuit" across this circuit as shown in Fig. 2, composed of inductance and capacity tuned to the right frequency, by which we mean that the inductance and capacity effects balance or neutralize each other at that frequency, we will get rid of one tone as it will be completely absorbed in the tuned circuit. By adding another tuned circuit as shown in Fig. 3, another tone can be eliminated. And by adding another tuned circuit as shown in Fig. 4, we will get rid of another tone. But, in so doing it is quite probable that the fourth tone may almost be eliminated, becoming so faint as to be hardly audible. For this reason the filter was developed.

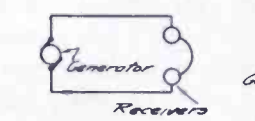


FIG. 1

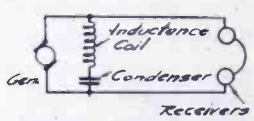


FIG. 2

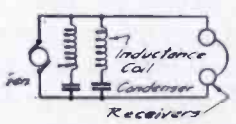


FIG. 3

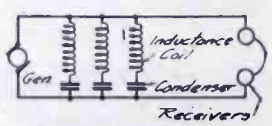


FIG. 4

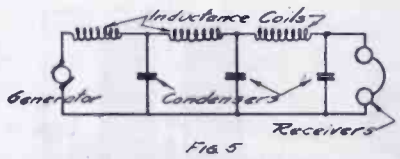


FIG. 5

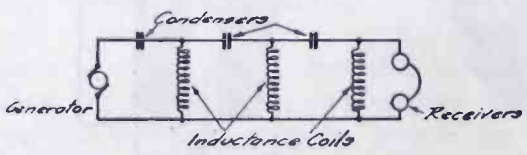


FIG. 6

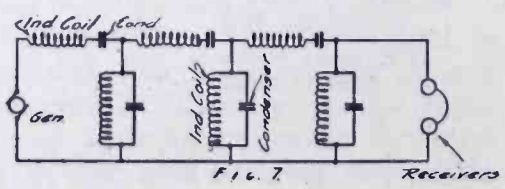


FIG. 7

Filters are made of inductance coils and condensers as the "tuned circuit" is, but they are arranged differently, and instead of picking out or passing along a number of single frequencies it selects or rejects a whole continuous band of them of any desired range at once.

There are, generally speaking, four kinds of filters in common use at the present time, the low pass filter which passes low frequency currents, rejecting the high frequency currents; the high pass filter which passes the high frequencies, rejecting the low with the line, as shown in Fig. 6. A condenser so placed offers a very high impedance or resistance to the low frequencies, but as the frequency of the current increases the impedance falls off. The inductance coils are placed across the line and absorb the low frequency currents, but not the high frequencies. These actions allow the currents of high frequency to pass through the circuit unhindered while the currents of low frequency are choked off.

The band pass filter is a filter which will pass a certain band of frequencies. Which is to say that if we wish to pass frequencies from 30,000 to 60,000 cycles only, then the filter must be designed to reject from 0 to 30,000 cycles and all above 60,000 cycles. Such a filter may be made with inductance and capacity in series with the line and inductance and capacity in parallel across the line. A band pass filter may be regarded as a combination of the low pass and high pass filter, in fact, to look at Fig. 7, one could almost say that the diagram for the low pass filter had been superimposed upon that of the high pass filter. We know from our discussion of high and low pass filters that the inductance in the line will retard, or choke off the high frequency currents, and that condensers in the line will retard the low frequency currents. So also the inductance across the line will absorb the low frequency currents and the condenser across the line will absorb the high frequency currents, combining these effects we see at once that very low and very high frequencies cannot pass through, but at a point in between the effects become balanced and currents of intermediate frequencies can flow.

Continued on page 60

Crystal Detectors and Telephone Receivers

By Ellery W. Stone

This constitutes the seventh and eigth assignments in the correspondence course on Elementary Radio being conducted by the Extension Division of the University of California. Previous assignments, questions and the supplementary data which make up the course may be secured by enrolling with the Extension Division, 301 California Hall, Berkeley, Calif.

IN the first and subsequent assignments we learned that radio frequencies are those which are above 10,000 cycles per second, the upper limit of audibility. The current which is generated at a radiophone transmitting station tuned to 360 meters has a frequency of 833,333 cycles per second. This means that the emitted radio wave has the same frequency, and the potential which this wave induces in the receiving antenna at some distant point also has the same frequency.

Since the current in the receiving antenna has the same frequency as the potential which causes it to flow, it follows that we are confronted with the problem of reducing this frequency of 833,333 cycles per second in the receiving set to a frequency which the ear can detect. In all radio receiving circuits, the device which effects this reduction in frequency from a radio to an audible one is termed the *dectector*.

We have previously learned that a transmitter employing the vacuum tube as the source of oscillations radiates undamped waves, i.e., waves which are not diminished in amplitude, each wave having the same height as the one preceding it. This is because the antenna of such a transmitting station is kept constantly charged with an electrical potential. With a spark transmitter such as that used for radiotelegraphy the antenna is charged with an alternating potential at the rate of about 1000 times per second. This means that between the crests or peaks of this alternating potential which charges the condenser, the oscillations in the antenna come to rest before the condenser is again charged. Such oscillations are called damped oscillations and the waves which they radiate are similar to the damped antenna oscillations which generate them, and are called *damped waves*. See Fig. 23.

Each set of damped waves which is radiated from the antenna is called a *train* of waves. The frequency of these wave trains is the same as the number of charges which the aerial receives in one second. Since in one complete cycle of alternating current, the condenser receives two charges—first in one direction and then in the opposite—the train frequency is twice the alternating current frequency. Most spark transmitters use 500 cycle current to charge the condenser or aerial so that the wave train frequency is 1000 per second.

In damped wave radiotelegraphic transmission, there are thus two frequencies, the audio frequency of the wave trains, which is twice the frequency of the alternating potential used to charge the condenser, and the radio frequency of the waves within each train. The latter frequency depends, as we learned in the third assignment, on the capacity and inductance of the condenser or antenna circuit.

In undamped wave or C. W. *telegraphic* transmission, there is but one frequency, that of the radio waves. Since these waves are not damped out, there is one wave train emitted for each depression of the telegraph key. In undamped wave *telephone* transmission, we again have two frequencies, that of the radio waves and that of the audio frequency sound waves (of the human voice, music, etc.) which *modulate* them.

Thus, undamped waves may also be broken up into wave trains. In the case of telephone transmission, these wave trains have the same frequencies as those of the voice or of music which actuate the telephone transmitter. C. W. telegraphic waves may also be broken up into wave trains by means of a buzzer or a rotary "make and break" device called the *chopper*. Such transmission is called I. C. W. or *interrupted* C. W. transmission.

You should bear in mind, however, that with spark or damped wave transmission, there is actually an interval of time between wave trains when no current is flowing in the antenna. During this interval, of course, no waves are radiated. With I. C. W. and telephone transmission, however, there is always current flowing in the antenna but it is increased and decreased into groups or trains according to the audio frequencies which are superimposed on it.

In telephone reception, we desire to make audible the train frequency since this is the frequency which corresponds to the voice or musical frequency at the transmitting station. The detector, then, must separate the radio wave or *carrier* frequency, as it is called, and the audio train frequency, making the latter audible. The detector performs the same function in telegraphic reception, making audible the spark or train frequency.

CRYSTAL DETECTORS

The crystal detector was not the first detector employed in radio reception but it has been in use since 1906 and is the simplest type of detector in use today. Practically speaking, there are but two types of detectors now employed—the crystal and the vacuum tube. The crystal detector is inexpensive to construct and to operate, and consequently constitutes the type of detector which the beginner or novice in radio usually employs.

The operation of the crystal detector is based on the fact that it will *rectify* small alternating currents— that is to say, it will pass considerably more current through it in one direction than in the opposite direction. A perfect rectifier is one which will permit current to flow through it in one direction only, allowing absolutely no current to pass through it in the opposite direction.

In our consideration of crystal detectors, we shall assume, for the sake of simplicity, that they are perfect rectifiers, although this is rarely the case.

In Fig. 26 and in subsequent figures, we observed that the crystal detector is always connected in series with the tuning device, either an inductance or a variable condenser, and a small fixed condenser, usually with a capacity of .001 mf. Across the fixed condenser is shunted the telephone receivers.

Fig. 45 represents a damped wave train, the potential of which is impressed across the crystal detector. The positive potential is represented by the rising and falling line *above* the horizontal zero voltage line, and the negative potential by the rising and falling line *below* the zero axis. When this potential is impressed across the detector in one direction, a current will flow through the detector. When the potential is reversed in polarity, however, the rectifying property of the detector will not permit a current to flow, so that we may say that the lower half of the current cycles is wiped out, as shown in Fig. 46.

Since the current in Fig. 46 is now entirely above the zero axis, it will be seen to be direct current inasmuch as it flows in but one direction. Such direct current, however, is not steady but varies in amplitude and is called a *pulsating* direct current.

These pulsations, of course, occur at intervals of radio frequency and hence

are not audible in the telephone receivers. Since direct current cannot flow through a condenser—hence the name *stopping* condenser—these direct current pulsations build up a charge on the condenser which slowly leaks through the telephone receivers. This discharge current assumes the form shown in Fig. 47, which is similar to a line drawn touching the peaks of the pulsations of Fig. 46. Such a curve is said to constitute the *envelope* of the current curve shown in Fig. 46.

It will thus be seen that from the train of alternating current waves of radio frequency shown in Fig. 45, we obtain first the direct current pulsations of radio frequency shown in Fig 46, and finally the direct current pulsation discharges of the condenser, shown in Fig. 47, which are of audio frequency. Each

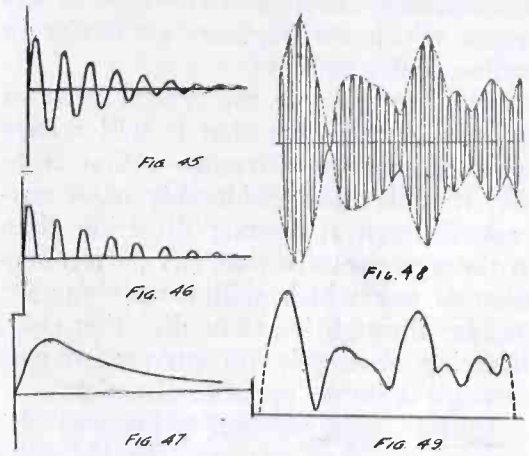


Fig. 45. Damped Wave Train
Fig. 46. Rectified Wave Train
Fig. 47. Envelope of Rectified Wave Train
Fig. 48. Wave Form of "0"
Fig. 49. Envelope of "0" Wave

discharge current pulsation produces a click in the telephone receivers. Since we will have one response of the telephone receiver for each wave train, we have thus reduced the radio frequency current to the audio frequency of the wave trains—a reduction in frequency which, as we learned in the first part of this assignment, must be effected in order to make the received current audible.

Figs. 45, 46 and 47 represent the rectification of a train of waves as sent out by a spark telegraphic transmitter. Fig. 48 represents the form of wave radiated by a radiophone transmitter when the sound "o" as in *"low"* is pronounced into it. As previously stated, the addition of the audio or voice frequency to the radio carrier frequency results in a series of trains but there is no appreciable interval when there is not some current flowing.

Fig. 49 represents the radio frequency current shown in Fig. 48 after it has been rectified, has charged the stopping condenser, and is being discharged into the telephone receivers. It is this discharge current, the envelope of the current above the zero axis of Fig. 48, which reproduces the sound "o" in the telephone receivers.

There are several types of crystal detectors in use. All of them, of course, possess the property of *unilateral conductivity,* i.e., they permit current to pass through them in one direction only. It is this property which makes them rectifiers. One of the most common crystals is *galena*—a sulphide of lead. It is silver gray in color, is easily shattered, and breaks into cubically shaped pieces.

Other crystals—in less common use—are the elements *silicon, tellurium, boron,* and *arsenic,* and sulphuric compounds of the elements iron (*iron pyrites* and *markasite*), copper and iron (*bornite* and *chalcopyrite*) and molybdenum (*molybdenite*). Certain oxides are also in use, namely—those of zinc (*zincite*), copper (*cuprite*), and lead (*cerussite*). The latter compound was widely used in the marine commercial receivers of the Marconi Wireless Telegraph Company and the Radio Corporation of America before they were replaced by vacuum tube receivers.

The crystals are generally mounted in metal cups, being retained therein by set screws or by a solder of low fusing temperature such as Wood's metal. If high temperatures are applied to crystals in mounting them, they are apt to lose their sensitiveness, i.e., their property of rectification. A fine contact, such as the point of a spring-brass or steel wire, is arranged to bear on the exposed surface of the crystal. The wire, or the crystal, or both, are mounted so as to be moved with respect to each other, since all points on the surface of the crystal are not sensitive. A careful search must therefore be made to ascertain the most favorable position of the wire for best results.

Occasionally, another sharpened crystal is substituted for the wire, and we find zincite being used with either bornite or chalcopyrite. Such a combination detector has the trade name of *perikon* detector. Similarly, arsenic compounds are often used in combination with silicon.

The perikon detector is very satisfactory, since a firm pressure can be maintained on the crystals. This obviates the possibility of losing a sensitive point by jarring. Further, it happens that almost any position of the perikon detector is sensitive so that very little difficulty is experienced in securing an efficient adjustment. For this reason, practically all the crystal detectors on the sets manufactured by the General Electric Company for the Radio Corporation of America employ the perikon detector. Most of the crystal detectors were invented by C. W. Pickard of the Wireless Specialty Apparatus Company and the patents covering them are controlled by that company. Fig. 50 illustrates a common type of crystal detector.

In operating a crystal detector, either before or after the tuning adjustment has been made, a careful search of the crystal should be made with the movable member—whether it be a wire, as in the case of the galena detector, or another crystal as in the case of the perikon detector—in order that the most sensitive position may be located.

Referring to Fig. 29 or Fig. 35, the complete operation of crystal detector reception, then, is as follows:

The incoming radio wave induces a potential at the terminals of the receiving antenna-ground circuit and a current of the same frequency flows therein. This current is brought to a maximum value by tuning this circuit to resonance with the impressed frequency. The tuning is effected with either the inductance or the variable condenser, or with both. The current in the antenna-ground circuit flows through the primary inductance of the receiving transformer and induces a potential across the terminals of the secondary. This potential is brought to a maximum across the terminals of the secondary circuit variable condenser by tuning the secondary circuit to resonance with the frequency of the induced potential. Practically, the same potential which exists across the secondary variable condenser is impressed across the crystal detector, which, due to its property of rectification, permits a series of direct current pulsations to charge the stopping condenser. The relatively slow discharge of the stopping condenser through the telephone receivers produces a click or response in the telephone receiver for each wave train.

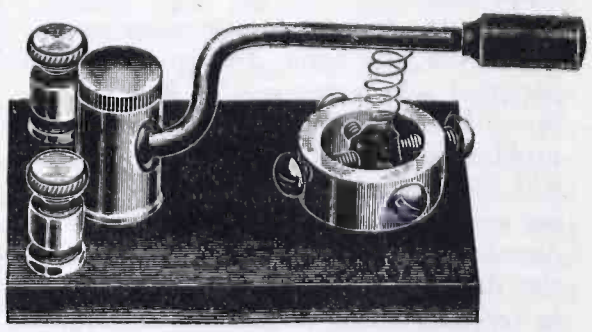


Fig. 50. Common Types of Crystal Detectors

A number of efficient receivers employing the crystal detector are on the market—notably the Aeriola Jr., the General Electric Type AR-1300, and the Wireless Specialty Type AR-1375 sets of the Radio Corporation, and the Everyman set of the De Forest Company. The latter set employs the galena detector while the others use the perikon.

While the vacuum tube is a much more efficient and sensitive detector, it is more expensive and more difficult to operate, and for this reason most beginners purchase sets which employ the crystal detector.

Continued on page 64

A Radio Frequency Amplifier

By Robert Kerrigan

The amateur interested in building a radio frequency amplifier set embodying standard practice with radio frequency transformers will here find a number of valuable suggestions as to constructional details. This constitutes the entry winning the fourth prize in the radio frequency amplifier contest recently conducted by the publishers.

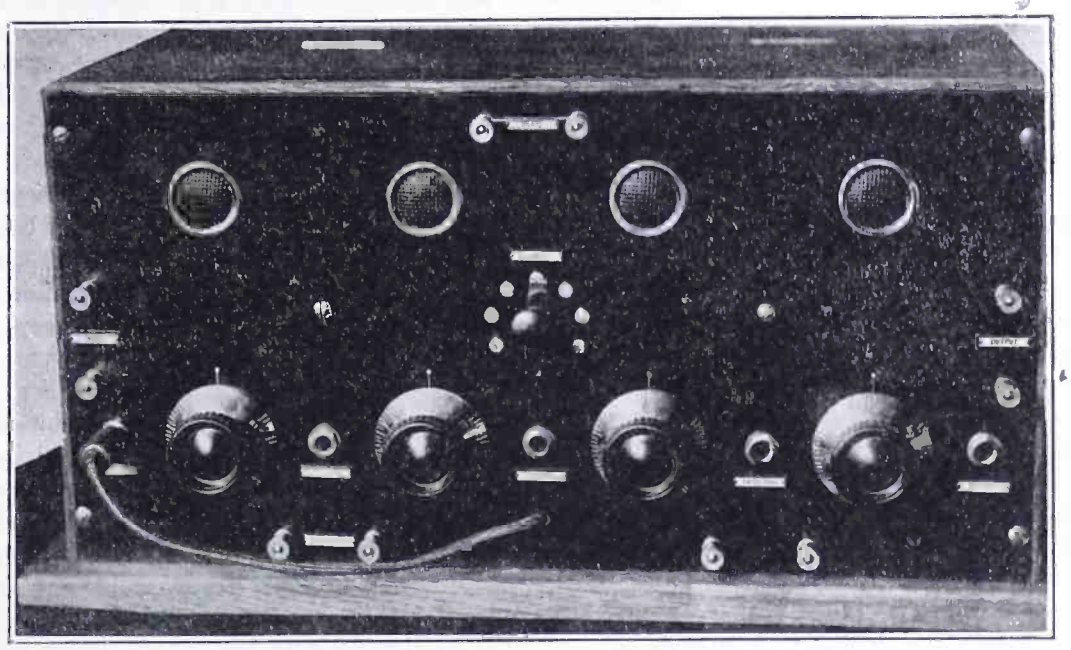
IN the design of this amplifier, flexibility was the foremost feature. The plug and jack arrangement incorporated in this set makes it possible to use the detector circuit alone, or with radio or audio frequency amplification, without departing from the efficiency of the set.

By a study of the diagram it will be noted that by placing the plug in the jack on the extreme left, the detector is connected to the tuner in the usual manner, provided the phone plug (on the amateur's headset) is in the next to the last jack from the right Moving the last mentioned plug to the right gives one stage of audio frequency amplification. These are the only two jacks that are used by the phones. Moving the plug attached to the flexible cord on the panel to the second and third jacks from the left, gives one and two stages of radio frequency amplification. By placing the phone plug in the correct position the set may be operated with or without the one stage of audio frequency amplification.

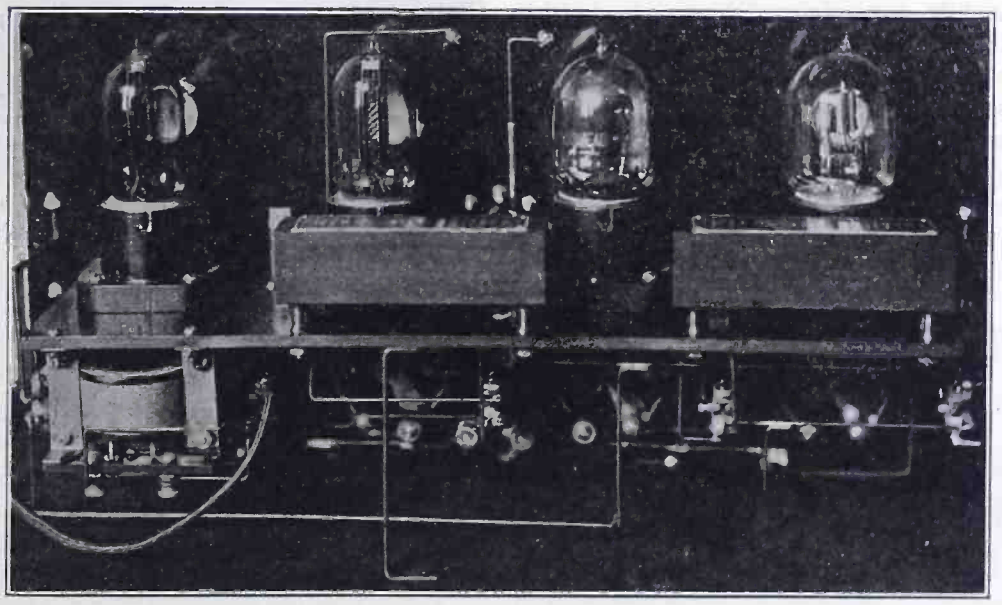
During the experiments carried out this was found to be the best combination for all practical work.

It must be noted that the jacks of the radio amplifier should be placed in the secondary circuit of the transformer. The audio frequency circuit is the same as usual.

Music will be found to be much clearer when using the radio frequency amplifier, provided the audio frequency circuit is not overloaded.



Front View of Set as Constructed by Author

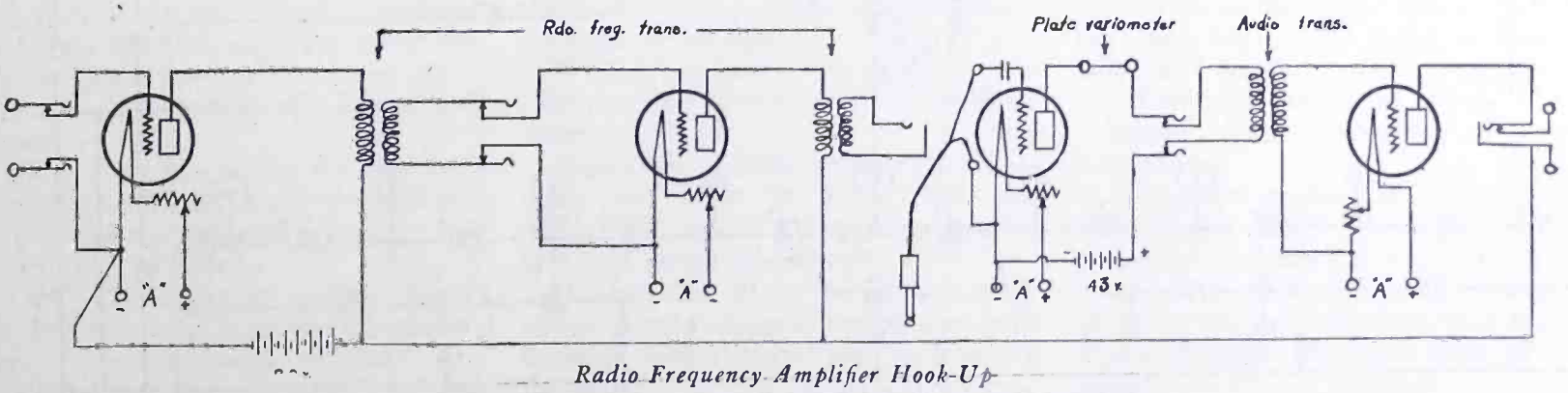


Rear View of Set

Five watt power tubes have been found to be well suited to audio frequency amplification and the plate potential may be somewhat higher than usual, provided the transformers are well made.

A word in regard to the tubes used in the radio frequency circuit will not be amiss. A tube of small internal capacity should be selected. Best results are obtained with AP amplifier tubes, although the Radiotrons work fairly well. A Western Electric V2 was tried as a matter of experiment, with poor results.

Provision is made to make the set regenerative if desired. A variometer may be connected to the posts at the top of the panel. This forms the plate circuit of the detector and these posts should be shorted if not used. It would



Radio Frequency Amplifier Hook-Up

be advisable to move these posts to the right and place two more to the left so a variometer may be inserted in the grid of the detector tube.

A variometer was taken and the series connection between the stator and rotor removed, leaving two separate coils, one to revolve within the other. The two leads from the rotor were connected to the plate binding posts of the detector and those of the stator connected in series with the grid of the first amplifier. This method has a strong feedback, but the plate coil of the detector has a tendency to pick up nearby signals, as it is coupled to the antenna circuit. All regeneration should be confined to the detector circuit for best results, therefore, this method is not as efficient as the first mentioned.

Far better results are obtained from telegraphic stations than from the broadcasting stations, when using radio frequency amplification.

All apparatus is mounted on a formica panel 3/16 in. x 8 in. x 16 in. The tube sockets and transformers are mounted on a sub-panel 3/16 in. x 4 in. x 14 in. and held to the panel by two 6/32 oval head machine screws.

The radio frequency transformers are made by the Radio Instrument Co. and are mounted behind their respective tubes, keeping the grid circuits as short as possible. These transformers are made to cover various bands of wavelengths, and fit into small pin sockets so they may readily be changed. The posts on the sockets are inverted so they protrude to the under side of the subpanel. This serves to hold them in place and makes for short leads, which are made on the under side with the exception of two.

The grid condenser may be made by clamping two pieces of copper foil whose active surfaces measure 5/8 in. x 1½ in. between two pieces of bakelite; mica is used as the dielectric.

Only centers are shown in the drawing of the panel as the others will vary with the type of apparatus used. The peep holes for the tubes are drilled with a one-inch drill. Windows may be inserted, or perforated screen placed behind the panel. This may be held in place by small pins forced into holes drilled at the back.

Referring to the picture, the binding posts at the middle left are for connection to the tuner, which is of the single circuit type. Those just opposite at the right are for additional audio frequency amplification if desired. Those at the lower left are for connection to the "B" battery of about 80 volts for the amplifiers.

It has been found best to use a separate "B" battery for the detector tube. This is contained in the cabinet and controlled by a seven-point switch. Space is left between each contact to prevent shorting the battery.

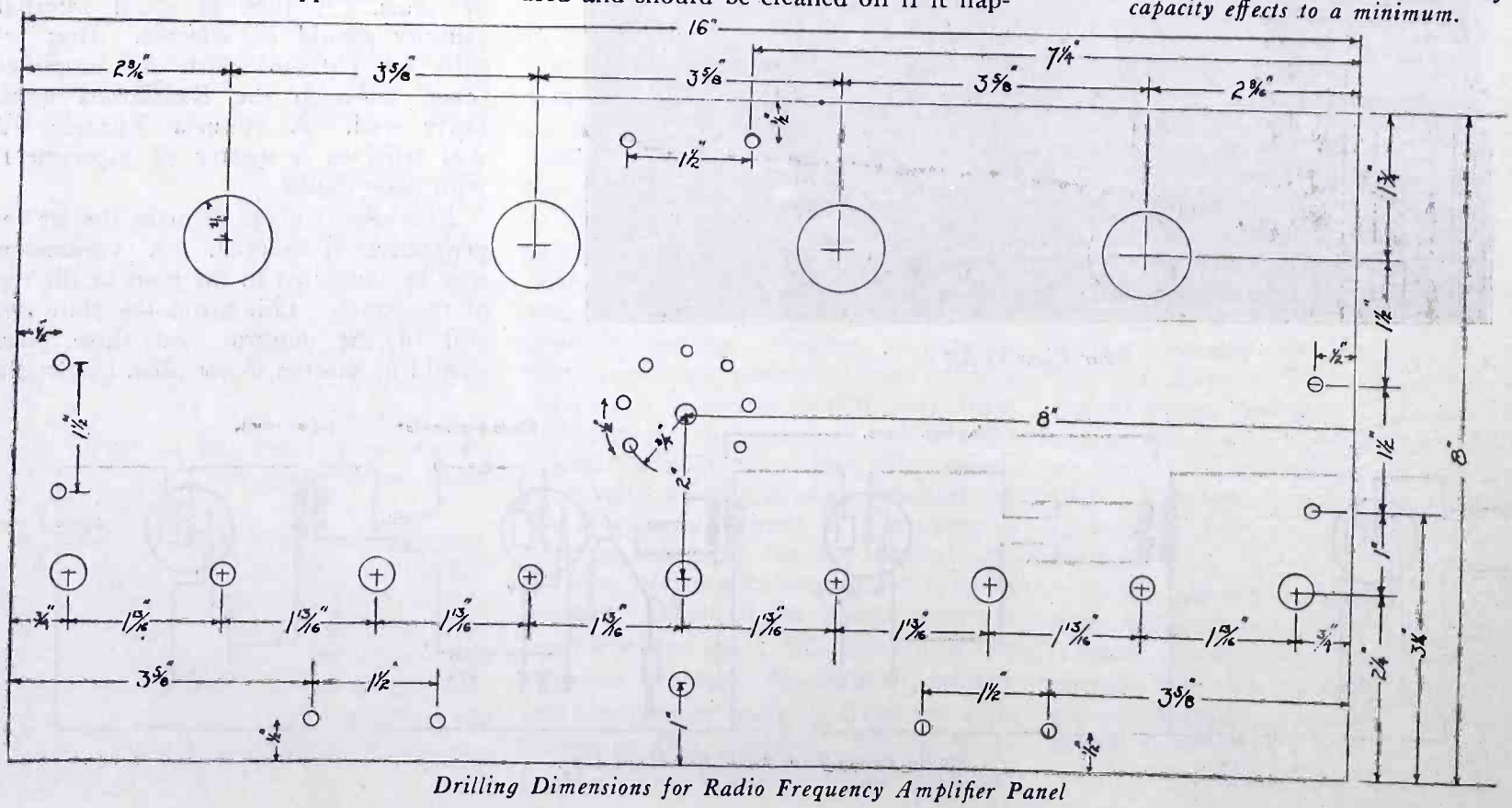
The "A" battery connections are at the lower right, while those at the top are for the plate variometer. In wiring, it is best to wire all filament connections first. It will be noted that the filament rheostat in the audio frequency amplifier is in the negative leg, which places a bias on the grid. All others are in the positive leg.

Use at least No. 14 wire in making connections and keep each lead as straight as possible. All wiring should be confined as much as possible to their respective tubes, being careful to keep the radio frequency leads from the detector circuit and this in turn kept away from the audio frequency circuit.

As little flux as possible should be used and should be cleaned off if it happens to splatter. Giving no heed to this may result in high resistance leaks between various parts of the set and lower its efficiency. Special care should be taken to see that the flux does not get in the insulation on the jacks.

Using this set at San Francisco with the bell wires for an antenna KUY at El Monte is distinctly heard. Using a 3-ft. sq. loop no difficulty is had in receiving from Sunnyvale, San Jose and Los Altos radiophones. When local stations are having their two-minute intermission, Stockton and Sacramento are heard on this loop. Tuning with a loop is extremely sharp and one should not expect results at the start. The author is well satisfied with this set and believes that anyone building it will be equally satisfied.

Harold Hamm discovers that a suit of mail, when properly grounded, reduces body capacity effects to a minimum.



Drilling Dimensions for Radio Frequency Amplifier Panel

"Wildcat Builds a Tuner"

By Sewell Peaslee Wright

Just as a sugar-coated pill goes down easier than the non-camouflaged bitter dose, so does a narrative "kink" sometimes get by better than the plain practical directions. This tale deals with soldering taps onto contact points and mounting a variable condenser without a template.

"HOWLING oscillators!" exclaimed "Sparks" McAllister as he eased into young Wildcat's shack. "What's this I see before me?"

Before this momentous question is answered, I must leave you in suspense, dear reader, while I describe these characters who have burst so suddenly into our quietude.

"Sparks" got his name—but why go into that? You know how fellows nicknamed "Sparks" get their monicker, don't you? If not, frame your license and get a job pounding brass and you'll find out pronto. "Sparks" McAllister was old enough to have the beginning of a bald spot, and to call the younger fellows "son" and get by with it; but plenty young enough to sit up till 2:30 a.m. to clear his hook. Twelve years of radio and some eight years of married life (although this latter is entirely aside from the subject) had given Sparks a lot of experience.

"Wildcat" was so dubbed because he had a trick of jazzing his rotary gap motor rheostat when he was signing off so that his spark gave a wild, quavering screech on the final "Dah-de-dah." He was, as you will surmise from this little peculiarity, much younger than Sparks, both in years and radio experience. Now let us rush back to where we left them, three paragraphs back.

Sparks waited for a reply, but got only a few muttered growls that sounded suspiciously naughty as "Wildcat" messed with a soldering iron that seemed to be always too hot or too cold, a coil of wire solder that was possessed of a devil, and a flood of soldering paste that was inundating the panel of a new set that Wildcat was trying to hook up.

Finally, desisting for a minute while the iron was heating for another attack, Wildcat kicked a chair towards his visitor and mopped a fevered brow with a handkerchief that was a bit soiled with soldering paste and battery acid.

"Dog-gone thing's a perfect mess!" he said, with a disgusted wave of his hand toward the set. "Such a cramped position to work in, soldering those taps onto the contact-points!"

Sparks glanced over the layout and grinned.

"Why don't you solder the taps onto the contact-point screws before you put the coil and the contacts in place? Lot easier!" he concluded.

"Gee! Could do that, couldn't you?" said Wildcat after a second's consideration. "I never thought of that!"

"You're not the only one!" grinned Sparks, filling a blackened old briar that smelled to high heaven. "There's not one in ten that thinks to do that; somehow the way you were doing it seems the natural way."

Wildcat unscrewed the contacts and grasped one of the tiny screws in a pair of heavy pliers in such a way that the head was flush with one side of the jaws, being careful not to apply pressure enough to injure the threads. Then he laid the pliers on the table, the head of the screw up, and soldered the contact in an instant, holding the wire tap with a pair of heavy tweezers, to prevent the conducted heat from burning his hands.

"Good idea!" he told Sparks, who lounged in a tip-tilted chair, his feet on the operating table, and his pipe fuming and gurgling happily away. Sparks merely grunted contentedly, and watched Wildcat finish the soldering job.

"The next thing," announced Wildcat "is to mount this infernal condenser. The panel is all drilled, but of course I didn't have any template, and I know the confounded holes won't fit right. They never do."

He inserted the shaft of the condenser through its hole, and turned the condenser around till the holes for the mounting screws coincided with those drilled in the panel for the screws—or, more properly speaking, he *tried* to make them coincide.

"I knew it!" he exclaimed. "Never knew it to fail! Two screws fit O.K., but the third is about a sixteenth off!"

He muttered something under his breath that he never learned in Sunday school, and then said resignedly:

"As per usual, I'll have to mount it with two screws, cut off the head of the third one and mount it with a bit of glue in the counter-sunk hole for appearance's sake!"

"Son, I can't figure for the life of me how a lad as bright as you would pull such a fool trick," drawled Sparks exasperatingly, as he blew a suffocating cloud of pungent smoke in the general direction of his friend.

Wildcat snorted. "I suppose you know how to do it better?" he inquired sarcastically.

McAllister nodded contentedly. Anything you want to know, son, ask daddy!" he invited. "Anything at all!" he added as an afterthought.

Wildcat let fly a burnt out tube, which Sparks dodged neatly, the bulb breaking with a sharp "pop" as it struck the wall.

"The fine art of mounting a V C," commenced Sparks in the didactic tones of a college prof, "is very, very simple—when you know how! The first thing to do is to get a heavy piece of cardboard—something like this, but not quite so soiled, if possible" he continued, picking up a piece of medium-weight bristol board from the littered floor of the "shack."

"We than take a sharp pointed pencil, and, twirling it back and forth, make a small hole in the cardboard—thusly!" and he suited the action to the word. "The hole is just large enough to receive the staff of the condenser—should be a tight fit. We then take some paint, or other similar substance"—he dipped the tip of his finger into a small can of black shellac that was standing on the table—"and carefully smear the face of the post which is drilled and threaded to receive the mounting screw, repeating this action until the three posts are prepared—so-fashion!"

He held up the condenser for Wildcat's inspection as though he were addressing a class.

"We then insert the staff of the condenser in the hole previously made for it," he continued, illustrating each step, "continuing this action till the mounting posts come firmly in contact with the cardboard, each one leaving its imprint. Care should be taken to see that these marks are not blurred in any way.

"The cardboard is then carefully removed, and on it we observe three tiny black rings, the centers of which show perfectly the size and exact location of the mounting screw holes." Use it as a template, and—there you are!" and Sparks spun the card onto the table.

"So darn simple!" said Wildcat wonderingly. "I wonder why I didn't think of it?"

Sparks carefully re-lit his pipe, which had gone out during his "lecture," and rose to depart.

"I just dropped in to tell you to be sure to be at the next radio club meeting" said he. "I am going to make a talk that I am sure will interest you."

"What on?" asked his friend.

Sparks made preparations to depart hurriedly.

"I'm going to speak on 'Things Little Boys Should Know About Radio!'" he exclaimed, and ducked out through the door just in time, chuckling to himself at the string of expletives that trailed bluely through the open door of the "shack."

"And It Came To Pass---"

Wherein Remarks on New Years Radio Resolutions Run Riot

By Sewell Peaslee Wright

AND it come to pass that even a year wherein the broadcasters cometh into power runneth its course, and the Christmas season cometh and goeth. Yea, the New Year loometh ahead, that season wherein the sons of men maketh divers resolutions, and sweareth all manners of "Wills" and "Wonts." As the poet who hath long since gone before putteth it: "Liveth there a man with soul so dead who never to himself hath said: 'I quit!'" And the answer thereto is "No!"

And so it came to pass that in a certain District wherein much CW warbleth in the stilly night a ham who hath many years of radio to his credit (or, as the broadcasters haveth it, to his discredit) becometh restless. He burneth out two 5-watters in a week, and instead of being thankful that they beareth not a 50-watt rating, he sweareth many things, and he sweareth just plain swearing also. He droppeth a V C on the floor, and he jammeth thereby the plates; and let him who hath tried it relate unto you the uselessness of trying to straighten them. He windeth a coil, and lo, the wire slippeth from one end, and cometh loose even unto the extent of sliding from the coil. He mounteth a tickler coil, and getteth the connection right the first time, which is too much!

He covereth up his apparatus with a cloth; he selleth his storage battery, and he sayeth unto all and sundry, I have sworn off of radio! And his wife rejoiceth exceedingly in the statement, and thinketh unto herself, What cometh next? And all this three days before New Years Day actually arriveth.

And on the second day before the first day of the year he readeth in the evening, and taketh joy in the fact that his ears feeleth not the pressure of the receivers. He rubbeth the corns on his external auricular apparatus with tenderness, and he thinketh, Lo, soon will these callouses be gone, and I shall be as other men. Yet somehow the thought bringeth him no great joy.

Ten o'clock cometh, and lo, it is the bed-hour of their neighbors, and of all good people. Yet he feeleth not sleepy, for hath he not been a member of the fraternity of Boiled Owls? Hath he not observed the coming of Aurora and her pink and gold host many a morning, tapping an arcing key the while? Yet, since these things were indeed of the past, he putteth them aside, and goeth into his chamber, and maketh himself ready for bed. Yet sleep cometh not.

An auto passeth, and its driver maketh a perfect "R" with his horn as he warneth a belated pedestrian of his coming. The radiator hisseth and sizzleth, and his aching ears striveth to make Continental thereof. The arc-light on the corner flickereth unsteadily, and he trieth to read as one readeth the blinker light. But the arc-light sendeth only "A-a-a-a-a-a-a-" over and over again, and he tireth of the sport. And finally he falleth asleep and dreameth that he heareth that D X station in the nth. district that he had tried for so long, and that he heareth it with exceeding loudness. And lo, he waketh, and it is the intermittent alarm of his Big Ben. And he saith unto himself things which are not fitting, except, mayhap, in times of great stress. He getteth up unwillingly, and it improveth not his temper when he thinketh that the day is Sunday, and he can sleep as long as he chooseth; for what careth one for sleep after one is half dressed?

And so all day he loungeth around, and he getteth in his own way, and that of his wife also. He findeth no interest in books, and the latest issue of Snappy Stories intrigueth him not. He fixeth the dripping faucet in the bath room, and putteth up a shelf, but time still hangeth heavily upon his hands. He writeth to three friends and to his brother, and it boreth him to extinction. And so the day weareth away.

Sunday night cometh clear and cold. The heavens glisteneth in the cold bright light of the moon, and not even one cloud marreth the beauty thereof. The aerial wires cutteth black and sharp across the radiance, and the ham looketh out of the window and croaketh, like the raven, "Never more!"

He falleth victim to the spell of the moon, and as he looketh, a vision cometh unto him. The hands of Time turneth backward, and lo, it is a year ago! Twelve o'clock on the night before New Years! The ether hums and buzzes and roars and whines and whistles and pipes in the headset with the notes of many stations. And the burden of the message that filleth the great arch of the heavens is "Happy New Year, O M!"

Our ham shaketh himself guiltily, and pulleth down the shade for such things are forever behind him.

He aideth his wife in making fudge, and eateth much thereof, but it maketh him not happy. He playeth solitary, and slingeth the cards across the room in disgust. His pipe tasteth abominably, and cigarettes burneth with an aroma like unto that of a blacksmith's shop. Yet, withal, he goeth not to bed at the appointed hour; rather he paceth the floor restlessly, and looketh frequently at his watch. And it was near the hour of twelve!

And suddenly our hero slammeth himself out of the house, and openeth the garage. He lifteth up the floorboard of his car, and worketh wonders with a pair of pliers and a wrench. Lo, he lifteth out the battery, and taketh it into the house with much grunting, for the weight thereof was considerable.

Up in the operating room, or, as he calleth it, "the shack," he worketh feverishly. The dust cover he trampleth under foot without a thought. The two remaining 5-watters he hooketh up, and he filleth the jars of his rectifier. He throweth the aerial switch, and it giveth him a thrill such as cometh but few times in a lifetime, for that which was lost is found!

The 5-watters lighteth up in competition with the detector and two step; the phones presseth familiarly on the calloused ears. He twirleth a dial and adjusteth a rheostat, and looketh once more at his watch. And the hour thereof was twelve.

Suddenly the diaframs waketh into new life; they vibrate to the whistles of a dozen stations: "Happy New Year, O M!" Our hero smileth happily, yea, a smile that passeth all understanding spreadeth itself over his features. Almost it seemeth that there shineth a drop of brightness in each eye, as he reacheth for his own key:

"Happy New Year, O M!"

* * * * * * * *

And the moral thereof is this: Don't do it—it's no use!

NATIONAL RADIO WEEK

Everybody is asked to boost radio during National Radio Week, Dec. 23-30. The purpose is to intensify interest in radio, not alone in broadcasting but also in amateur operation. To do this every present owner of a receiving set is urged to talk nothing but radio during the week, to invite his friends to his home to listen in, and to enthuse them with the enjoyment possible from a radio set.

The broadcasting stations are planning to put on especially good programs throughout the entire period. The newspapers will be given lots of good copy for publication. The dealers will have special displays and advertising. The movement is national in scope and is intended to be an annual affair.

Concert fans and amateur operators alike can easily interest their friends in listening to the broadcasts. There are millions of people who are curious to hear a radio concert and will jump at the chance. But while you have the boys there don't forget to show them that the real kick in the game comes from the code messages. Get a stack of code cards and pass them around among the novices so that they, too, may realize the importance of code messages. Every broadcast listener is a possible amateur transmitter. Convert him while interest is being stimulated by National Radio Week.

The Radium Bulb

By Albert Lippinpool

Frequently a radio experimenter has an idea, too difficult to materialize in present fact, but pregnant with future possibilities. Rather than forget it entirely he puts it into fiction. Such a possible accomplishment is suggested by the author of this story. After reading it you will wonder—whether?

"HUH! Here comes the toreador." said someone in the crowd of students. "Hello, Art. How's the old electrons shootin' today, huh? Sit down here a minute, can't you?"

"I'm just simply lovely, Dan.—Hello, everybody. Got a great invention under way now." Art laid a blueprint and slide rule on the warm stone steps of the Chemistry Building, blinked behind his shell-rimmed glasses, and lit a cigarette. "See that blue-print? That's it. That's going to r-r-r-revolutionize the whole business! That's going to make Marconi, Steinmetz, and the rest of the old gang look like a bunch of oil cans. If we can only put these here high-frequency, calibrated milkbuckets on the market for less than the siwash Electric Company sells them, we'll clean up a fortune." Art coughed, flicked the ashes from his cigarette in a business-like way, and wagged his finger at the crowd, as he finished his speech solemnly: Gentlemen, since you are all my friends, I'll sell you the first shares in my new company at two mills each!"

One of the fellows yelled, "Oh, Arthur! You devil!" and threw a "Jones' Calculus" at the "great inventor." Others followed the example, and the "master mind" grabbed his blue-print and slide rule, and departed. He shouted, "So long, gents. See you later," over his shoulder, limped into the maw of the dark, brick building and was swallowed for the day.

The storage battery of the college radio set had run down a degree or so, and Art's hair had two good curls across the top, under the telephone headset, when, with his blue eyes watching an ammeter, slowly he turned the handle of a rheostat. Gradually the meter-pointer leaned over to the right—up to 30 milli-amperes. Then, suddenly, it bounced back to zero again. "Ohhh!" groaned Art, "that's not as good as yesterday's! And another good bulb burned up. That's the fifth one that's gone this week. Now, if I were in the Signal Corps again, all I'd have to do would be to dig into the barrel and pull out another tube; but when you have to fork over five pesos at every lick, it isn't so pleasant." Art found his hand fingering a piece of paper on the black laboratory table. The blue-print. He looked down at it, and set his mouth. "It's tubes, it is, by heck, it's tubes, tubes, tu— Oh, damn the tubes!"

"Dot iss a rare old English dialect you use, Art'ur. Wot's de trouble?" said a rough voice from the doorway of the little room.

"Oh, Professor Geiger! I beg your pardon — eh, why, I just blew out another tube, professor. I'm afraid I'll go bankrupt if I keep on experimenting."

He was watching the set and listening to the humming in the phones.

"Ah, my boy, you're too anxious," and the professor came under the drop-light and placed a hand on Art's shoulder as he regarded the apparatus with him. "You try to reach around de world wit' a one-tube set, and den you wonder why de bulbs blow out. Too anxious, too anxious — Wot's dis, my boy?" Professor Geiger looked through the lower lenses of his spectacles and pointed to the blue-print.

"Oh, that. Eh—that's just a little scheme I'm working on; bulb for improving receiving apparatus. — Say, Prof. Geiger. When do we have our next examination?" and Arthur pushed the blue-print into a folder, hastily.

"Vy, next Monday, Art'ur." Professor Geiger made a smile, faintly sardonic, and yet compassionate, as he walked away. He had had "little schemes" himself, when he was Arthur's age.

Art turned to watch him go. A light in the corridor, just outside the room, silhouetted the professor's figure in the doorway. His hands clasped behind his hunched form, his head shaking skeptically, he turned into the hall and lumbered away, leaving a dying echo of footsteps in the room.

Then, for the first time, Art lost his confidence in his little secret scheme. Arthur knew from experience that what Professor Geiger thought was generally right. And now the professor seemed to doubt Art's capability of developing a better tube than those already on the market.

The young man's head nodded and his gaze went back to the bench. A calendar proclaimed that this day was Tuesday, the fourteenth day of November. Underneath the numerals was a scribbled note. Arthur bent over and read, *"Bulb due today — Monasch Laboratories."*

"Well," he thought, "today's the day. If they only don't get too curious about what they are making. But then, the Monasch Laboratories manufacture all kinds of freak apparatus. All the profs. send their orders there, and, after all, there's no special reason why they should give my invention any more attention than is necessary. Prof. Geiger said he thought they were an honest company, too, and what he thinks is generally right." And then, as though to taunt Arthur once more, his memory recalled the professor's distrustful attitude when he had left the room.

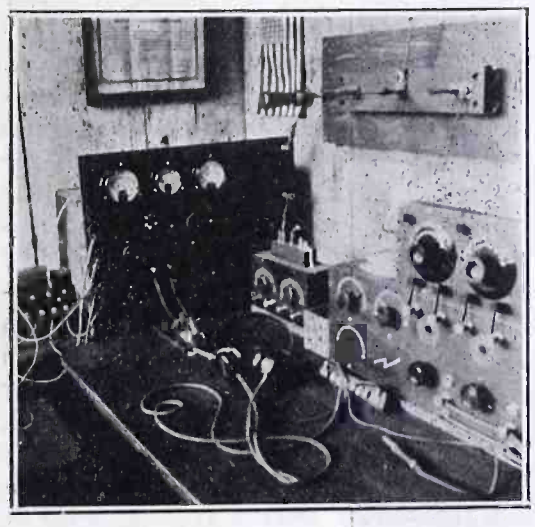
It was not until he returned home, that evening, that Arthur could drive from his mind the picture of the old professor doubtfully shaking his head in the doorway. But when Art found a box, from the Monasch Laboratories, waiting at the house for him, Professor Geiger was forgotten. The young

Continued on page 86

AN INTERESTING A.C.-C.W. STATION

By LYNDON F. SEEFRED, 6EB

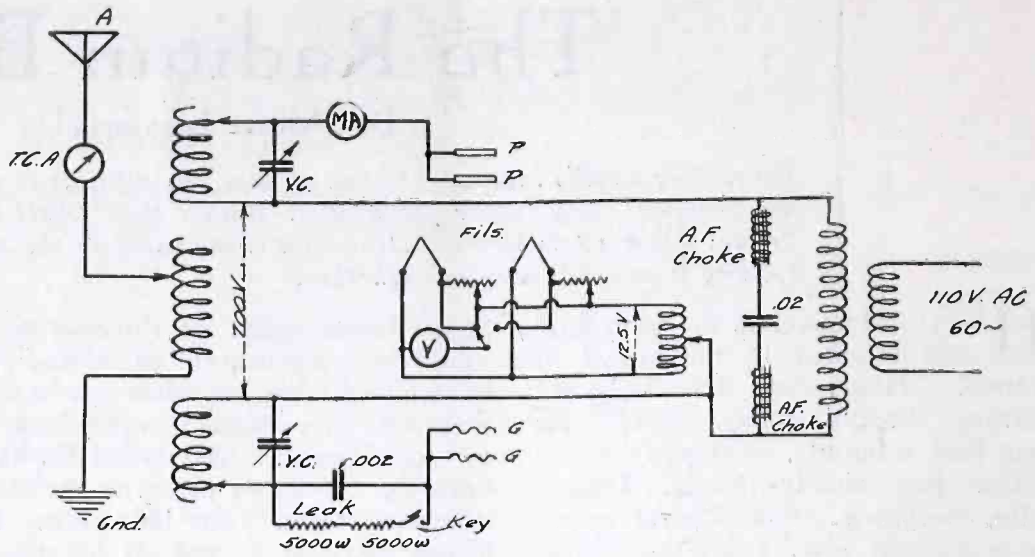
This station consists of a 10 watt a.c.-C. W. transmitter and has been in operation since February, 1922, when the spark set was dismantled. Using 700 V., 70 milliamperes on the anodes and 8 V. on the filaments, of two Cunningham 5 watt tubes, the radiation is 1.5 amperes (thermo-couple). The power is furnished from a 200 watt Acme transformer. The meters are, from left to right, 0—15 V. Somerville, 0—500 milliampere Somerville, 0—5 thermo-couple Jewell. The rheostats are General Radio, 2 ohms—2.5 amperes each. A two-point switch is used for connecting the volt meter on the filaments of each tube. Two double-spaced Wireless Shop C. W. transmitting variable condensers are connected



6EB's Station

to the inductance, one around the grid coil and the other around the plate coil. The antenna and ground coil is set between the other two, and all are wound on a 4-in. bakelite tube, the wire being No. 14 soft drawn copper. A small Dubilier mica condenser of .002 mfd. is used for a grid condenser and two 5000 ohms Radio Corporation grid leaks shunted around it with a key in series which is a heavy silver point Mesco telegraph key.

For filter, a couple of home-made audio-frequency chokes are used in conjunction with two old condensers that were used when spark sets were the "worm's shoulders." One is a Dubilier .01 mfd. 21,000 V. 1 k.w. mica condenser and the other is of the "oil-dielectric" type which consists of 52 12 in. x 14 in. No. 18 aluminum plates separated 3/8 in. in 32 gallons of Magnet transformer oil.

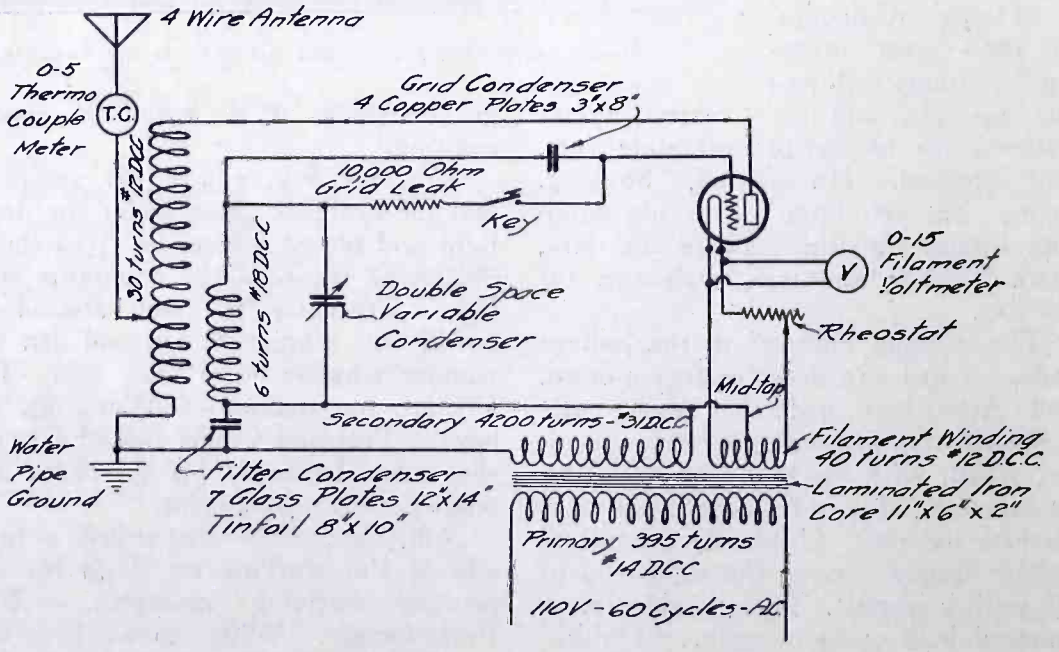


10-Watt A.C.-C.W. Circuit at 6EB

At the right of the transmitter is seen an ancient crystal receiver which is calibrated from a General Radio wavemeter for tuning the transmitter. On the right of this is seen a modified C. R.-5 receiver with one stage of A. F. amplification and Baldwin fones. The antenna is an L type, 50 ft. high, 45 ft. between 15 ft. spreaders, 51 ft. leads, and 4 wires—7 strands of No. 22 copper wire in each. No countrepoise is used. Just the water pipe and some metal buried in the ground.

The best distance the above C. W. transmitter has been heard and worked was 6ZAC at Hawaii, 2100 miles air-line from Los Angeles. The next best distance was when operator 6AX of Oakland copied me very qsa while he was aboard the KKEI, 350 miles southeast of Unimak Pass (1700 miles northwest of San Francisco) or 2,050 miles from here. Others worked (shown in brackets) or heard by are: 5ME, Dallas, Texas; 6th district too numerous; 7NA and (7DP), Portland, Oregon; (7TH), Walla Walla, Washington; 7SG, Aberdeen, Washington; Canadians — 9BP, Ex-5AX, Prince Rupert, B. C., and 9BD, Vancouver, B. C.; twice by 9AHC, Ellendale, N. Dakota; (9ZAF) and 9DTM, Denver, Colorado; 9PS, Wichita, Kansas; 9FK, Clinton, Iowa; 9AON, Clayton, Missouri; 9DR, Minneapolis, Minnesota; (9XAQ), Boulder, Colorado; 9AMI, Mason City, Iowa; and Mr. John Berg, Jr., at Pierre, So. Dakota. All the above was verified by my log book and I wish to say right here that it is much more of a pleasure to know that your set was *really* heard at these places rather than believe every card you receive, like some fellows do. I have kept a steady log book since the winter of 1913, starting in the radio game the winter of 1908, and answer *all* long-distance cards. I hope others will get the habit also. The hook-up of the transmitter is shown below.

In conclusion, I would like to state the transmitter and receiver are all home-made with the exception of standard parts, and they were purchased through the prompt and courteous service of Mr. Fred Cristian, Electric Lighting Supply Company, 216 W. 3rd Street, Los Angeles.



Five Watt A. C. C. W. Circuit at 6EA.

With the above a.c.-C. W. circuit on one 5-watt tube, I have "QSO"—6ZAC, 9DR, 9PS, Canadian 4BV, 5XD, 9AMB, 9BJI, 9DTM, 9ZAF, and heard by 8CZN, 8IB, and by a dozen "9" stations.

—H. C. SEEFRED

A Filament Heating Transformer for C. W. Transmitters

By Chas. K. Fulghum

Herewith are complete practical instructions whereby the amateur can construct a transformer for heating tube filaments with alternating current. Included, also, are directions for satisfactory operation. The author has had wide experience in construction work and has anticipated the needs of the constructor.

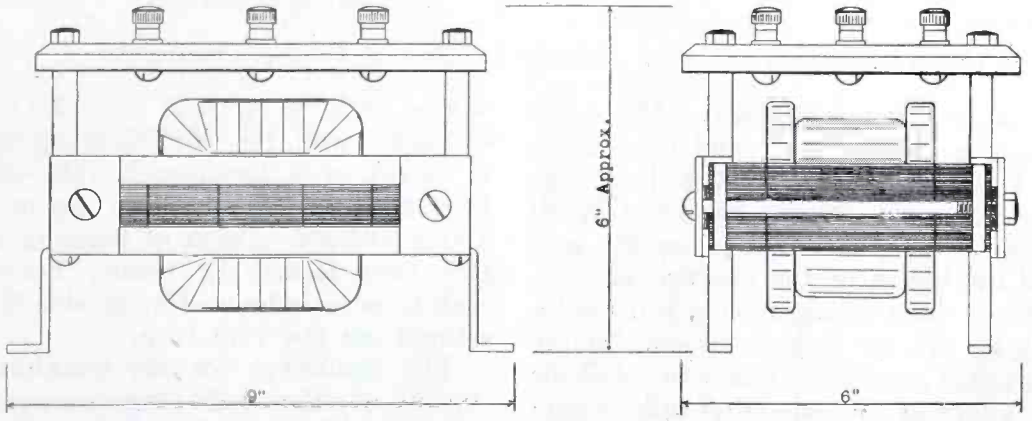
THE use of alternating current for heating the filaments of vacuum tubes used in C. W. transmitters, needs little or no introduction to the majority of experimenters using C. W. transmitting equipment, and its points of superiority over other methods of filament excitation requires little comment.

The matter of expense, both initial and operating, is of importance to anyone using power tubes, and it is certain that filament excitation by a.c. is far less expensive than any other recognized method. Of still greater importance is the cost of power tubes, and it has been proved beyond question, by theory, research, and practical operation, that there is a material difference in the life of tubes excited respectively by direct and alternating currents, the tubes showing longer life in every case being those operating with a.c. filament excitation. It scarcely falls within the scope of this paper to present reasons for this, but it should be impressed on the reader that the above statement is a well verified fact.

Filament excitation by a.c. is usually affected by a small step-down transformer operating from 110 volt, 60 cycle a.c. power mains. Such a transformer is built with secondaries wound for from 10 to 15 per cent greater voltage than that required by the filaments of the tubes to be operated, in order to compensate for the voltage drop of the wiring. The transformer, which is usually equipped with more than one secondary winding, especially when kenertron rectification is used to supply the plate potential for the transmitting tubes, may or may not have secondary windings developed for filament excitation purposes. In the latter case, the transformer differs in no way from the ordinary step-down power transformer, but in connecting the transformer to the filament circuit a resistance of approximately 100 ohms should be shunted across the filament terminals and the plate and grid returns and high tension connections made to the center of this resistance. It is obvious that this arrangement will give rise to certain unavoidable losses in the transmitter, and when used for phone work, there is some difficulty in balancing out the a.c. hum.

Where the utmost in satisfaction and efficiency is to be desired, a transformer with windings developed for filament excitation should be used. In such a transformer, a tap is taken from the mid-point of the secondary winding and to this the plate and grid, and high tension connections are made.

It should be mentioned at this point, that transformers with high tension windings for pre-rectification circuits, with filament heating secondaries wound on the same core, cannot be recommended. While such transformers are unquestionably a compact arrangement, it is decidedly preferable to have separate transformers for filament excitation, not only as a factor of safety, but because of the greater efficiency and better regulation to be had with such equipment.



End Elevation *Side Elevation*

Fig. 1. General Assembly and Overall Dimensions of Filament Heating Transformer

The construction of a transformer for filament excitation is discussed in the following paragraphs. As described, the transformer is designed to operate at a primary potential of from 105 to 115 volts, 60 cycles. The secondary potential is 12 volts when operating at an output of 150 or 350 watts according to the type of secondary winding employed, two of which are described. Since the 50 and 250 watt tubes available for experimental purposes require respectively approximately 75 and 177 watts for filament excitation, the constructor can readily ascertain which type of secondary winding he should employ.

When built to the specifications described, the transformer may be operated for extended periods of time with the temperature rise not exceeding normal, and overloads, not to exceed 25 per cent of the rated load, may be safely handled when the transformer is to be operated for a short time only.

The core is silicon transformer steel in laminations approximately .014 in. thick. Such steel is readily obtainable from most dealers in electrical supplies, although many times it is possible to find the material wanted in discarded transformers. Dealers equipped with facilities for cutting laminations will do this work for a nominal sum; otherwise, the constructor should have the laminations cut at a machine or tin shop where gate-shears are available.

The dimensions and number of laminations required are as follows: 304 pieces, 4 in. x 1 in.; 200 pieces, 2¼ in. x 1 in.; 100 pieces, 4 in. x 1½ in.; 4 pieces, 5 in. x 1 in.

If the steel as obtained from the dealer has not been varnished, the constructor should do so before assembling the core, by dipping each lamination into a thin solution of shellac, and allow it to become thoroughly dry.

From the illustrations it will be noted that the shell type core has been adapted for this transformer. The superior results obtained in practice with transformers constructed with this type of core, well warrants its use, and at the same time it offers less chance of setting up stray magnetic fields due to leakage from unbalanced windings.

The laminations are assembled according to sketches in Fig. 2. These illustrate clearly the relative positions of the various laminations and the manner in which they are stacked. When properly assembled, each joint in the core will be a perfect lap-joint, allowing little or no magnetic leakage. It should be noted that this core assembly presents as nearly as possible a practical method of obtaining rigid core construction, using rectangular laminations, at the same time keeping core losses at a minimum.

When completely assembled, the core should be clamped together until the

laminations are tightly compressed, and each of the various elements, with the exception of the central leg, should be bound temporarily with friction tape. The central leg, on which the windings are placed, should be wrapped with several turns of heavy bond paper well shellaced, and over this two turns of empire cloth, the last turn being held in place with shellac.

The windings for the transformer are made in three coils, two secondary

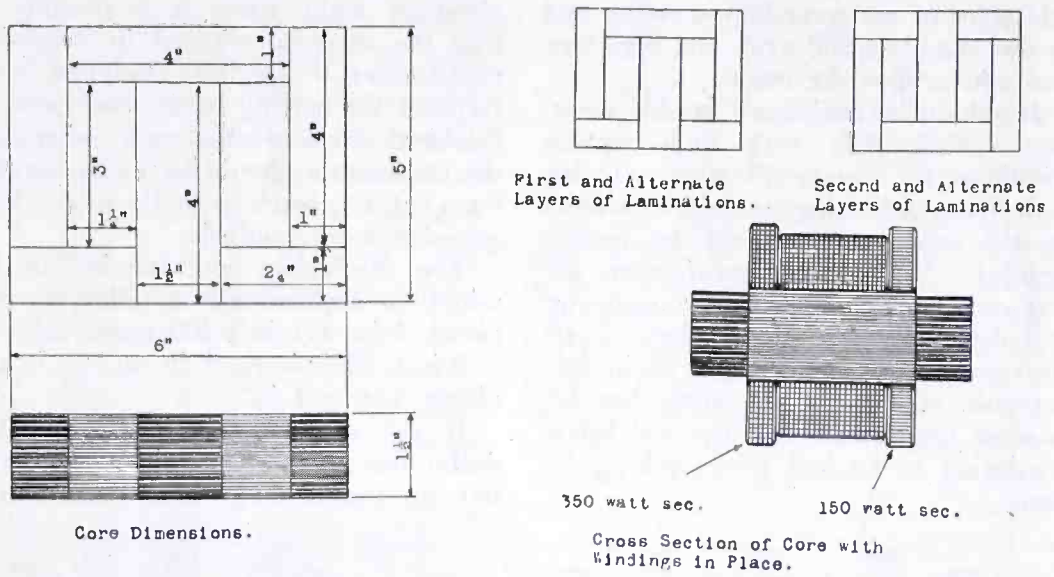


Fig. 2. Details of Core Assembly for Filament Heating Transformer

windings and one primary. All of the windings should be wound on a mandrel of wood, approximately 1 5/8 in. square, or of sufficient size to make allowance for the insulation on the core and the taping on the finished coil.

Since the winding, taping, and insulation of all the coils is practically the same, it is scarcely necessary to detail the procedure of the individual coils, a general description of the process applying equally well to the construction of each coil.

The coils are wound on the wood mandrel over one or two turns of cardboard, which should be left in the coil when the coil is removed from the mandrel and taped. Each end of the finished coil should be fitted with a cardboard form of the same shape and size as the end of the coil. These forms are of material aid in keeping the coil in shape while it is being taped. The taping should be done toroidally, that is the tape should be passed around the coil from end to end, through the center and around the outside of the coil. One layer of friction tape will suffice if well lapped, otherwise two layers should be used. The taped coil should be completed by giving it a coat of shellac or coil varnish and allowing it to become thoroughly dry.

The winding dimensions for the various coils are as follows:

The primary winding consists of 300 turns of No. 14 D. C. C. copper wire with taps taken from the 260th and 280th turns. The winding should be in 15 layers of 20 turns per layer. Between each layer of wire should be wound a turn of paper, and over the last layer of wire at least three turns of heavy varnished paper.

The two 150 watt secondary windings consist of 30 turns each of copper ribbon .02 in. wide. Since the ribbon usually come uninsulated, it will be necessary to include between each turn a continuous winding of empire tape. A tap is taken from the 15th turn.

The 350 watt secondaries are each wound with 30 turns of No. 10 D. C. C. copper wire, the winding being made in layers of 4 turns each, the eighth layer requiring but 2 turns. As in the 150 watt coils, a layer of paper or empire tape should be wound between each layer of wire and a tap should be taken from the 15th turn.

The mountings for the transformer consist of the following parts: 2 brackets with legs, 9 in. x 2¼ in. (over-all); 2 brackets, 7½ in. x ½ in. (over-all); 4 end plates, 1¼ in x 1¾ in. (over-all); 4 tubes, ½ in x 1½ in. (over-all).

The brackets which support the core and clamp it together, are constructed from ½ in. angle iron. Details and dimensions of these brackets and the other core mountings are given in Fig 3. The end plates are made from strap iron and the tubes for supporting the panel, from brass tubing having an internal diameter of ¼ in.

The terminal panel is constructed from ½ inch slate or bakelite. If slate is used care should be taken to choose a piece free from metallic veins. The panel template is given in Fig. 3. It should here be noted that all holes in the panel and mountings are drilled ¼ inch, except those for the binding posts, which should be drilled according to the size screw used with the posts.

For assembly, one end of the core should be removed, and the winding placed on the central leg in the order illustrated in the sketches in Figs. 1 and 2. The end of the core is then replaced and the temporary bindings of friction tape removed from its parts. If the core has been correctly constructed there will be eight extra laminations. These laminations are arranged on the top and bottom of the core over the outside laminations in such a manner that when the brackets are clamped in place there will be no ends of any laminations free. Bolts, 3/16 in., 4 in. long, are used to clamp the brackets to the core and to support the panel. After the brackets are in place, the small end plates should be arranged at the ends of the brackets, using bolts, 3/16 in., 6 in. long, to draw the end plates together and keep the brackets from spreading. The tubes for supporting the panel and the panel are put

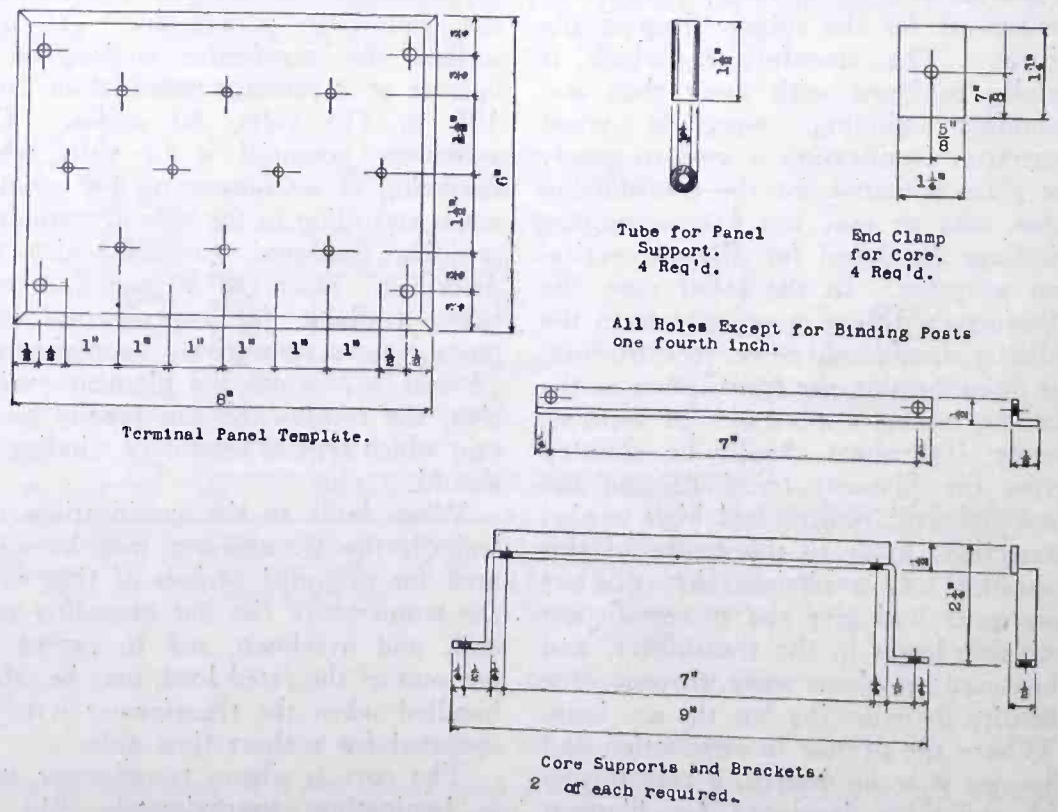


Fig. 3. Miscellaneous Details of Core Support and Panels

in place and the bolts tightened until the core is held firmly together.

The transformer and panel are wired according to the diagram in Fig. 4. It will be noted that the terminals of the secondary windings are so arranged that the coil can be bridged together when desired.

The completed transformer should be tested for core vibration as mentioned in one of the following paragraphs, and if excessive vibration is found, the various bolts should be tightened until the trouble is eliminated. The transformer may be finished by giving it a coat of enamel or white shellac and allowing it to dry in a place free from dust.

The transformer is connected to the transmitting set by connecting the outside terminals of the secondary to the filament terminals and the center tap of

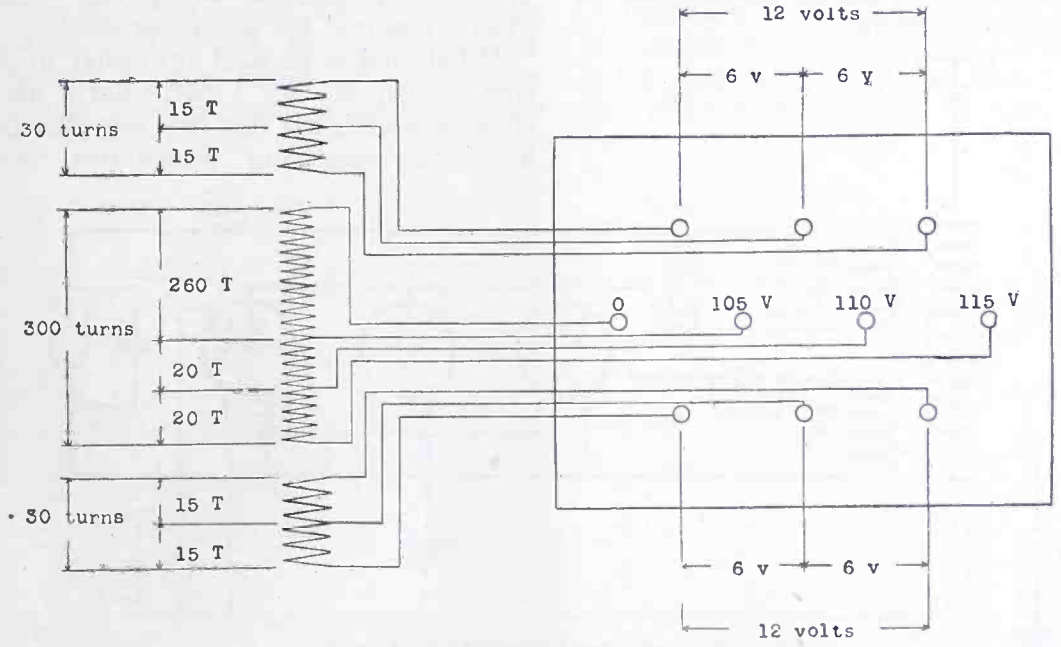


Fig. 4. Schematic Wiring Diagram of Filament Heating Transformer

the secondary to the plate and grid and high tension returns. If possible, as a matter of safety, a circuit should be used that will allow the center tap to be kept at ground potential, otherwise, there is some chance of high frequency currents being induced in the primary winding which may possibly result in a burnt-out transformer.

Regulation of the secondary voltage is provided for to a certain extent by the taps in the primary winding, although their real object is to provide a means of adapting the transformer to circuits of different voltages. When one rheostat is used to regulate the filament current, it should be included in the power circuit in preference to the filament circuit. However, when a power modulation circuit for radiophone work is used, it is desirable to adjust the filament temperature of the modulators and oscillators independently and rheostats in the filament circuits of each tube can, in this case, be employed to advantage.

The unsatisfactory results frequently met with in practice where transformers are used to supply the filament heating current, can usually be traced to one of three sources, i.e., poor transformer construction, deficient power supply, or inadequate knowledge of the circuit phenomena involved when a transformer is used for filament excitation.

Poor or faulty transformer construction usually manifests itself by causing an a.c. hum in the transmitted signal, especially noticable when the plate supply is derived from a motor-generator unit. If care is used in winding the secondaries of the transformer, and especial care taken in the location of the central tap so that the potential between each terminal of the secondary and the central tap is equal, no trouble should be had with self-modulation caused by variations in the grid potential.

Another cause of self-modulation frequently found in practice, indirectly traceable to poor transformer construction, although eliminable by the proper disposition of the transformer with relation to the transmitting equipment, is caused by minute vibrations of the transformer being conducted to various parts of the transmitter, causing slight vibrations in the wiring or more frequently a vibration of the electrodes of the transmitting tubes. It should, therefore, be made a point in construction to see that there is little or no chance for vibration in the laminations of the core. The best method of testing the transformer for excessive vibration is by placing it on a resonant surface, such as a table-top, and noting the intensity of tone when a current is passing through it. Since, even in the best of transformers, there will be a slight hum, it is advisable to mount the transformer in such a way that there is certainty of no vibration reaching the transmitting equipment.

Poor power service has caused the experimenter more trouble than many of them are aware of, and in the majority of cases it is impossible to remedy it. Complaints to the power company rarely if ever effect a change in the service. Hence the best thing that can be done, unless one can afford the expense of a low-voltage motor-generator unit for filament excitation, is to "grin and bear it."

Circuit phenomena are highly involved technical studies, and few have been fully investigated. One, however, fairly familiar, although often overlooked, is the impedance offered by the filament heating winding to the high frequency currents flowing in the filament circuit. It can readily be understood how the secondary winding acts as a choke to these currents, although in many cases little impedance will be offered them due to the inherent capacity of the secondary winding. However, in many cases, shunting a condenser of approximately .001 mfd. across each half of the secondary winding on either side of the central tap, will materially increase the output of the transmitter.

BROADCASTING IN BRAZIL

Steps have been taken for the introducing of radio broadcasting in Brazil and indications point to a promising future market for receiving apparatus. Until recently radio broadcasting was practically unknown, but the Centennial Celebration being held at Rio de Janeiro has served to stimulate interest in radio and various concerns in Brazil have been active in taking it up.

The Rio de Janeiro Light and Power Company has recently finished a broadcasting station on the heights of Corcovada, using a wavelength of 483 meters. Music from the Municipal Theater is sent to Corcovada summit by telephone and after amplification is sent out by radio. A studio near the summit also furnishes concerts and other entertainments which are heard locally. Additional broadcasting stations are now located at Monroe Palace (Congressional Building) and at the offices of the Marconi Wireless Telegraph Company. A number of receiving sets have been installed in the exposition buildings.

Imports of wireless apparatus have been received both from the United States and Germany for sale during the exposition. The requirements of the Brazilian law, however, make it obligatory for any persons wishing to install a receiving set to secure a special permit from the Department of Transportation and Public Works. Only such receiving sets as have been approved may be sold by importers especially licensed to make such sales. The restriction and that limiting the sale to persons who have received a license to install and use wireless apparatus have hindered the exploitation of this important product. It is hoped, however, that by the beginning of the year a more definite policy will be established by the Brazilian government

Operating Transmission Vacuum Tubes in Parallel

By Jesse Marsten

In view of the controversy regarding the relative advantages of self-excited amplifiers and of the master-oscillator-amplifier system of radio telephony, the comparisons drawn in this article are most timely. Incidentally every transmitting amateur will here find some good suggestions for his contemplated C. W. set improvements.

IT is often necessary and desirable to operate vacuum tubes in parallel so as to secure greater power output. Thus, since power tubes are turned out in 5 and 50 watt sizes, in order to obtain intermediate powers such as 25 watts, it is necessary to use a number of 5 watt tubes in parallel. There are certain features of parallel operation which are not quite evident and which should be considered. The amateur will find that in changing from a one-tube set to a two or three-tube set it is not sufficient to merely add his extra tubes. Other changes in circuit adjustments have to be made. It will be the object of this article to point out some of the features involved in parallel operation of tubes. At the same time comparison of the master-oscillator-amplifier system and the self-excited oscillator system will be made.

In working transmitting tubes in parallel there are two alternative methods of operation: (1) operating the tubes in parallel as self-excited oscillators and (2) operating the tubes in parallel as amplifiers, the grids of these amplifiers being excited by voltage derived from a master oscillator. These two methods are illustrated in Figs. 1 and 2 respectively. In the first instance, the tubes feed their output directly to the antenna. In the second case one master oscillator furnishes enough oscillatory energy to feed the grids of the bank of amplifier tubes which feed the amplified output into the antenna. These two methods are different in their operation and the advantage rests almost entirely with the master-oscillator-amplifier system. The reasons for this will become apparent in the course of the discussion.

When power tubes are connected in parallel the total power output is equal to the sum of the individual outputs of the tubes. If the tubes are all alike and have the same power, say W watts, then the total power output of n tubes will be nW watts. That is the power output of a number of tubes in parallel is directly proportional to the number of tubes, assuming like tubes. Since power is proportional to the square of current, the current is proportional to the square root of power. Hence if the current output of one tube is i amperes, the current output of n tubes will be given by $i\sqrt{n}$ amperes. In other words the output current of a number of tubes in parallel is proportional to the square root of the number of tubes. These are the quantitative relations between current and power of one tube and n tubes, assuming the tubes to be alike. By assuming the tubes to be alike we mean that the mechanical construction and the electrical constants, such as internal plate resistance and amplification factor, are alike. When this is not the case the above relationships have to be modified. When the tubes are not alike it will be impossible to secure the maximum power out of all the tubes at the best adjustment.

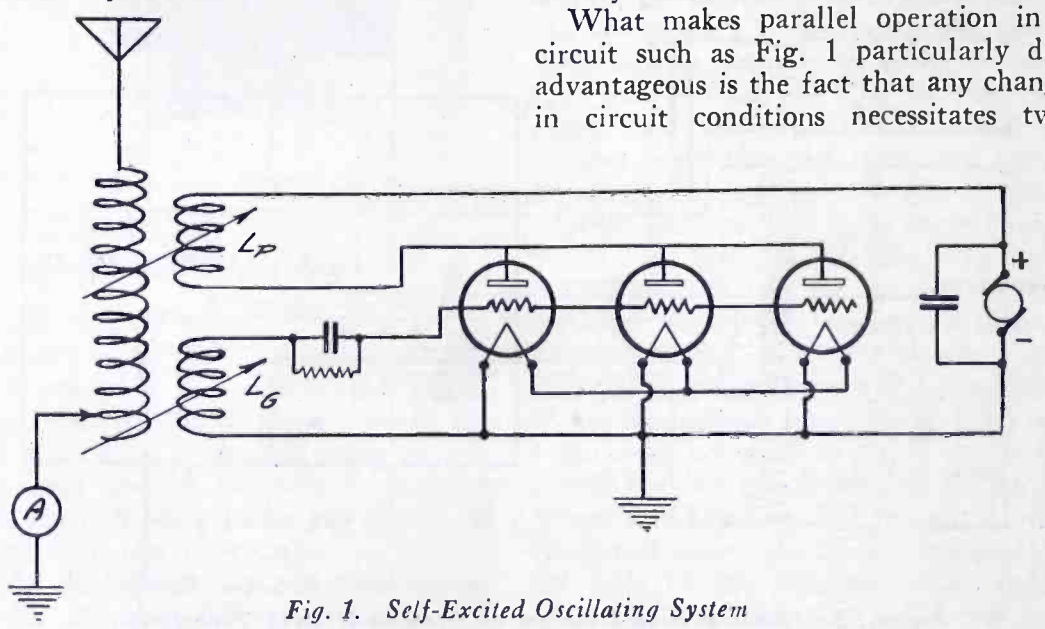


Fig. 1. Self-Excited Oscillating System

The goal aimed in the operation of tubes in parallel (as in any other circuit) is maximum output and efficiency with *stability of operation*. In tube sets the problem of stability is of considerable importance, as frequently small changes in circuit constants will result in cessation or irregularity of oscillations. One of the first requisites for stable operation of parallel tubes is *tube uniformity*. The greater the variation in the internal construction of the tube, the spacing of the elements, the greater will be the instability. The reason for this will be clear from the following. In oscillatory tube circuits the radio frequency potentials applied to grid and plate—in other words the grid and plate inductances—must have values within definite limits for best and stable operation. These values are determined largely by the constants of the tube and the load circuits. The constants of the tube in turn are determined by the internal construction of the tube and spacing of the elements. If now two or more tubes are operated in parallel and these tubes are non-uniform it will be obvious that the values of grid and plate inductances (L_g and L_p) required for best and stable operation may be different for the different tubes. In fact the values of L_p and L_g which are necessary to make one tube oscillate may not make the other tubes oscillate, the result being very unstable operation at low efficiency and output, or no operation at all. With very non-uniform tubes it may be impossible to get the bank of tubes to oscillate at all. Uniformity of tube structure when tubes are used in parallel as in Fig. 1 is strictly essential for stable operation.

What makes parallel operation in a circuit such as Fig. 1 particularly disadvantageous is the fact that any change in circuit conditions necessitates two important and sensitive readjustments. Suppose the circuit has been definitely adjusted for best output. If now there should occur a change, say in antenna capacity, which is not an unlikely occurrence in an airplane, due to swaying of the antenna and lead-in, it would be necessary to readjust both the feedback from antenna to grid and the antenna-plate coupling. If this were not done instability or even cessation of oscillations might ensue. This readjustment would be doubly difficult in the event the tubes were not uniform for the reasons given in the previous paragraph. A further disadvantage in this system of directly exciting the antenna from a bank of self-excited oscillator tubes is that the frequency of the radiated waves is subject to variations. Since in the circuit of Fig. 1 the transmitted frequency is determined entirely by the antenna constants and is not controlled by the tube circuits, any change in antenna constants, such as capacity, will result in a corresponding change in the frequency of oscillations. It is at once evident that this would be a great disadvantage in beat reception of C. W. signals.

In general, tubes as manufactured today are sufficiently uniform to permit of parallel operation. Assuming this uniformity, it will be found that as the number of tubes worked in parallel increases adjustments have to be changed to accommodate this increase. When one tube is connected to a circuit as in Fig. 1, or any other oscillating circuit, there are certain definite adjustments which will give maximum output at any particular wavelength. These adjustments are dependent upon the internal plate resistance of the valve and the load resistance, and are such as to make the plate circuit resistance equal to the antenna resistance when both are transferred into the same circuit. Mathematical analysis shows that for the best adjustment the plate inductance or plate tap is directly proportional to the internal plate resistance of the tube. When two or more like tubes are operated in parallel their internal plate resistances are in parallel, hence the total resistance is $1/n$th the plate resistance of one tube. Hence the plate inductance will have to be reduced proportionately to take into account this reduction of plate resistance. In other words a number of similar tubes in parallel is equivalent to a larger tube having a plate resistance equal to $1/n$th that of one tube, assuming n tubes in parallel. Likewise when tubes are operated in parallel the grid inductance must also be decreased below the value required for one tube.

The reason for this reduction in plate inductance as the number of tubes in parallel increases will be seen from the following considerations. Within limits a certain definite relationship must exist between antenna, grid and plate for best operation. That is the grid and plate radio frequency voltages must have some optimum values within limits. Assume one tube to be working on the circuit and an oscillatory current i amperes flows through the plate and grid coils at the best adjustments. Then the necessary grid voltage for best operation is given at the working frequency by

$$E_g = 2\pi f L_g i$$

Now when two or more tubes are operated in parallel the output current is increased as explained in a previous paragraph. Consequently to secure the requisite plate or grid voltage the inductance has to be decreased to compensate for this increase in current.

The reduction in plate inductance as the number of tubes in parallel increases cannot increase indefinitely. A point is reached where it is impracticable to increase the number of tubes. It is evident that if too many tubes are added a point is reached where the reduction in plate inductance necessitated by the increase in tubes is so great as to make coupling between plate and antenna insufficient for maximum transfer of energy. When this stage is reached it is better to shift over to a larger power tube.

Inasmuch as the value of the plate inductance decreases with the number of tubes in parallel it can be shown that the chances of critical operation increase. For stable operation can only take place within a certain range of plate inductance values, the average value of which is the optimum value. Now the smaller this optimum value is the smaller will be the range of inductance within which stable operation takes place. And since the optimum value of plate inductance decreases with the number of tubes operating in parallel it follows that the chances of critical operation increase with increase in number of tubes used.

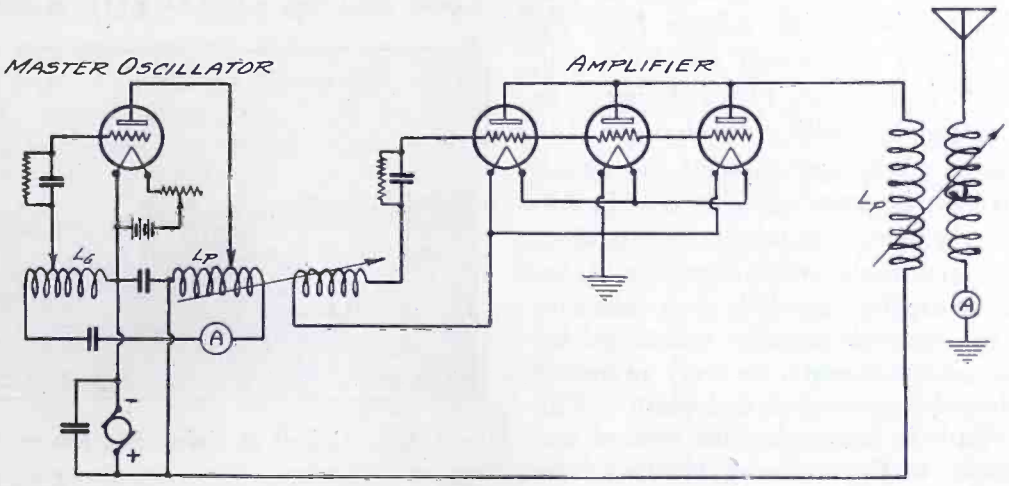


Fig. 2. Master Oscillator Amplifier System

The above considerations apply to the self-excited system of Fig. 1. We now come to the system employing master oscillator and bank of amplifiers in parallel as in Fig. 2. In this system one oscillator tube generates r.f. oscillations in a closed circuit. Radio frequency voltage is obtained from this closed oscillating circuit either by inductive or conductive coupling and impressed on the grids of the amplifier tubes. The amplified output is then fed into the antenna and radiated. The master oscillator has to furnish sufficient power to cover the losses in its own circuit and the losses in the grid circuit of the amplifiers.

The first advantage of this system over the straight self-excited system is that the frequency of the oscillations transmitted by the antenna always remains constant. The frequency of the transmitted oscillations is that of the voltage applied to the grids of the amplifiers. This frequency is the same as that of the master oscillator circuit and is determined by the constants of this circuit which are fixed. This frequency is radiated by the antenna regardless of any changes in antenna constants.

The second advantage of operating the amplifier system is that nonuniformity of tubes is not as great a drawback as in the self-excited system. In the case of the amplifier the grid voltage is secured from a separate independent source and is not controlled by any considerations of the amplifier circuit. Regardless of what the condition of the amplifier circuit may be, there is always available the grid voltage for amplification since this is furnished by an external source. Furthermore, whatever this voltage may happen to be, power will be obtained from the amplifiers since the grid energy is amplified, whereas in the case of the self-excited system if the grid voltage is not within the proper range no oscillations may be produced and hence no output.

A third advantage in the operation of amplifiers is that only one adjustment is necessary whenever any changes occur in the amplifier circuit. Since the grid voltage is secured from the external source no feed-back adjustment is necessary as it is in the self-excited system. The only adjustment that needs to be made is the antenna-plate coupling.

As far as the plate inductance value goes the same considerations apply as in the self-excited system. The plate inductance decreases with increase in the number of tubes. Inasmuch as the plate inductance decreases with the increase in tubes it is essential in operating that leads to and from the plate coil be made shorter than with a single tube, since these leads may constitute a considerable percentage of the total inductance. Furthermore since the power increases with the number of tubes it is also desirable to increase surface area of the coil conductors to take care of the increased current.

One of the chief advantages of the master-oscillator-amplifier system over the self-excited system arises in the case of telephony. In the case of the circuit of Fig. 1, if telephony were desired, modulation could be efficiently accomplished in only one way, namely by the use of the Heising system of plate injection, as in Fig. 3. Now it is a well known fact that in this system it is necessary to use as modulator the same power tube as in the oscillator. Consequently the self-excited system of Fig. 1 would require an equal number of

modulator tubes as oscillator tubes, which is quite an expensive proposition besides being somewhat awkward and unwieldy. In the amplifier system this difficulty is overcome. Since the amplifier simply amplifies the output of a low power oscillator, if we can modulate the output of the master oscillator then this modulated radio frequency can be similarly amplified and radiated. This modulation can be effected by the Heising system by means of one tube as in Fig. 4. In this way a saving in tubes is effected and the set is not so unwieldy and bulky. The fewer tubes there are the less renewals will have to be made.

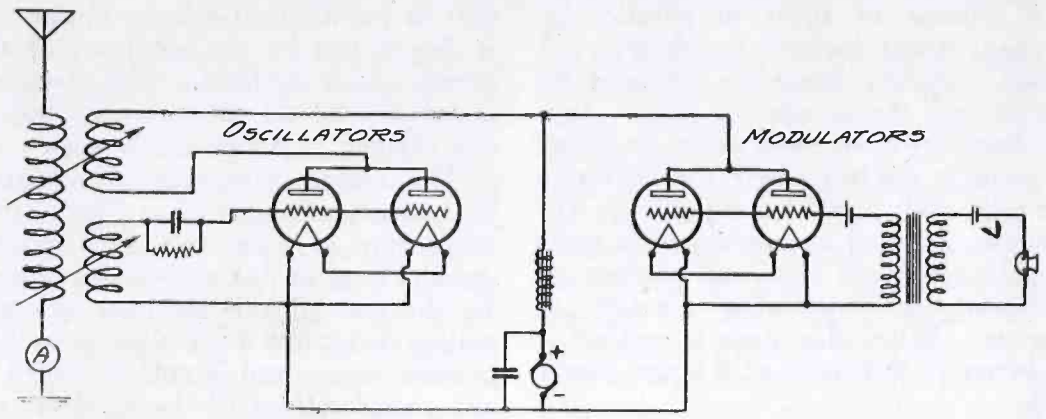


Fig. 3. Modulation System for Self-Excited Parallel Oscillators

The amplifier system is generally found in practice to give higher operating efficiencies than the self-excited system. This is due to the fact that in the amplifier the choice of applied grid voltage is not limited by operating conditions and can be so adjusted as to give maximum output with minimum input. That is the mean grid potential of the amplifier tubes can be chosen for best results, since this grid voltage is obtained from an external oscillator which can be operated to give the desired voltage. This is not altogether possible with the self-excited system since the grid voltage is dependent upon other adjustments such as feed-back and plate antenna coupling, and the average grid voltage obtained is limited by values consistent with securing oscillations. In general for the self-excited system an efficiency of 50% at maximum output is about the best that can be obtained, whereas for the amplifier system this can be made much higher, 75% being values secured. The efficiency referred to here is the conversion efficiency, namely antenna output divided by plate input.

In applying the radio frequency voltage to the amplifier grids it is preferable to obtain this voltage from the plate side of the master oscillator coil, as shown in Fig. 2. This is because the grid is more sensitive to changes than the plate. The operation of the amplifier system is attended with certain difficulties which must be guarded against. Thus frequently the amplifier tubes begin to oscillate on their own initiative due to internal capacity couplings between grid and plate, or stray inductive coupling between grid and plate. This may result in destroying the desired amplification of the applied grid input from the master oscillator. To avoid this it may be necessary to insert small resistances in the grid lead of the amplifier or reduce the voltage applied to the grid. Frequently the antenna ammeter reads a current which is very high and unexpected. This may be due to parasitic capacity currents which do not enhance the radiation at all. No specific measures for detecting this or guarding against them can be given, but care must be taken to see that no unnecessary capacity couplings are present.

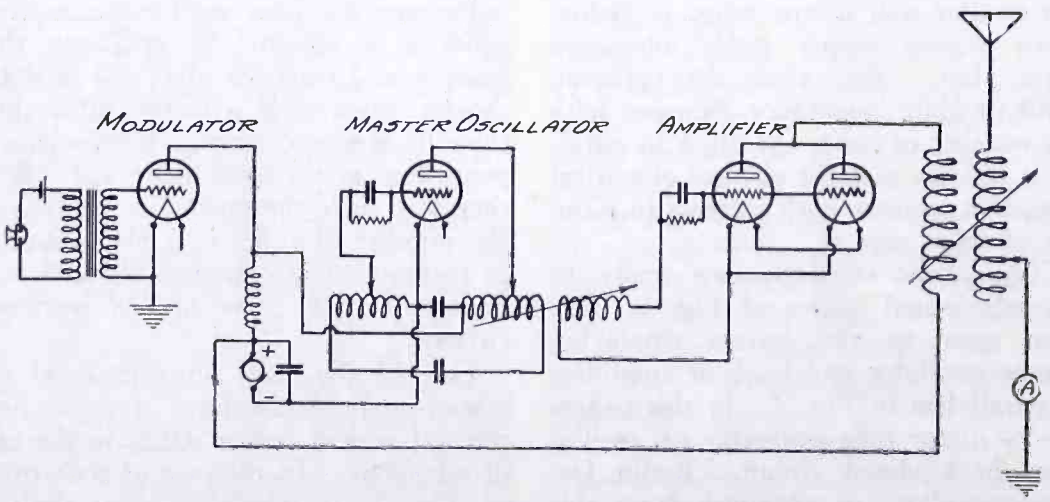


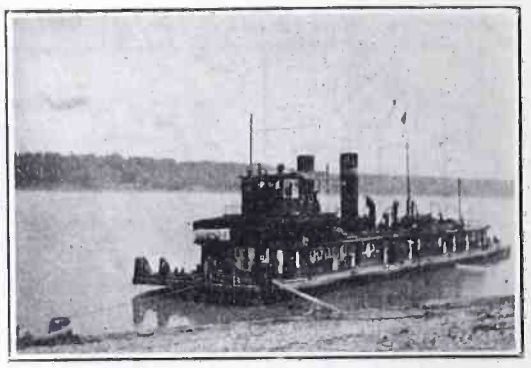
Fig. 4. Modulation System for Master Oscillator Amplifier System

RADIO ON THE MISSISSIPPI RIVER

By H. A. STEINBERG

With the inauguation of the Federal Barge Line on the Mississippi River, came the realization that radio on this river is essential. Few people outside the radius of the Mississippi know that the Government is operating a line of boats to re-establish navigation on this river as well as relieve the railroad congestion. The line is operated by wireless. All boats of the Mississippi river section of the Federal Barge Line, also known as the Mississippi-Warrior Service, are equipped with 2 k.w. Marconi commercial type P8B transmitters, good Navy tuners and 2-stage amplifiers. With this apparatus we are able to work Memphis, which is headquarters, from any part of the river from New Orleans to St. Louis, the northern and southern terminals.

Static during the summer is fierce. There are times when WYDB at Memphis with her 5 k.w. set cannot be heard fifty miles, on account of the heavy atmospheric conditions. Then there are times when one could not wish for better working conditions, because we are off the commercial wavelength and have little interference, and Oh Boy! what a relief it is for a sea-going op. to get off 600 meters where everybody, friend or enemy, is trying to jam you!



Str. "Cairo" at Cairo, Ill., Levee

We have a remedy for this static nuisance. In making a report each letter is sent six, seven or even ten times before starting on the next letter, so if you miss one or two letters you can't help making sense out of a message. It takes a little more time, but it is the slow but sure way.

The ops. at WYDB are all experts, both in operating and in handling the apparatus, and for accomodation, can't be beat. The station is kept in pink of condition at all times, with a nice musical note. If you care to calibrate your set to 1200 meters, or if you want to test your set and want a reliable station just tune in WYDB, every three hours from 6 a.m. to 9 p.m.

We work a three-hour schedule, giving all movements of boats during the three hours. These reports are all

Continued on page 80

The Cause and Cure of Receiver Noises

By G. M. Best

Radio is like an oyster, not only in being best in the "R" months, but also in that a noisy noise annoys the listener. How these mysterious annoyances may be ferreted out and eliminated is herein well told by the author, who writes from the fulness of his own success in so doing.

INTERFERENCE, in radio parlance, may be either that which has its source in radio transmitters or that which emanates from causes entirely remote to radio itself. It is of the latter that little is known by the average radio fan, and I will briefly discuss some of the causes of the buzzing, grating, clicking and other sound heard so often in receiving equipment.

In practically every community there exists a complicated network of power lines, the voltages of which range anywhere from 11,000 volts to the ordinary 110 volts for house-to-house consumption. These lines are the cause of more extraneous disturbances in the ether than any other source and the worst of it is that without the assistance of the power companies themselves it is practically impossible to remedy the trouble. Most of you have heard at one time or another a loud buzzing or hissing sound, rough in the extreme, that seems to come in equally well on whatever wave you are tuning to, and which cannot be eliminated except by disconnecting the antenna and ground leads. This noise is caused by faulty insulators in the higher voltage power lines, and the only way to cure the trouble is by either replacing the insulator, in case it is actually defective, or by the arrival of a good hard rain, which washes off the accumulated dirt and other material which often acts as a conductor to the high voltage. Do not confuse this noise with the ordinary a.c. hum, which is caused by the low voltage wires in your own home, and which is usually increased rather than lessened, when the antenna is disconnected from the set.

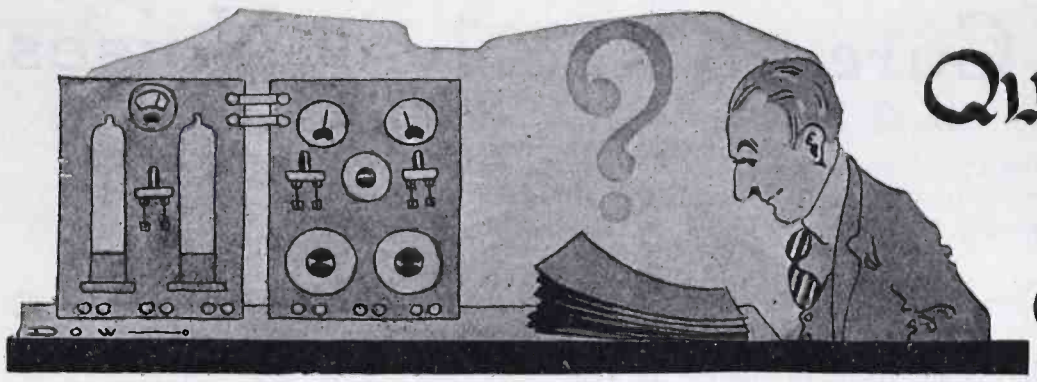
Another source of noise coming from without is the street lighting system employing a series d.c. arc. Occasionally one of these lights becomes defective, and arcing occurs between parts of the automatic carbon feeding mechanism, with the result that high frequency oscillations over a broad band of wavelengths are generated and a sharp hissing sound in the receiving set is the result. I recently read of a case where interference of this kind was so bad at one station that the man, in desperation, installed his set on a motor truck and, starting out, took bearings with a loop in all directions from his home, and finally located the defective lamp a few blocks away. A short conversation with the lighting company resulted in complete elimination of his troubles from this source.

Many of you have heard numerous loud and sharp clicks in your phones, and have laid them to static. If you live in a densely populated region, such as in an apartment house district, or in the business section of a city, the chances are that nine clicks out of ten were caused by your neighbors, who produced the noises when switching their electric lights on or off. The sudden make or break of a lighting circuit sets up a spark at the switch contacts, and this spark will transmit a surprising distance. I recall a recent experience in a town in Northern California, where I was asked by a friend to examine his receiver and determine if possible how the tremendous static which he was experiencing could be eliminated. As he described it, the noises were in all the time, and so loud that it was practically impossible to hear the distant broadcasting stations, even at night. Upon listening-in on the set, in the forenoon of a clear, cloudless day, I was at first quite surprised, for the static, or whatever it might be, was very loud, and no signals could be heard through it. It was also accompanied by a loud buzzing, so that my friend was more or less disgusted, and figured that his town must be a poor radio location. I had him place the equipment in his car, and we motored to a place a few miles outside of the city, on a high hill, far from power lines, or other noise producers. A small antenna was tied to a convenient tree, and a wire laid on the ground acted as a counterpoise. Upon listening-in, the ether was as quiet as could be desired, and signals were heard on several wavelengths. Having established the fact that the set was working properly, and that the noises were not static, we returned to town, and set up again in the old location. This time I examined the antenna and its surroundings, and discovered that it was parallel to and about 25 ft. from a large group of telegraph wires. With this in mind, I returned to the receiver, and was able to identify some of the clicks as part of a Morse telegraph message. More of the clicks were located in a group of railroad crossing signals, nearby, so that every time a train went by the noise in the receiver would double in volume. To eliminate this trouble, a counterpoise of bare wires was laid on the floor of the hall where the set was installed, thus avoiding a common ground connection with the telegraph wires and crossing signals. Often the use of a ground connection to a water pipe common to neighboring power apparatus will introduce serious difficulties in the way of noise, in a sensitive receiving set.

Another source of trouble, which is very intermittent, however, is the charging of the lightning arresters at large power sub-stations. This will produce a harsh, grating sound that lasts for a few seconds, and usually occurs twice a day. It is caused by a large, high voltage arc at the switch contacts, when the sub-station attendant breaks the charging circuit to the arresters. This trouble is not serious, as a rule, but is mentioned to aid in identifying the various noises you may hear.

The last, but the most troublesome noise is a.c. hum, as it is often called, distinguished from the other noises by its steadiness and musical tone. Unless your set is directly underneath a high voltage line, the noise is coming from your house wiring, and the easiest way to rid yourself of the trouble is to thoroughly shield the cabinet of your set, and ground this shield to the negative of your "B" battery, which in turn is connected to a good ground connection. Thin sheet copper makes a good shield, as tin foil is too easily damaged. If you have transmitting as well as receiving apparatus, this shield is almost essential, as the presence of power transformers and wiring in the vicinity of the vacuum tube apparatus will surely introduce noise into the receiving system if care is not taken to shield the latter.

If you have a great amount of trouble of this nature, particularly from nearby power apparatus, such as motors, elevator machinery, and the like, the installation of a small counterpoise, as near under the antenna as possible, will without doubt be a great aid in eliminating the disturbances. Many regard the counterpoise as useful only in transmitting, but on the contrary, a counterpoise is as good, if not better, than the ordinary water pipe ground, both for general reception and noise elimination. A good receiving counterpoise can be made of eight wires insulated if desired, about 40 ft. long, with about 2 ft. separation, and 6 to 10 ft. above the ground. The wires may be insulated from the ground by porcelain cleats or antenna insulators. If it is impossible to erect the counterpoise outside of the house, a network of wires in the cellar, provided that they are not too close to the house lighting system, will answer the purpose.



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

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

How do honeycomb coils compare with spider web coils, as to selectivity? Please furnish a list of coils necessary to cover wavelength range of 150 to 1500 meters, giving sizes of primary, secondary and tickler, to be used with .001 condensers. What size of wire should be used? O. A. D., Vallejo, Calif.

On the short waves, the spider web coils will have the advantage, but on the longer waves, I doubt if you could tell the difference between the former and the honeycomb type. No. 24 wire should be large enough in winding the coils. The list is given herewith:

Wavelength Range-Meters	Primary Turns	Secondardy Turns	Tickler Turns
150-360	25	30	35
300-800	50	60	75
600-1500	100	125	125

What dimensions should the chokes in the filter circuit of a 200 watt tube set be? J. H., Phoenix, Ariz.

For filtering out the commutator hum of a d. c. generator, a filter composed of 2 henry chokes, and two 2 m. f. condensers, as shown in Fig. 1, will probably answer your purpose. If you are using rectified a. c., a filter composed of a 3 henry choke, and 10 m. f. on each side, as shown in Fig. 1, will be the best combination.

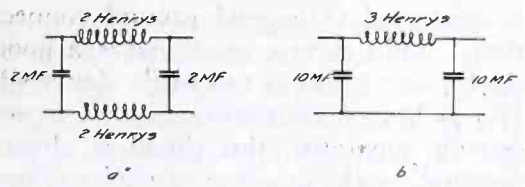


Fig. 1

Is a 1 m. f. condenser too large to be used as a blocking condensed in a C. W. circuit using a. c. for the plate voltage? L. F.

Yes, the reactance of a 1 m. f. condenser to the 60 cycle source of supply is so low that the condenser would present practically a short circuit to your power transformer. A condenser of .01 m. f. or less, usually from .002 to .005 m. f., is necessary, in order that the reactance shall be several thousand ohms to the power transformer, but practically negligible to the radio frequency circuit.

Is it possible to take the secondaries of Ford spark coils and by rebuilding the core and winding a primary, to use same for the high voltage supply of a C. W. set? J. H., Raton, N. Mex.

I very much doubt if you could get a satisfactory transformer from such a combination. I do not believe that the secondary of a Ford coil is wound with wire large enough to carry the current that a 10 watt C. W. set would draw from the transformer. It would be far more satisfactory for you to build a transformer especially designed for the proper voltages.

(a) Can a chopper be used in a 100 watt self-rectifying C. W. set such as is used by Mr. Dow? (b) Can the output of a transmitter using d. c. on the plates be modulated by a magnetic modulator placed in the ground circuit? How does this method compare with plate modulation? (c) What is a good filter system to use with an electrolytic rectifier? (d) Which is best to tune the secondary of a variocoupler for 200 meter work only, a condenser, or a variometer? R. K., Palo Alto, Calif.

(a) No, as the output is already modulated at a frequency of 120 cycles. (b) Yes. Antenna modulation is not as satisfactory as plate modulation. (c) See Fig. 1, diagram "b." (d) With a condenser.

Please publish a circuit using 3 steps of radio frequency amplification, using Erla Type AB 1-2-3 transformers, with some simple switching arrangement that will enable me to cut out one or all of the amplifiers. J. L. B., Oakland, Calif.

The circuit you wish is shown in Fig. 2.

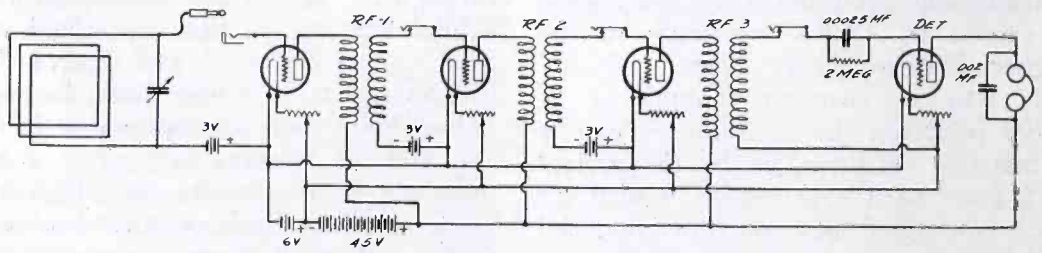


Fig. 2

I have a detector and two-stage amplifier which works very well on nearby stations, but I cannot hear distant ones on detector alone. Can you tell me what the trouble is? J. W., Berkeley, Calif.

The chances are that you have not yet learned how to tune for stations whose signals are very weak. It would be very difficult to diagnose your trouble without knowing exactly what you have in the way of apparatus.

Am building a one-stage radio frequency amplifier, and am not sure how to pole the batteries. What make of radio frequency transformer is the best to use in this circuit? J. H. C., Esparto, Calif.

If you will study Fig. 2, you will see how to arrange the polarity of the A, B and C batteries in the correct manner. I am sorry, but I cannot recommend specific pieces of radio apparatus in this column.

How can I connect a variable condenser, loose coupler, and a variometer with a Remler control panel, type 330. Please tell me if the strain of an antenna would pull down a cement chimney. F. H., Aberdeen, Wash.

The apparatus you list is shown in Fig. 3. Not knowing how strong your chimney is, or how large the antenna, I can only surmise that if you attach the antenna to the base of the chimney, you will probably not have any trouble. If the antenna is only a single wire affair, the strain will not be enough to disturb the ordinary type of concrete chimney.

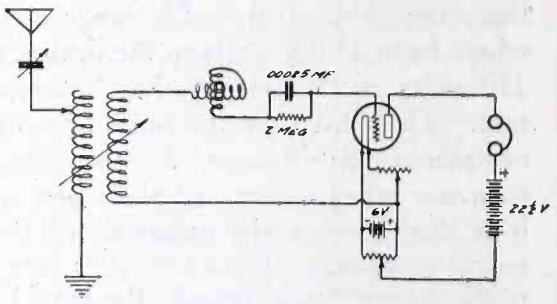


Fig. 3

In September RADIO, on page 27, an amplifier was shown in which a. c. was used for lighting the filaments and supplying the plate voltage. Was the standard 4 prong tube used in this circuit? H. L. M., Orange Cove, Calif.

Yes, standard amplifier tubes were used, with the bayonet lock and four prong terminals.

How long should a Radiotron amplifier tube, with six volts on the filament and 45 volts on the plate, give service? H. R. A., Charleston, S. C.

About 1000 hours of intermittent service, provided that the filament is not subjected to voltages greater than six.

What is the difference between "Radio" and "Wireless"? Please publish a circuit using 1 variocoupler, 2 variometers, detector and 1 stage of amplification. On cloudy nights, my antenna series condenser often has small blue sparks jumping between the plates. Is it dangerous, and what causes it? T. A. G., Pendleton, Ore.

Webster says: "Wireless is any form of telegraphic or telephonic communication effected by means of electricity without the use of wire conductors." "Radio" is a popular term which means exactly the same thing. The circuit you wish is shown in Fig. 4. The sparking between your condenser plates is caused by atmospheric discharges from your antenna circuit to the ground. You should have a lightning arrester in the antenna circuit if the discharges are at all serious, and in any case to protect

your set from damage in case of nearby electrical storms.

What size honeycomb coils should be used for wavelengths of 2500 and 20,000 meters? Please give the specifications for a variocoupler that will receive 2500 meters.

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

For 2500 meters, the primary coil should be 150 turns, the secondary 250, and the tickler 250 turns. For 20,000 meters, primary is 1250, secondary 1500 and tickler 1500 turns. The primary or stator winding of a variocoupler to receive at 2500 meters should have 200 turns wound in bank form, with at least ten taps. The rotor need not be changed provided that you have a secondary loading inductance of at least 200 turns, to load the secondary to 2500 meters.

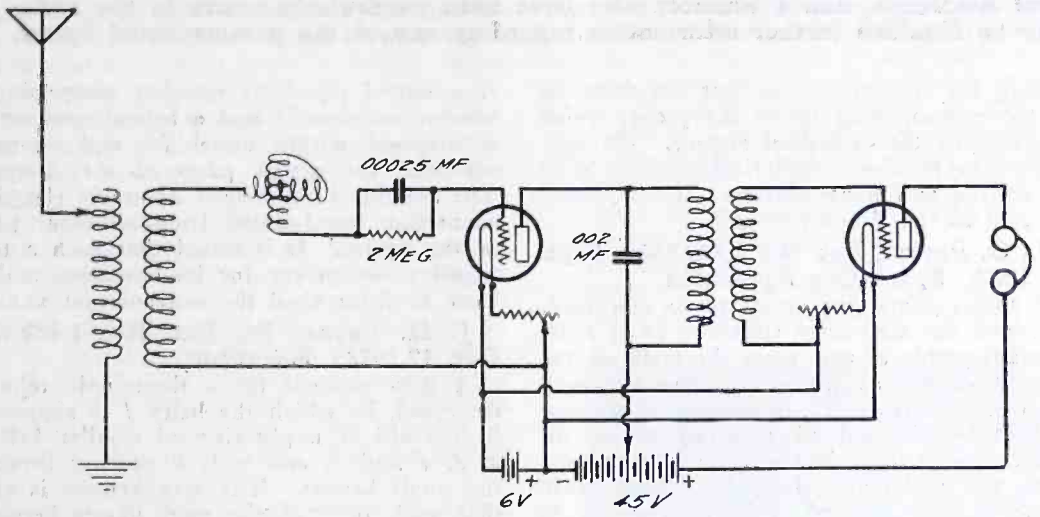


Fig. 4

Can No. 36 wire be used in winding honeycomb coils?

H. J., San Mateo, Calif.

No, for the resistance is very much too large for radio frequency work. No. 26, 28 and 30 wire is used for the small, medium and large sized coils, respectively, in standard honeycomb coils.

A friend of mine in New Zealand would like a diagram of a good one-tube transmitter, for phone and key.

A. H. W., Norwood, Ohio.

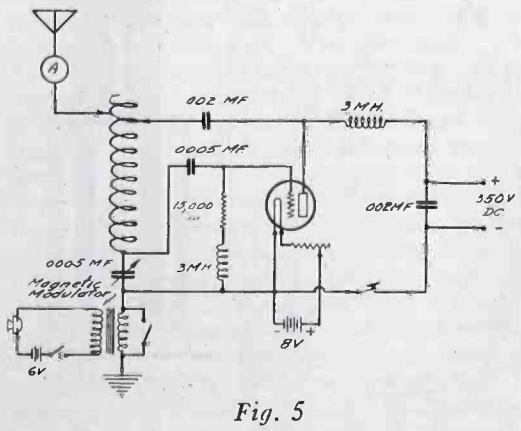


Fig. 5

The circuit is shown in Fig. 5. In order to get any kind of modulation, it would be best to use a magnetic modulator in the antenna circuit.

The signal officer at the Presidio, San Francisco, Calif., has on hand about 300 copies of each of the Signal Corps pamphlets, "Elementary Principles of Radio Telegraphy and Telephony," and "Two Way T. P. S. Set," and "Ground Telegraphy or T. P. S." These pamphlets are very well prepared and would be useful to the amateur fraternity. They are available for distribution to any amateurs who write, giving their names, addresses and ages.

NOVEMBER DX AT 6XAD

By MAJOR LAWRENCE MOTT

Signal-ORC-U.S.A.

Again with no intent toward boastfulness —but merely with the hope of encouraging C W effort—by the proving of that which may be accomplished with it, I give herewith my DX records for November, 1922:

A. Harvey McNaughton, operator on *West Nosska*: 1350 miles, 1150 miles and 950 miles E.-N.-E. of New York, on one tube.

C. W. Bailey (NOC) operator on the U.S.S. *Orion*—175 miles off the coast of New Jersey.

H. C. Hansen, of Ramsey, N. J., on ship 20 miles east of Savannah and in dock at Savannah, Ga.

W. E. Gray, S.S. *Trinidadian,* while lying in Savannah harbor.

Now for the Districts' reports:

(But ere I give the list permit me to apologize for the not giving the "stations' worked" in detail. I am crowded with postcards, letters, wires, and I would thank all my correspondents for their courtesy in writing to me. The fact of the matter is that in the operation of 6XAD I have *"bitten off more than I can chew"!!* Approximately I have been in effectual communication with 20% of the stations from which I have had cards, etc. To each operator I have OK'd his *work* with 6XAD, by card, and hence I sincerely hope that "all hands" are . . . . . happy!)

May I interpolate, just here, that I know that there are a very great many Eastern Stations calling 6XAD — nightly — but that they cause so much QRM among themselves that I am practically . . . . . helpless! A few nights ago I heard several "2's"—many "3's"—some "4's" and many in the other Districts, but so great was the ensuing "jam" of the air that I managed to log but a very *few!*

1BEC on indoor arial, 1BES, 1TS, 1AUN, 1BWW, 1BFT, 1BKQ, 1AW, 1BWJ, 1CMK, 1MO, F. G. Sands, Danbury, Conn.; Harry Frecker, Passaic, N. J.

2AVE, 2LJ, 2AGC, 2AEH, 2ANM, 2BRB, 2BZJ, 2CJA, 2CHC, 2CKR, Harold Johnson, Hartford, Conn., 2BZJ, 2WH, 2BFX, 2AFP, 2BFX, 2BNZ, 2BMS, 2CAD, (2EL), 2RY, 2BCK, 2CAC, 2BII, 2CQJ, 2AFG, 2WB, 2CAB, 2CNH.

3SA, 3GN, 3DS, 3PZ, 3CO, 3BV, 3OR, 3HG, 3JE, 3AJG, Camp Alfred Vail, N. J. (Sig. Corps Officers), 3AFB, 3BNU, (3BLF), 3APV, 3YO, 3BEF, 3BTL, 3ADP, 3CAN, 3SM, 3LR, (3BFM), (3BHM), 3ACC, 3JE, (Can.) Hosp., Washington, D. C., Verne Joiner, Toronto, Canada, 3XM, 3BD, 3OK, 3BVA, 3BV (Can.).

4HZ—So. Jacksonville, Fla., 4GG, 4DY, 4LT, 4MY, 4NT.

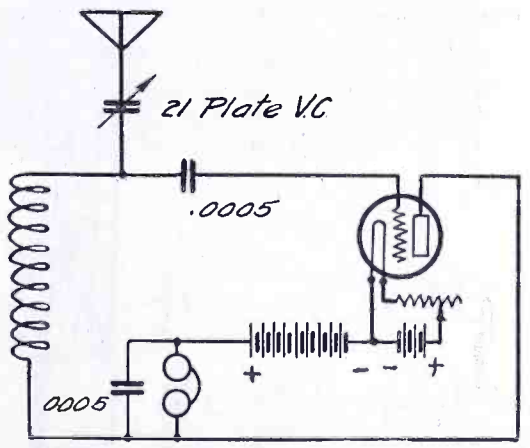
5QS, (5IK), (5DA), (5XAD), (5EK), 5RR, 5SF, 5DI, 5TC, 5SK, 5QY, 5AAH.

6BNW, 6AAW, 6ZAC—Honolulu, 6BMY and Homer Jaggers, Kahuku, Oahu, T. H.

7TH, 7QN, 7EH, 7CZ, and many others.

(8BXX), 8ALC, 8ALO, 8AIG, 8BXH, 8BIP, 8KG, 8QX, (8BEO), 8AA, 8LM, 8QC, 8TG, 8DAE, 8ON, (8AWP), 8BO, 8ZO, 8UQ, 8VH, 8GP, 8ZAF, (8AQO), (8AXC), (8CQX), (8CKO), (8AOL), (8ASV), City Public Schools Ops.—Menominee, Mich., 8ADH, 8BWB, (8NB), 8ZAG, 8CTP, 8BVP, 8ADN, 8BUC, 8AVD, 8CEM, (8ADT), 8AIH, 8AXB, 8AAW, (8YD), 8CK, (8BKE), (8BUM), (8CAZ), (8CGX), (8BXH), (8LT), (8ALT), (8AM), (8BVR), (8AZF), (8CKM), (8BDV), (8ALT), (8VY), (8BSS), (8AME), (8XE), (8BF), (8CKO), 8PJ , 8BGL, 8CYU, 8BKM, 8BWA, 8CTN, 8AMD, 8CIX, 8CZI, 8CEI, 8CPD, 8ADN, (8ZY), (8BSS), 8CAY, 8CHP, 8AXN, 8CXF, 8FQ, 8CF, (8BVR), 8VC, 8AIW, (8AXI), 8AEO, 8AAW, 8AL, 8YN, 8CWR, 8AER, 8VW, 8KW, (8ASL), 8CSE, 8BUU, 8ABE, 8VO, (8CKM), 8CEF, 8BHF, 8BZY, 8CYT, 8ZB, (8FT), 8BDV, 8CYT, 8ACF, (8CKO), 8CQL.

9AZP, 9BXT, (9BED), 9AOE, 9DKB, 9BKJ, (9YAJ), (9DR), (9ZN), 9AAP, 9DSD, 9AL (Can.), 9AW (Can.), Sam Taggart, Worcester, O., 9XAC, 9CLZ, 9DNC, 9DWK, 9DVW, 9DVL, 9GK, 9CNS, 9AON, 9II, 9CIP, (9AWM), 9ALF, (9DFB), (9ECR), (9ARZ), (9CTR), (9BFG), (9BIE), (9BDS), 9ADL, 9BCF, 9BIJ, (9DFB), 9DVW, (9EI), 9DVL, 9CXP, 9CJC, 9CAH, 9CDV, 9AQM, 9AWS, (9BYA), 9AUL, 9CTF, 9BJT, (9DKY), 9AZP, 9BZO, 9DMA, 9BJT, (9CTR), 9BWQ, 9ACW, 9BXD, 9CVL, 9AUA, (9EI), 9YAJ, 9BDS, (9GK), 9EX, (9CNS), 9BFG, 9SJ, (9DR), 9BP, (9BZI), 9CYB, (9BIK), 9HO, 9DZI, 9DKB, (9DFB), (9BZI), 9PN, 9DCN, 9CSA, (9APS), 9BIF, (9AVZ), (9BRK).



A New No-Ground Circuit from Kenneth Adams, 2060 E. Main St., Stockton, Calif.

MORE RECORDS BROKEN BY 6ZAC, 9AWM, 1AW

Under date of November 22, 1922, C. J. Dow, 6ZAC, advises A. H. Babcock; "I wish you could have heard us last night. We broke all records plumb to smash. 1AW sent me a message through 9AWM, and had his answer via 9AWM in 14 minutes, 8 seconds. The only way we could have outdone that would have been to work directly across to 1AW. I won't give up trying for that either. 9AWM gets me on his detector like local stuff, and we are excellent QSO regularly. He says they ought to hear me way past him. 50 watts!" 6ZAC is at Wailuku, Hawaii. 9AWM is L. V. Berkner, 117 E. Summit St., Sleepy Eye, Minn. 1AW is H. P. Maxim, 276 No. Whitney St., Hartford, Conn., president of the A. R. R. L.

DIGEST OF RECENT RADIO PATENTS

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

B. Bradbury, Pat. No. 1,430,883: Oct. 3, 1922. Signal Receiving System.

A receiving system is described, in which the radio frequency signals are joined with oscillations from an audio frequency source *8*. This source is constantly operated, but due to the particular arrangement of the circuits associated with tube *1* and detector *11*, it is powerless to affect the phones *15* unless the radio frequency signals are received. To obtain this effect, the tube *1* uses an anode *4* in addition to anode *3*, which anode *4* is included in the output circuit, and the potentials of both anodes are so chosen that there is a negative resistance to anode *4*. The resistance *14* is however made large enough to prevent self-sustaining oscillations. Finally the coupling between coils *9* and *12* is so loose that no audio frequency current can pass. When, however, radio frequency signals are received, the modulated amplified waves are impressed on coil *9* and induce corresponding waves in coil *12*.

H. H. Beverage, Pat. No. 1,434,985: Nov. 7, 1922. Radio Receiving System.

Substantially the same system is utilized in this scheme as described in connection with the prior Beverage patent No. 1,434,984. However, by the aid of proper additional apparatus, it is possible to cause the antenna *1, 2* to respond only to one of any of several wavelengths. This is accomplished by adjusting the resistance *5* so that the damping in the antenna may be of the proper value to eliminate the undesired signals. To neutralize the residual interfering currents, coils *21* and *22* and phase shifters *23, 24,* may be used in the detector circuits.

L. O. Parker, Pat. No. 1,428,856: Sept. 12, 1922. Spark Gap Apparatus.

A rotary spark gap apparatus is described, in which the stationary electrode *26* is radially adjustable to and form the teeth on the disc *22*, as well as in a circle concentric with the disc. This latter adjustment is accomplished by the aid of a small pinion *39* meshing with teeth in the plate *30* that supports the stationary electrode. The screw propeller *20* is utilized in the present case to rotate the disc *22*, and such an installation is especially useful for airplanes.

H. P. Donle, Pat. No. 1,435,455: Nov. 14, 1922. Electric Current Controlling Device.

A thermionic device of radically different construction and operation from the conventional audion is described. A central heated filament is used, having two axially displaced active portions, one of which is indicated at *13*. Around the upper portion is disposed a control electrode *20*, and around the lower portion is disposed a cylindrical anode *19*. Both the anode *19* and control electrode *20* are disposed around the evacuated vessel *10*. A so-called equalizer member comprising a tubular annulus *21* and a helical member *22* is disposed within vessel *10*, and its parts surround the active parts of the filament. The annulus *21* and helix *22* are in electrical connection but isolated from all other parts of the device. It is stated that such a tube requires less power for its operation and is more sensitive than the conventional audion.

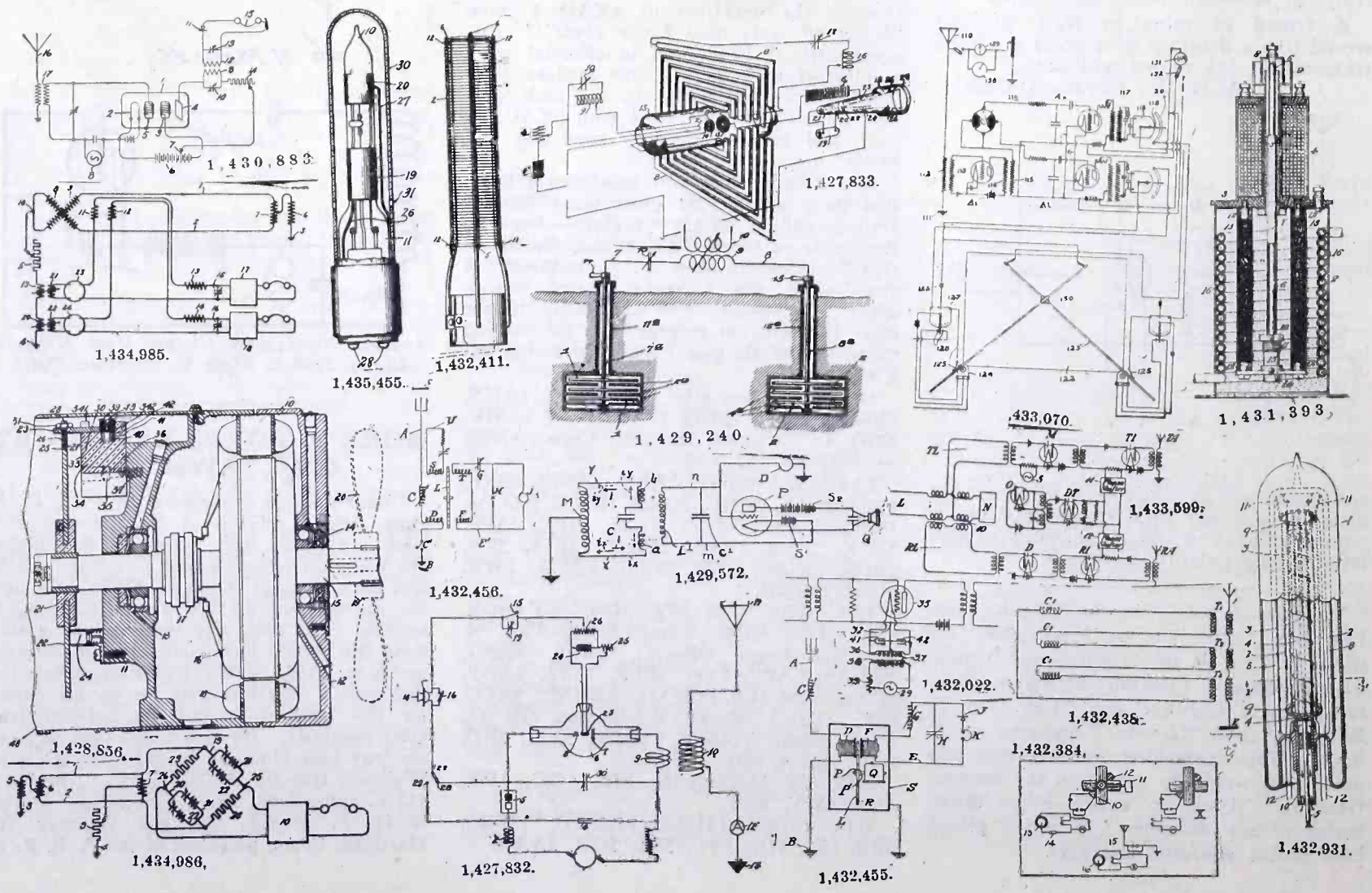
J. H. Payne, Jr., Pat. No. 1,432,411: Oct. 17,1922. Electrode.

A grid element for a thermionic tube is described, in which the helix *1* is supported by the aid of a plurality of smaller helixes *2, 3, 4* and *5*, and rods *6* passing through the small helixes. The arrangement is such that each turn of the grid passes between two turns of the helixes *2, 3, 4, 5* and is locked in position by rods *6*. In this way, there is no necessity for soldering or welding the turns in place.

A. N. Goldsmith, Pat. No. 1,432,456: Oct. 17, 1922. Method and Apparatus for Transmitting Sustained Wave Signals.

In order to modulate the transmitted radiations of a sustained character, there is interposed a toothed conducting disc *L* between the coupled coils *D* and *F* respectively in the antenna circuit and the local generator circuit. The disc *L* is rotated at such a rate

Continued on page 95



NEWS OF THE BROADCASTERS

NEW KFI ON CLASS B RATING

Replacing four former Los Angeles broadcasting stations with one giant radio central station, Radio KFI, owned and operated by Earle C. Anthony, Inc., on Thanksgiving Day went on the air with its new 500-watt Western Electric set. The new station is in many ways the most elaborately equipped in the Southwest, and the co-operative arrangements that have been made to furnish talent for it insure programs of wide interest.

Wide range is expected from the new station because of its especially favorable location and equipment. Located on the Los Angeles Packard building at Tenth and Hope streets, the station is removed from the central business section by several blocks. The building itself is four stories in height, of reinforced concrete. The towers of structural steel which carry the antennae are 96 feet in height above the roof of the building, and 30-foot wooden pole extensions above the steel towers will raise the aerials thirty feet higher than any building in Los Angeles, as the city has a 150 height limit on all its business structures.

On the roof, too, is the sound-proof studio, tastefully decorated, and a handsome reception room. Every precaution has been taken to secure absolute quiet in the studio, including a set of electric signals between the various rooms to eliminate the necessity for conversation.

The Los Angeles Examiner, while they retain their present station KWH, have installed a Western Electric input amplifier by which they send their programs from their own studio rooms at the Examiner office to be broadcasted by KFI. A portable input amplifier has been secured that is available for the use of KFI upon any occasion. Through an arrangement completed with the telephone company private lines will be run to KFI so that news from sporting events, special lectures or notable speeches, concerts, etc., can be broadcasted.

In addition to this, the Western Radio Company of South Hope street have closed their present broadcasting station, and are furnishing their regular programs over KFI. The Leo J. Meyberg Company of 950 South Flower street have also closed their broadcasting studio on the Hamburger building and will furnish their talent to the KFI programs.

The station has been established by Earle C. Anthony through his conviction that the proper sort of radio broadcasting is a sort of public service. "During the past few months, when we were operating KFI with 100-watt equipment, we received thousands of letters of appreciation, suggestion and comment, coming from more than half the states of the Union," Anthony declared in a recent interview. "We believe that as a California organization that has prospered through the patronage of California people through many years it is no more than right that we should render this service to the people of the state in general. Then, too, from the standpoint of advertising the state of California, we believe it important that the voice of a great Los Angeles central station should be heard by the thousands of radio fans who nightly listen all over the United States. Owing to the difference in time, the air is clear of local interference in the East and Middle West before we are off the air for the evening. As a consequence, KFI is heard very widely throughout the United States, and we believe this factor makes good California broadcasting of especial value to the entire radio industry."

CLASS B MUNICIPAL STATION FOR SAN DIEGO

The City of San Diego has applied for Class B Broadcast License and will install a 500-watt Western Electric Radiophone set, at the great Spreckels Organ pavilion, Balboa Park. The committee appointed by Mayor John L. Bacon is doing everything possible to rush the installation of this new station. Dr. Humphrey J. Stewart, internationally known organist, and official organist at the Spreckels outdoor organ, is most enthusiastic as to the possibilities of organ recital broadcasting and the use of the great outdoor organ at San Diego for equipment purposes in conjunction with selections by vocal and instrumental artists.

Arrangements are to be made for an afternoon and evening program which will in no way conflict with other broadcasting stations in the interference zone. The antenna in the case of this municipality-owned broadcasting station will be of large dimensions since it will be unobstructed by buildings, a section of Balboa Park free from streets and structures having set aside for this installation.

Finance is provided for complete installation of antenna, radiophone apparatus, and salaries for monitors, for a period of twelve months. All details of construction and installation will be under the direct supervision of a Western Electric Company radio engineer.

With the installation of the municipal station it is stated that several local San Diego broadcasting stations may discontinue operation, pooling their programs in favor of the City plant. San Diego should be congratulated on this addition to the famous outdoor organ which will permit of a nation-wide audience instead of one confined in the limitations of the Pacific. Dr. Humphrey J. Stewart is well known in San Francisco, where he is still the organist for the Olympic Club.

RADIO FAIRY TALES

"All right children—the story for today will be about little Mary and her bo-peep. Little Mary had a long curly face. It was the only face little Mary had and she was very proud of it.

"Oh," said Mary, "if I only had a face like a walnut. Then I could fly away and be a birdie or a lamb or something."

Just as Mary spoke, a fairy tapped her on the armstice.

"I heard you thinking," said the fairy. "Whatever you want you shall have." (Fairies always pull that stuff.)

Little Mary jumped up and down clapping her hands.

"Oh," she said, "I know who you are. You are James Whitcomb Riley."

The pretty fairy hung her head. She knew it was no use and never had been.

The next month, Mary and the Crocodile were playing tag in a bread pudding. Mary liked the raisins and the Crocodile was sad because his grandfather had been made into a purse.

"Never mind," said Mary, "I'll find you a nice flower to wear in your buttonhole and that will please Mr. Owl."

So she did. And he was.

But the Butterfly was too ill to care, and so Mary had to wait until the fairy came again and batted the butterfly on the head and turned it into a Prince in skin-tight pants with a flossy feather in his kelly.

And so, children, little Mary got her wish.

Tomorrow night, you shall hear all about Grandpa Peanut and his goober children, and learn to work a shell game.

Good night children. This is KKKK owned and operated by the Bedtime Story Telling Radio company, with branches in every large city, and 500-watts available day and night for the kiddies of America. Sleep tight and let us know by mail or telephone how our modulations sound at a distance of 1,000 miles or more. Good night kiddies! KKKK signing off!

Yes, this is KHJ, ... in operation. Input panel, transmitter panel and power panel, reading from left to right. KHJ, 500 watts, has done a great deal for Radio in the Southwest since November 1st. Can you see the milliammeter readings? Somewhat indistinct. However, the antenna ammeter reads eight and five-tenths amps. "Uncle John," the bedtime story telling genius, and "Cousin Bill," the humorous news reader, are on the job in the studio, a beautifully furnished room with proper broadcast accoustice. This is just the instrument room. The back in the foreground belongs to G. C. Farmer.

LETTERS TO THE EDITOR

The Gibbon's Receiver

Sir: Many people have written me whether or not the 400 turn coil of the Gibbon's receiver (described in my letter published in October RADIO) was a honeycomb. For the benefit of others who may be in doubt, I will say that it *is*.

Judging by letters received, there seems to be some difficulty in making this circuit work properly. You have to make your set oscillate first. Do this by adding or subtracting plate voltage—28 volts are necessary on my set, where in my variometer outfit 16 volts are best.

I find that a grid leak will greatly improve reception. This is of medium value. One can be made by mounting two binding posts on a board about ⅛ in. apart and drawing a heavy line between them, with India ink. Connect the leak *across* the grid condenser. This will allow some of the plate current flow onto the grid.

The best value can only be found by experimenting. I find that a different value for different stations is best, but that is too much bother. A good all-around value may be had in the following way. First, light the filament of the tube so that the set "howls." This is with a station tuned in. Then cut in the grid leak and adjust it for maximum clearness. Then make all necessary adjustments for tone quality with the filament rheostat. I only notice a difference with local stations. It makes them both clearer and louder. But on distance the leak keeps the set from spilling over and howling. A shrill whistle will be heard when the correct value is found. (Best all-around value.)

I can cover about 1000 miles with the detector alone, and, of course, much greater distances with an amplifier. If you don't reach the Atlantic coast the first night, stay with it. I have not got them yet.

The beauty of this set is its simplicity. Any more "improvements" will spoil it.

Yours truly,

Berkeley, Calif. GILBERT EARLE

A Sensible View of the Interference Question

Sir: I wonder if I might have a few words to say in your worthy magazine, without incurring the eternal enmity of the amateurs, as they are called. I notice considerable comment of late, in both your publication and QST, that able exponent of the A.R.R.L., regarding the situation that has arisen, involving the amateurs, radiophone listeners and broadcasters. There seems to be some serious internal strife, tending perhaps toward a civil war; a great deal of feeling worked up, "All Over Nothing At All." Now, it just happens that I am that peculiar combination, of amateur, radiophone listener and broadcaster, sort of a "Triangle Kay Bee," so to speak. Therefore I am in a position to view the situation from the several angles.

As an amateur, I am almost entitled to a charter membership, having been actively interested in and experimenting with radio for the last nineteen years. Starting out as just the average American boy, playing with radio and thinking radio day and night, when I perhaps should have been giving more time to my studies. Then a few years at high school, a few more at college and then out into the world; just the experience of the average young man. Now, the point that I am trying to bring out is, that being just the average, I had only the facilities and resources of the average amateur, which is pitifully meager. Consequently, in all these years I have made no startling discoveries, or useful contributions to the field of science, although I did put over some of the first long distance amateur radio. So, with thousands of us.

Isn't it a fact then that we amateurs, as a class are taking ourselves entirely too seriously? True enough, we did do some telegraphing to England, but it created only a ripple in the public interest and was soon forgotten. Our operations far into the night; what do they really amount to? Aren't we kidding ourselves pretty much about the importance of our doings? No one turns any business of real vital importance over to us; our operations are too uncertain and erratic. Thus it is; the public cannot be sold on radio, except insofar as it is of useful service. That is the real measure of the commercial value or importance of any big thing, that is to be put over with the public.

Consider the radiophone listener, the novice, neighbor Jones perhaps. He is a business man, doctor or lawyer; at any rate representing the busy useful side of life, the commercial or professional. He never knew anything about radio, never thought anything about it until he heard that there was music in the air, and bought a receiving set to hear it. Pretty quickly he learned to operate it too, hearing concerts from all over the country, and therein lies the rub. Isn't that the reason that we amateurs are so "out an injured," the fact that Jones learned to operate that receiving set in a few nights, and accomplished what it has taken us years to do? We are afraid that he will soon learn as much about it as we know ourselves, so we are off him for good and ever.

Yet Jones has just as much right to be on the air with a receiving set as we have; has just equal rights with us to learn all there is to know about radio. He gets a great kick out of the concerts and information that he picks up, and so does his family; it provides them all restful and instructive entertainment. Isn't it a fact that we are just jealous of such as he, and have little or no just grounds for any grievance? Fact is, I am a radiophone listener myself, as I said before. I get a lot of pleasure out of the concerts; some of them. I have never experienced much interference from amateurs' 200 meter transmitters; not at all at any distance. The locals in my particular vicinity behave very well in this respect, however it is rather exasperating to have some X or Z station bust up a perfectly fine selection from one of the Class B stations, and that at 400 meters. I use a three-circuit tuner too, and it tunes sharp. Oh, it is a fact that the X's and Z's are liable to be heard anywhere up and down the scale. What they accomplish by all their testing, goodness only knows. They are granted these special privileges, however, so it is useless to say any more about them. That is the conclusion reached by the average radiophone listener. There is nothing that he can say or do, that has any weight against the amateur, because the amateur is licensed.

I have said that I am a broadcaster; here I hang my head in shame, because it was broadcasting that stirred up this ill feeling. However, I am not a broadcaster at heart, but rather by circumstance. I was led into it of necessity, incidental to the development of a radiophone, for a very special and useful purpose. When I accomplish this end, I shall cease broadcasting. In the meantime I will keep down to a minimum amount of it, and am having nothing to say about amateur interference. As I said before, the amateurs in this vicinity are very good about that, and I should worry about the ones at a distance.

All is not well among the broadcasters either, for there seems to be an undercurrent of jealousy, and for why, I know not. Most anyone can build a broadcasting station; the circuits are of common knowledge, and the apparatus on the open market. The success of a broadcasting set, just as with an amateur set, is measured pretty much by the amount of money put into it. Why one should be jealous of another because he has more money to put into a set, it rather a mystery; for when the final "bust" comes, the one with the greatest investment stands the greatest loss. It is almost certain that there will be a bust too; for broadcasting is either directly or indirectly an advertising scheme, and there are far better ways of advertising than cluttering up the air with it. Broadcasting will dwindle down to a few powerful, high class stations, and that is just what it should do, as the field can be satisfactorily covered, with little or no interference and at a minimum expense. It seems to me then, that since the Government holds the key to the whole situation, that we had best not attract too much attention by our squabblings, lest we suddenly find the lid clamped down on the lot of us. Let's be peaceful and let this situation smooth itself out.

ONE OF YOUR READERS

Interference Again!

Sir: In the December issue of your magazine "A Novice" is so pitifully inaccurate, and yet so well in accord with the distorted view of his class, that he deserves some answer.

First let me refute his statement about the interference of spark stations, and state that they do not interfere, *provided* proper means are used to get rid of them! I am about 3000 ft. from the Beach Station of the Federal Telegraph Company. This station uses a 7 kw. spark set and with *properly designed sets,* the interference can be reduced so that it is not bothersome, on signals from nearby broadcasting stations! There are also many amateur stations in this city, some of whom are within a mile of my station. With properly adjusted apparatus loosely coupled I have *never* had any of them interfere on 360 meters!! This proves, without doubt, that the trouble with "A Novice's" set is that it is either poorly designed, or adjusted—probably both.

"A Novice" attempts to justify the use of the single circuit tuners, by stating it is the misfortune of the novice rather than his fault. If the proposition of cost alone is to be considered, which is apparently what the gentleman is driving at, I fail to see it at all. The average single coil set could be re-built to use inductive coupling at an outside cost of $40 or $50; certainly not any $3000 or $4000 that he seems to believe is the cost of an inductively coupled set. I have no knowledge of any sets today that cost such a price, and if I could manufacture a few, and sell them at the price, simply because they were loose coupled, I'd be very glad to do so, and retire on the proceeds. I'd even include a transmitter or two with them at the price! ! ! !

As far as the Westinghouse "RC" receiver goes, they are not worthy of consideration as "tuners," as they simply don't tune. They were, it is understood, designed to work, with the assumption that all spark sets were to be done away with.

I can see no reason why interference should be experienced on a Grebe CR-8 set. This is a two-circuit apparatus, of proper design, and capable of very sharp tuning. Any trouble with this set is probably due to a lack of knowledge of the proper methods of "twisting the knobs."

The gentleman assumes the work of the amateurs is all worthless. Is the stuff sent out by the broadcasting stations any more valuable? If so let him show it, and state where any matter has been transmitted, except the weather warnings, market reports, and the like, which, incidentally, were broadcasted for many years before the radio phone was thought of. Time signals are sent from a few broadcasting stations, but even these are repeats of Naval stations on longer wavelengths, and have been sent for the past twelve or fifteen years by the latter stations.

To cite several specific examples of the times when amateurs have proved themselves of value: I know of one automobile dealer who orders his parts from his supply house by radio. Another amateur station in the Sierra Nevada mountains in California is the only means of outside communication during the winter months. A station in Portland, Oregon (amateur), heard the distress call of a vessel in collision on the Columbia River, and handled business with the agents ashore, and permitting proper arrangements to be made for salvaging the vessel, and saving the lives of twenty odd men. An amateur in Texas heard the distress call of an Army Airplane, communicated with him, and prevented the loss of the plane and its passengers. Amateurs received police reports broadcasted by one of their number, and reported them to their chief of police, who captured thieves and stolen machine (in New Jersey). Amateurs operated stations and had the only means of communication for days, during floods in Ohio River Valley, and assisted actively in directing rescue work, by radio., etc., etc. Oh no, the amateur never does anything, at all.

I presume that the gentleman would like to have gone to sea, during the late war with broadcast listeners (novices) as radio operators. The listeners would have doubtless been able to get into the swing of commercial work in a week, or two, and handle wartime code warnings, and confidential distress messages, of course. They would also have been of immense assistance in the Signal Corps, as they are generally such superb operators, that they could copy verbatim all of the German secret code, that was finally deciphered by another amateur. The achievements of the American Radio Relay League, in the transmission of congratulatory messages from the governors of nearly every state in the Union, to President Harding, is no doubt of no importance, in the "Novice's" eyes, nor is the fact that the same organization transmitted a formal invitation from Chief of Police Vollmer, of Berkeley, Calif., to every police chief, sheriff and other municipal officer in the United States, to attend the Police Chiefs' Convention held recently in San Francisco.

No doubt the personal achievements of some of the amateurs are of no importance whatever either. The development of the original feedback circuit—or regenerative system—was developed by one amateur Armstrong—now Major in the U. S. Signal Reserve Corps—after having served in France with great honor. The further development of this circuit by Paul F. Godley—another amateur—is doubtless of no value, or importance in the eyes of "A Novice." The fact that a large number of the present radio engineers came from the amateur ranks is of little importance, also. For example, Mr. L. Clement, who is head of the Radio Research Department of the Western Electric Company, was an amateur. Mr. Earl C. Hanson, Expert Radio Aid U. S. Navy, Washington, D. C., was a Los Angeles amateur. Mr. M. B. West, a Middle-west amateur, served as District Communication Superintendent, of the Great Lakes District, U. S. Navy, during the War. The list is too long to bother with to carry further, but I think little more need be said—yes—one thing more. A large proportion—probably 80 or 90% of the present broadcasting stations—were built, installed or operated by amateurs, many of whom go home, and "pound the brass" as soon as their spell of the day's broadcasting is over!

In contradistinction to this, WHAT have the broadcast listeners, the novices, accomplished???? Nothing, and then some, by comparison. I have no record, or anything they have accomplished, except kick and holler at everything and anything that they, in their ignorance don't understand, or like.

I do not mean to discredit the splendid class of entertainment and amusement material sent out from the broadcast stations, which serves to lighten the burden of many a shut-in, and stay-at-home, who would be unable to hear any news of the outside world otherwise. Nor do I mean to run down the splendid work of those stations that broadcast weather, crop, and similar reports, but I desire to call attention in the latter case, that these weather reports are transmitted on longer waves, by telegraph, by Naval, and other stations which the novices are unable to read or understand, and therefore the present system is simply an adaptation of the existing conditions, to meet the new class of listeners.

A. H. BABCOCK
Newly Appointed A. R. R. L. Director for 6th District

To return to the single coil argument again. A single coil system, and a properly tuned set may be illustrated by a very simple comparison. Imagine a cheap automobile with an engine, four wheels, and a seat on the gas tank; no clutch, brakes, gear shift, or other modern appliance being installed. This machine would doubtless *run*. There is no doubt but that it would, but, without *proper controls,* the machine would be useless, and it would more or less "run amuck," if started down the highway, or if driven through heavy traffic. This corresponds to the single coil tuner. It will undoubtedly "run," to perfection, i.e., it will bring in the signals with great audibility, and is very simple to adjust, but, on the other hand, it "runs amuck" when any other station starts in, after the first one has started up. It is usually entirely incapable of "selecting" the station desired, and even when it possesses some selectivity it is not sufficiently sharply tuned to eliminate any interference to speak of. A properly built tuner, with variable inductive coupling, corresponds to the properly designed automobile, which has all the necessary and desirable controls, such as gear shift, clutch, etc., which were assumed to be missing from the cheap machine. Such a receiver, if properly adjusted, is capable of being steered through a great deal of interference, and will not cause any-

Continued on page 95

WITH THE AMATEUR OPERATORS

A. H. Babcock, 6ZAF, of Berkeley, Calif., has been appointed to fill the unexpired term of A. E. Bessey, 6ZK, who has resigned as director of the American Radio Relay League in the Sixth District. Mr. Babcock, in public life the consulting electrical engineer for the Southern Pacific Co., in private life has long been an enthusiastic radio amateur. Because of his many years of experience, his high professional standing, and his aggressive personality, he has often been a friend at court for many a youthful amateur. He has played the game for the pure love of it and brings to his new duties a sympathetic understanding of the boy's point of view and an intimate knowledge of the practical and technical side of radio. Under his direction it is hoped that the A.R.R.L. will forge rapidly ahead in its work in the Sixth District.

Carl D. Elfving advises that QRA of station 6AJE is 140 Ellsworth Ave., San Mateo, Calif., and not 334 McHenry Ave., Modesto, Calif., as listed in the call book.

The call of 6BZ has been re-assigned to Lawrence B. Hall, Los Gatos, Calif.

The new address of E. G. Arnold operating 6ZAA and 6AT (portable) is 647 No. Madison Ave., Pasadena, Calif.

2ND is the call of Charles Younger, 247 Neal Dow Ave., Westerleigh, Staten Island, N. Y.

The new address of W. K. Aughenbaugh, operating 8AKI, is 1432 12th Ave., Altoona, Pa. Will appreciate word from anyone hearing his 5-watt 1 C. W.

Call letters 6RR are issued to C. P. Ballard, 415 N. Gower St., Los Angeles, Calif., and not to F. S. Barton of the same city.

W. W. Lindsay, Jr., of Reedley, Calif., signs 6ZF for traffic and 6XAV for experimental work.

THE OBLIGATION OF A "Z" LICENSE

By ALLEN H. BABCOCK

The Radio Laws and Regulations provide for Special Amateur Stations, the licenses for which permit the use of longer wavelengths and a higher power, to make possible communication between amateurs over exceptional distances and in spite of extraordinary natural difficulties. Such station licenses are known as "Z licenses" because their station call letters always carry that letter following the Radio District number.

Since these licenses confer special privileges, they are the desideratum of progressive amateurs, some of whom fail to recognize the fundamental fact that acceptance thereof carries with it special obligations and responsibilities.

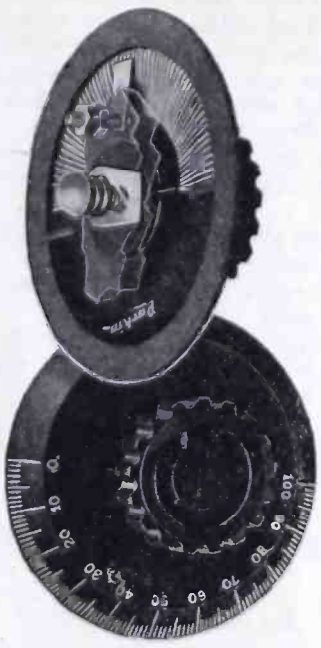
Obviously, the end and aim of practical radio work is communication; hence, those who are given special facilities for communication, must communicate if they expect their special privileges to continue. It will be well therefore for all Z station logs to show all messages handled in and out, so that in case questions are asked when renewal of Z licenses is requested the record may be clear and convincing. A fine method of making it conclusive is to take active part in the organized traffic of the American Radio Relay League, (join the League if you are not already a member); and, in any event, report monthly your traffic figures to your District Manager, whose records are useful to the District Radio Inspector when he is acting upon original or renewal applications for Z licenses.

MORAL: In Radio, as in much of everything else in this life, get into the game if you wish your special abilities to be rewarded.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS

PARKIN DIAL TYPE RHEOSTAT

A novel and effective idea is embodied in the dial-type rheostat made by the Parkin Mfg. Co. of San Rafael, Calif., and illustrated herewith. As may be noted from the picture, the resistance element is placed in a recessed groove in the back of a 3 in. Bakelite dial. This is mounted outside the cabinet, eliminating heat from the inside of the set and giving more cabinet space.



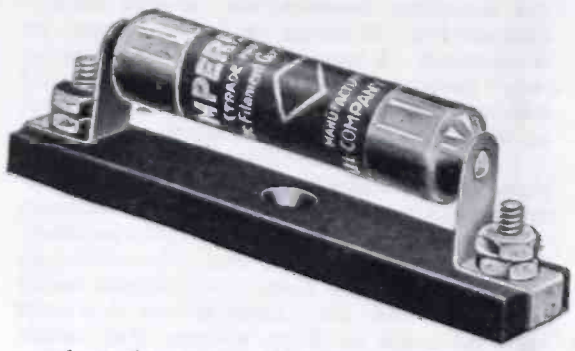
Parkin Dial Rheostat

The dial is molded of black Bakelite, and highly polished to a beautiful lustrous finish. The 100 division scale reads from right to left for clockwise rotation, and graduations are filled with brilliant white enamel for easy reading. The knob is of molded Bakelite. An off position is provided, and a stop on the dial engaged the stationary contact at the extreme positions. Resistance is 5 ohms, carrying capacity 1½ amperes.

AMPERITE AUTOMATIC FILAMENT CURRENT ADJUSTER

Investigations by the engineers of the Radiall Company of New York City show that the life of a vacuum tube can be lengthened by keeping the filament temperature between 1800 and 2200 degrees Centigrade. The filament crystallizes and becomes brittle below 1800 degrees and vaporizes above 2200 degrees. To maintain this close temperature control they have devised an automatic filament current adjuster known as the "Amperite." This may be substituted for a rheostat in any amplifier tube circuit and eliminates the need for a voltmeter to prevent overloading the tube. Due to the variations in detector tubes, the use of a rheostat is advised with the Amperite, no adjustment being required after the rheostat has once been set.

This device is manufactured in two styles, one for the standard tubes taking about 1 ampere with 5 volts off the usual 6-volt A

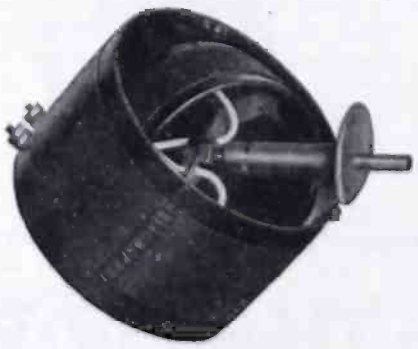


Amperite Automatic Filament Current Adjuster

battery and the other for tubes requiring 4 volts, 0.8 amp. The device automatically keeps the current within 0.08 ampere inspection of the variation in battery voltage.

THE LORAIN VARIO-COUPLER

A varicoupler especially adapted for easy mounting in the panel is being made by the Lorain Radio Supply Co. of Lorain, Ohio, as illustrated herewith. The panel simply has to be drilled for three screws and the shaft and the coupler may then be mounted.



Lorain Variocoupler

The rotor and stator are tightly wound on Formica tubing, the rotor revolving easily and quietly. The stator has 60 turns, with taps every 6 turns. The taps are large loops not easly pulled out and need only be scraped slightly to remove insulation. The rotor has either 30 turns plain winding or 70 turns bank winding.

The connections to rotor are flexible wire, insulated with rubber tubing. The range is approximately 150 to 550 meters, with average antenna and series condenser.

TRADE NOTES

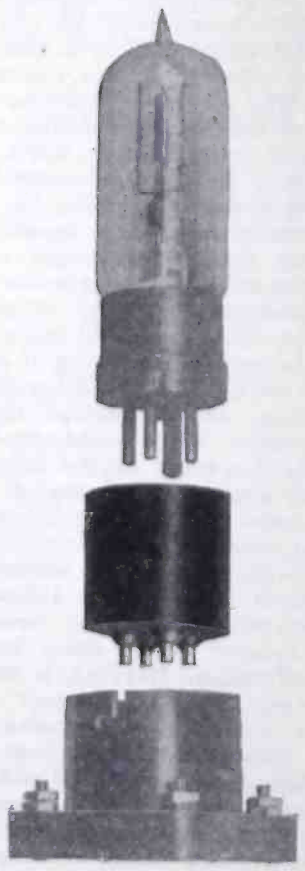
Western Radio, Inc., has been organized at Seattle, Wash., with John C. Mitchell as president, H. S. Allen as vice-president, J. W. A. Legge-Willis as general manager, and T. M. Gardner as secretary-treasurer. They represent twenty-seven manufacturers, as exclusive jobbers of radio equipment.

Dubilier Condenser and Radio Corporation of New York City advise that their "Ducon" device for utilizing lighting wires as an aerial has been approved by the Underwriters' Laboratories of the National Board of Fire Underwriters.

A NEW TUBE ADAPTOR

The WD-11 vacuum Tubes, which have recently appeared on the market, are particularly desirable for portable sets, as they require but 1½ volts for the filament supply, and where one or two tubes only are used, the source of energy can be an ordinary dry cell, thus eliminating expensive storage batteries, and charging apparatus for same. These tubes are said to show good operating characteristics both as detectors and amplifiers,radio frequency or audio frequency.

They have one disadvantage in that they require a special socket. It is, therefore, necessary to either change the sockets in the receiving set, or build a new set in order to use these tubes. To eliminate this difficulty, the J. Jos. Lamb Co. of Detroit, Michigan have developed an ingenious device to accommodate the WD-11 Tube and make it possible to use this tube in the standard vacuum tube socket.



Tube Adaptor

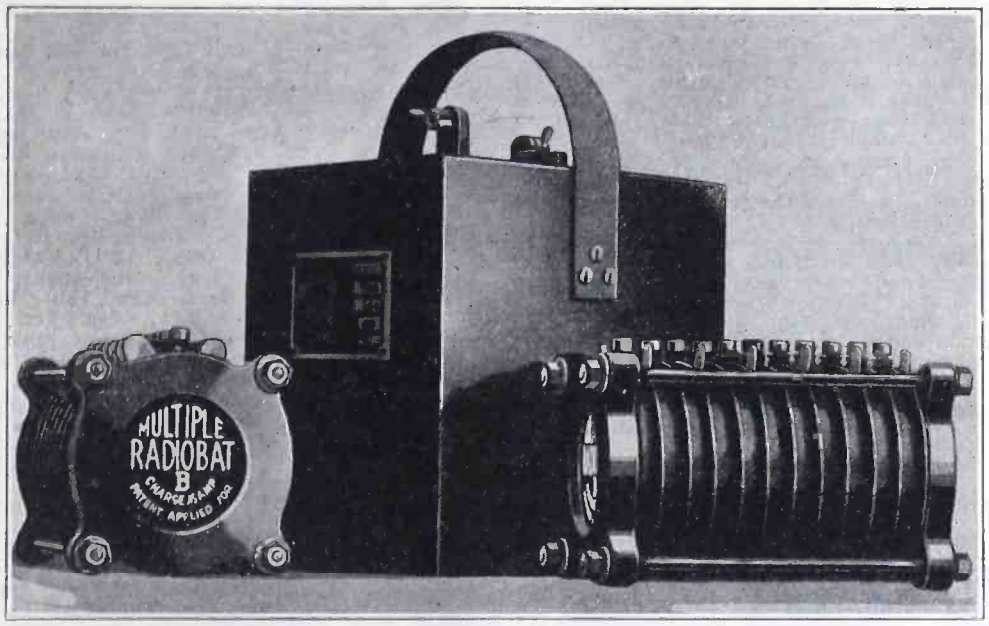
This adaptor is made of hard rubber in the form of a plug with the usual four prong contact base, the upper portion of the plug being fitted with four split-tube contactors which take the prongs on the base of the WD-11 tube. The internal connection of the device is so arranged that when the adaptor is plugged into the ordinary tube socket, the connections are exactly the same as when using the standard tube.

The use of this device will permit an interchange of tubes in any standard set, and will allow the present set owner to change to the WD-11 tubes, if he so desires. The new device is entirely fool-proof and practically indestructible.

NON-LIQUID STORAGE "A" AND "B" BATTERIES

This illustration shows a group of "A" and "B" storage Radiobats which incorporate a number of revolutionary new features of considerable interest to every radio fan. Both "A" and "B" types of these new principle batteries contain a solid electrolyte which makes them non-spill. This feature will be appreciated by every radioist who who has ever spilled acid from his battery on his mother's or wife's best carpet.

Another interesting feature is the absence of separators, which reduces internal resistance to a minimum. The Radiobat grid (the metal mesh into which is pressed the "active material", forming the "plate"), has a double reinforced construction. This construction adds 25 to 30% more actual metal



A and B Storage Radiobats

per square inch. The plate is, consequently, just that more rugged and does not buckle. This reinforced strength plus the solid electrolyte, makes the use of separators unnecessary. Due to the fact, however, that the secondary reinforcing mesh in the grid does not come to the surface of the plate, there is actually more active surface per square inch of plate area. In the case of the Radiobat "A," this results in a battery 25 to 30% smaller and, consequently, easier to handle than any other "A" battery of equal rating.

The Radiobat storage "B" is even more unusual and interesting. It is compact—only 4 inches square by 7 inches long—scarcely larger than a large size dry cell "B". It has no glass jars to break, no liquid to leak. The most notable feature is its utter noiselessness of operation.

It substitutes the steady, sustained voltage characteristic of a storage battery in place of the irregular constantly dropping voltage of a dry cell, thus eliminating all hissing and crackling noises with which all radio operators are familiar. Changing voltage in the plate circuit is the direct cause of most tube noises and most of what is blamed on static. Sustained voltage does away with this and results in a marvelously clear true-tone reproduction of each word and note.

The Radiobat Storage "B"is economical as well. It is easily rechargeable at home from either ac or dc and outlasts its value in dry cell "B"s on each home charge.

NEW RADIO CATALOGS

Catalog R-4, from Julius Andrae & Sons, Milwaukee, Wis., covers a very complete assortment of all parts needed in the operation and construction of a receiving or transmitting set. This includes complete receiving sets from many of the standard manufacturers. In its 72 pages, 6x9, the discriminating amateur will find descriptions and prices of any apparatus or supplies he may need.

Bulletin No. 20, from Roller-Smith Co., 233 Broadway, New York, is devoted to "Universal" receivers and loud speakers. The latter comprises an especially designed horn with two carefully matched built-in receiver units.

Parkin Mfg. Co. of San Rafael, Calif., are distributing a new catalog of parts, including dials, knobs, rheostats, sockets, lever switches and binding posts. Of especial interest is the new Parkin .001 m.f. variable condenser, which is 3 in. in diameter and only ⅛ in. thick.

"Quality Amplification" is the subject of an attractive folder from the General Radio Co. of Cambridge, Mass. It deals specifically with the development of audio frequency amplifying transformers, culminating in their Type 213A.

The California Radio Association, 37 California St., San Francisco, is distributing an interesting leaflet regarding what it is doing for its members.

The Federal Telephone & Telegraph Co. have issued a new Radio Frequency Bulletin No. 119-W, which is a complete textbook on radio frequency amplification and contains several valuable circuits. This catalog will be distributed free to anyone who cares to write in for one.

Telephone Maintenance Co. of Chicago are distributing a 32-page illustrated catalog and price list of "Telmaco" Quality Radio Apparatus, including their own complete receiving sets, and parts from various manufacturers.

"Practical Radio" by H. S. Williams, 427 pages, 5x7½, published by Funk & Wagnalls Co., New York City, and for sale by RADIO, San Francisco. Prices $1.75, net; $1.87 post paid.

Novices frequently ask what they might read before trying to understand what is ordinarily published in the columns of RADIO. This book is an answer. Written as a fascinating narrative, it brings an easy understanding of the principles that underlie radio phenomena. Radio is treated as a wonderful game for boys. The action of the crystal and the triode, the movement of electrons, the meanings of symbols and hook-ups, and the how and why of the regenerative and amplifying radio receiver are all told in simple, interesting language. Aerials, radio-frequency amplification, and super-regeneration conclude that portion of the book devoted to receiving. There are short chapters on the general principles of sending radio messages, "wired wireless," radio control of distant apparatus, the problems of the advanced amateur, and radio as a public utility. The entire treatment is practical, making an excellent text not alone for the novice but also for the amateur desiring to review his knowledge.

NEW RADIO PARTS

Those assembling their own sets will be interested in several new parts made by Alden-Napier Co. of Springfield, Mass. These include the De Lux socket, a small space socket and a Condensite dial as illustrated herewith.

De Lux Socket.

The De Lux socket has a patent clip which makes a positive connection to the prongs of the vacuum tube under any and all conditions. As the tube slips into place there is a wiping action across the bottom and at the side. The operator using these sockets in his set can be sure that he is free from open circuit troubles in this part of his apparatus. As this socket is slotless and made of *genuine* Condensite it is practically unbreakable. It serves equally well for 5 watt power tubes as there is ample spacing between the contact strip and the bottom of the base.

Small Space Socket.

The small space socket is also made of Condensite and as it occupies a minimum of space it is particularly useful where two or three tubes are to be used. It is not affected by the heat of the tubes or of a soldering iron.

Condensite Dial.

As the dial is likewise made of Condensite it will not warp and it runs true. Due to the shape of the knob and the fact that the numerals are placed on the bench, the fingers can be placed on the knob without hiding the numerals, an unusual feature in a 3 in. dial.

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

BY 6ZY, WAIKIKI BEACH, HONOLULU, T. H.

1bka, 2afb, 2bgm, 2fw, 2fz, 2go, 2awl, 2lo, 3auu, 3co, 3dh, 4km, 4fg, 4id, 4gh, 4by, 5ag, 5aec, 5di, 5ek, 5eo, 5gv, 5kc, 5nk, 5px, 5pb, 5sf, 5sk, 5sm, 5tc, 5uo, 5zau, 6ak, 6alu, 6avr, 6atg, 6ada, 6aqu, 6awt, 6akt, 6arf, 6abx, 6ahq, 6asj, 6arb, 6aat, 6avd, 6bun, 6bcr, 6bjy, 6bac, 6bu, 6biq, 6bql, 6bqc, 6cp, 6cc, 6cu, 6cn, 6en, 6ea, 6ec, 6eb, 6ek, 6gf, 6gx, 6ik, 6iv, 6jd, 6ka, 6mqu, 6oaa, 6pi, 6qy, 6tc, 6tw, 6ti, 6zg, 7sc, 7bk, 7hm, 7bj, 7uu, 7zo, 7lr, 8anb, 8aqo, 8aio, 8anj, 8amd, 8awm, 8bo, 8bfm, 8bxa, 8bef, 8bxh, 8beo, 8caz, 8cgp, 8cmi, 8cf, 8cbd, 8ml, 8nd, 8ow, 8pd, 8xae, 8yd, 9aul, 9amb, 9awm, 9axu, 9aog, 9aws, 9avz, 9aw(Can.), 9awl, 9am, 9aux, 9brq, 9bb, 9brg, 9cp, 9cg, 9ccv, 9cfy, 9cip, 9dpa, 9dtc, 9dsm, 9dky, 9dtm, 9dpa, 9gk, 9lz, 9uu, 9wu, 9yaj, 9zn, 9zaf.

BY 5DI, 2209 AZLE AVE., FORT WORTH, TEXAS

All C. W.—1aw, (1ii), 1xm, 1xu, 1xz, 1aaw, 1bka, 1bwj, (1cmk), (1cnf), 1cxx, 2bv, 2cc, 2el, 2gr, 2nz, 2os, 2qv, 2ud, 2wr, 2zk, 2afp, 2aso, 2bqd, 2cbw, 2ccd, 2ckr, 2cma, 2cqz, 3bz, 3ca, 3hg, 3hl, 3jt, (3ot), 3qv, 3pz, 3sd, 3xm, 3yo, 3zw, 3aay, 3apr, 3atz, 3auw, 3bef, 3bgt, (3bhm), 3bip, 3blf, 3bva, 3bza, 4bx, 4by, 4cg, 4co, (4eb), 4eh, 4es, 4fg, 4gl, 4gs, 4hw, 4id, 4jz, (4kc), 4nt, 4ur, 4ya, (5ek), (5el), 5fv, 5is, (5jb), (5pv), (5ta), 5tj, 5uo, 5vy, 5xk, 5xu, 5xv, (5aec), 5ano, 6ah, 6cc, 6ft, 6gr, 6gl, (6jd), 6lj, 6iu, 6zh. 6zx, 6aag, 6ajh, 6alg, 6anp, 6avd, 6awp, (6awt), 6baw, 6bcr, 6bmd, 6boe, 6bqc, 6bqz, 6bsa, 6bug, 6bvg, 6xad, 6zac, 7gw, 7zo, 7zu, 8aa, 8ae, 8bk, 8bo, 8cf, 8hj, 8ib, 8ix, 8ml, 8qk, 8ro, (8vy), 8xc, 8yd, 8yu, (8zy), 8zx, 8aed, 8agz, (8aim), (8alc), (8ame), 8anb, 8aqo, 8axc, 8axd, (8azd), 8azf, 8bdv, (8bjk), 8bke, 8bnz, 8btl, (8bvr), (8bwa), 8bxa, 8bxx, 8byf, (8byn), 8bzy, 8cfx, 8cgx, 8cjd, 8ckm, (8cko), 8cpd, 8cur, 8cuu, 8cyt, 8zag, 9ei, 9gr, 9ii, (9yu), 9zl, 9acb, 9agz, 9agr, 9aly, 9anw, (9aog), (9aon), 9aps, (9apw), (9aqm), (9arj), 9ase, (9asn), 9ate, (9atz), (9awm), (9ays), 9bhd, 9bie, (9bik), (9bvy), 9bzz, 9cba, (9ccv), 9ces, 9cfc, 9cfg, 9cgk, (9cgl), 9ciy, 9ckp, (9clz), 9cma, 9ctr, 9cvo. (9dbv), (9ddy), (9def), 9dky, 9dta, 9dyn, (9zaa), Can.—(3bv), 3dh, 3gk, 4bk, (4bv), 9al.

BY CAN. 5CN. 3290 GRANVILLE ST., VANCOUVER, B. C.; ONE TUBE

C. W.: U.S.—2fp, 4bq, 4cg, 4eb, 4ft, 4hh, 5di, 5ek, 5eo, 5kc, 5nk, 5n, 5sm, 5va, 5hc, 5zb, 5acf, 5zap, 5xad, 5za, 6cf, 6cp, 6cc, 6fh, 6if, 6en, 6ea, 6ft, 6ka, 6pi, 6gx, 6nx, 6rd, 6oh, 6ku, 6xh, 6zh, 6zo, 6zr, 6zx, 6iv, 6tc, 6aag, 6aat, 6akw, 6aec, 6alx, (6arb), 6ahq, 6alu, 6awt, 6apw, 6ajh, 6abx, 6auu, 6ahp, 6atv, 6avd, 6asj, 6atc, (6agp), 6bqf, 6bjq, 6bkd, 6bcj, 6bic, 6boe, 6bcd, (6bcr), 6bkb, 6bmd, 6bes, 6bjk, 6bjf, 6bko, 6bsa, 6bbc, 6bqz, 6bqg, 6amn, 6bjr, 6aiy, 6bum, 6bvg, 6bvz, 6cjf, 6zf, 6zac, 6xad, 6xav, 6xas, 7bs, 7bk, 7bj, 7df, (7dp), 7du, 7lu, 7tt, (7tn), 7fi, 7qn, 7jf, 7qt, (7nn), 7oz, 7oo, (7wm), (7sc), 7sy, 7ri, (7th), 7ny, (7rn), 7mf, 7nj, 7wx, (7ot), 7jm, (7jw), 7lm, 7zo, 7zu, 7zk, 7xc, (7zb), 7aft, 7aic, 7afs, (7aea), agf, 7adf, 7aad, 7atx, 7aem, 8ab, 8az, 8bk, 8cf, 8uc, 8uk, 8qi, 8qk, 8vy, 8xe, 8yd, 8zz, 8asv, 8aqo, 8afd, 8aio, 8cur, 8apy, 8azd, 8bef, 8axc, 8bfm, 8bke, 8bdu, 8bzv, 8bnj, 8zaf, 9pn, 9pi, 9qi, 9ii, 9uu, 9qf, 9dr, 9zn, 9hm, 9amb, 9als, 9aou, 9aiy, (9awm), 9asf, 9ajp, 9ajh, 9gk, 9avz, 9api, 9axt, 9akb, 9arz, 9abu. 9ami, 9aap, 9axu, 9apw, (9aul), 9aon, 9aps, 9bji, 9bed, 9bev, 9bme, 9bxa, 9bhm, 9bey, 9bds, 9bik, 9cci, 9cgd, 9cmk, 9cns, 9dug, 9dpl, 9dsm, 9dky, 9dyn, 9xaq, 9xaj, 9doz, 9xav, 9zaf, (bt3), ad7.

Heard and worked in daylite with sun still shinning—6ajh, 6aat, (7sc), (7zb), 7kj (spk).

C. W.: Canadian—3bv, 3xn, (4dq), (5ct), 9ac, 9bg.

Spark: U.S.—6ao, 6cc, 6gr, 6fh, 6km, 6ic, 6ib, 6qr, 6hc, 6vx, (6ff), qra?, 6qr, 6ik, 6tu, 6acr, 6amk, 6aak, (6abw), 6aof, (6alv), 6ani, (6aqu), 6amw, 6ark, 6bqc, 6bip, 6bak, (7ge), (7nn), (7fr), 7of, (7oj), 7vo, (7ot), 7jf, (7vf), (7bb), 7wg, (7tw), (7mu), 7sj, 7ne, (7ki), 7mc, 7zk, 7zu, 7zg, (7abs), (7aea), (7agi), 7acn, bq3.

Spark: Canadian—(5dx).

All stations hearing 5CN on spark or C. W. pse QSL. Any stations in the above list wishing a report on their sigs pse drop a card to 5CN.

By 6EB, 343 So. Fremont Ave., Los Angeles

C. W.: Can.—4bv, 5cn, 9ac. 5di, 5ef, 5px, (5qy), 5tj, 5xad, 5za and buzzer, 5zav, 6ada, 6ajf, 6ak, 6akl, 6aoi, 6aor, 6aqw, (6arb), 6arf, (6asj), 6avn, 6avw, 6awt, 6bbh, 6bcd, 6bcr, 6bjy, (6bmd), 6bnu, (6bnw), (6bsa), 6bum, 6bwp, 6cc, 6dd, (6fh), 6gf, (6iv), 6ku, (6lo), 6lv, (6nx), 6ok, (6rd), 6rm, 6tc, (6ti), 6xb music, 6xd music, 6uw, 6vm, (6zac), 6zh, 6zo, (6zx), 7abb, 7aem, 7bb, 7bj, (7bk), 7cz, 7fr, 7gk, (7jw), 7lr, 7sc, (7th), 8aav, 8aqo, 8asv, 8bdu, 8bfm, 8bzy, 8ck, 8vy, 8yd, 8yu, 8zy, 9amb, 9arz, 9asg, 9avz, (9awm), 9aya, 9ays, 9bey, 9bik, 9bji, 9bxa, (9cns), 9dky, 9dtm, (9xaq), (9zaf), 9zn!!! hi. 50 watts a.c. C. W. here since Oct. 30th.

By 6ZH ex 6AJH, San Ysidro, Calif.

C. W.: 2fp, 3ot, 3zv, 4eb, 4gh,, 4hw, 4id, 4ya, 5di, 5ek, (5er), 5cy, (5ir), 5kc, 5nk, 5pb, (5px), (5qy), 5sk, 5sm, 5uj, 5un, 5uo, 5vo, 5xb, 5xd, 5xk, 5xt, 5xy, (5za), (5zh), 5xad, 5zas, 5zav, (5acf), 6's too numerous, 7bb, (7bj), 7bk, 7dp,7jw, 7lr, (7lu), 7mf, (7ot), (7oz), 7sc, 7th, 7tj, 7tq, 7zo, 7zu, 7zv, (7adp), (7aem), 8bk, 8cf, 8ib, 8qk, 8sp, (8wr), 8xe, 8xu, 8uz, 8yd, 8zy, 8zz, 8aim, 8amm, 8apy, 8aqo, 8asv, 8awx, 8axb, 8axc, 8azb, 8bef, 8bfm, 8bxh, 8bzy, 8caz, 8cmi, 8cun, 8cur, 8cyv, 9fh, 9fv, 9gk, 9ox, 9pi, 9pn, 9ps, 9uh, 9uu, 9zn, 9zy, 9afk, 9aix, (9amb), 9anq, 9apw, 9arz, 9asf, (9aul), (9avz), (9awm), 9ayh, (9ays), 9bcb, 9bds, 9bed, 9bey, 9bgh, 9bhd, 9bie, 9bik, (9bji), 9bqw, 9bpl, 9bud, (9bun), (9bqx), 9bzy, 9cde, 9ccv, 9cfy, 9cns, 9cow, 9dfb, 9dky, 9dsm, 9doz, (9dte). (9dtm), 9dwk, 9dyn, 9dug, (9xaq), 9yaj, 9zaa, (9zaf), ad7, qra? Can. 3co, 3dh, 3xn, (4bv), 9aw.

By 6ASN, 2043 Berryman St., Berkeley, Calif.

C. W.: 5qt, 5aac, 5anx, 5za, 7ab, 7bk, 7bj, 7dp, 7ia, 7lc, 7lu, 7mf, 7ny, 7jf, 7jy, 7rn, 7sc, 7to, 7tq, 7ud, 7wm, 7zb, 7aau, 7aad, 7afk, 7aic, 9dy, 9zl, 9amb, 9ami, 9anf, 9avy, 9bey, 9bji, 9bzi, 9bzm, 9dui, 9dva.

By 6EA, 343 So. Fremont Ave., Los Angeles

All C. W.: Can. 3xm?, Can. 4bv, 5di, 5px, 5tj, 5za—buzzer, 5zav, 6ak, 6bf, 6cc, (6fh), 6gf, 6gx, 6iv, 6ku, 6lo, 6lv, 6nx, 6sz, 6tc, (6ti), 6tw, (6uw), 6vm, 6xb—voice and music, (6zh), 6zi, 6zo, 6zx, 6xad, 6xav?, (6zac), 6aat, 6ajf, (6ajh), 6akl, 6aoi, (6aor), 6arb, 6arc, 6asj, 6atq, 6awt, (6bcr), 6bmd, 6bnw, 6boe, 6bsa, 6bwp?, 7bb, 7bj, 7bk, 7bp, 7fd, (7jw), 7ot, 7sc, 7th, 7tq, 7zb, 7zo, 7abb, 7aby (7aem), 7afw, 8cf, 8ib, 8yd, 8yu, 8abc, 8asv, 8axc, 8bfm, 8bxx, 8bzy, 9bm, 9gk, 9vk, 9yw, (9amb), 9avz, 9awm, 9bed, (9bji), 9cns, 9dtm, 9xaq, (9zaf), kfaf—voice and musice, kdpt—voice and music, kdpu, kdpv and bt3. My 5 watter was reported heard by 5nv, 7bb, 7fk, 7ft, 7ri, 7sp, 7vf, 7vx, 7acs, 9cjc, wsr—1,800 miles northwest of Los Angeles, and kkkei—1,115 miles northwest of San Francisco.

By 6BQL, 575 21st Ave., San Francisco, Calif.

C. W.: Can. 4bv, Can. 5cn, Can. 9ac, 5aw, 5bq, 5di, 5ek, 5fv, 5kc, 5my, 5nb, 5nn, 5px, 5qy, 5sm, 5uo, 5ade, 5za, 5zaa, 5zas, 5zav, 5xad, 6bf, 6cc, 6cu, 6ea, 6eb, 6ec, 6eo, 6en, 6ft, 6gd, 6ii, 6iv, 6jd, 6ka, (6ku), (6lo), 6om, 6pi, 6pt, 6rr, 6tw, 6wr, 6xz, 6zb, 6zf, 6zg, 6zh, 6zn, (6zo), 6zr, 6zt, 6zz, 6aag, (6abx), 6ada, 6aeh, 6agp, 6ahp, (6ahq), 6ajc, 6ajh, 6akl, 6alu, 6amn. 6amt, 6aoi, (6apw), 6aqa, (6aqw), 6arf, 6atg, 6atj, 6atq, 6auy, 6avd, 6avn, (6avr), 6avv. 6bbc, 6bbh, (6bdw), 6beg, 6beq, 6bes, 6bet, 6bgh, 6bjq, 6bjy, 6bjr, 6bkb, 6bko, 6bki, 6blu, 6bmd, 6bmy, 6boe. 6boo, 6bor, 6bpj, 6bpz, 6bqb, 6bqc, 6bqd, 6bqf, 6bqg, 6bqp, 6bqr, 6bqv, 6bqy, (6bqw), 6bqz, 6brf, 6brk, 6bum, (6bun), 6bvg, (6bwy), 6xad, 6xas, 6xav, 6zac, 6zal, 7ad, 7bj, 7bk, 7dp, 7du, 7hm, 7iv, 7jf, 7jw, 7lr, 7lu, 7mf, 7ng, 7nn, 7ny, 7ot, 7qk, 7ra, 7sc, 7sf, 7sq, 7sy, 7th?, (7tq), (7ud), 7uu, 7wm, 7xc, 7zb, 7zk, 7zo, 7zu, 7zv, 7aem, 7aft, 7afw, 7aic, 8bk, 8cf, 8ib, 8kg, 8ml, 8on, 8pk, 8qk, 8xe, 8yd, 8zy. 8aim, 8aks, 8amt, 8anb, 8asv, 8azd, 8bfm, 8bke, 8bxa, 8cfo, 8xae, 9av, 9cr, 9dp, 9fm, 9gk, 9kp, 9pi, 9pn, 9qf, 9xm, 9yf, 9zn, 9zk, 9aap. 9adg, 9afk, 9aja, 9amb, 9ami, 9anq, 9aon, 9aps, 9apw, 9aul. 9avz, 9awm, 9ays, 9bds, 9bed, 9bie, 9bik, 9bji, 9bun, 9bxq, 9cfi, 9cfy, 9cmi, 9cmk, 9cns, 9dhb, 9doz, 9dtm, 9dum, 9dyn, 9yaj, 9zaf, 9xac, 9xaq, bt3, bq3.

By 6BQR, 953 West 7th St., Los Angeles, Calif.

C. W.: 5ma, 5px, 5za, 5zh, 6aat, (6abx), 6agh, 6ajf, 6ak, 6akl, 6alv, 6atc, 6atq, 6atu, 6av, 6awt. 6bbh, 6bcd, 6bcj, 6bcl, 6bcr. 6bic, (6bjy), 6bmd, 6bnw, 6bqf, 6bum, 6bsj, 6cc, 6cp, 6fh, 6gf, 6gr, 6gx, 6gy, (6ii), 6ku, 6sz, 6tc, 6ti, 6um, 6vm, 6xj, 6za, 6zf, (6zh), 6zm, (6zo), 6zt, 6zx, (6zz), 7aea, (7aem) 7bj, 7gk, 7iw, 7lu, 7mf, 7oh, (7ot), 7qt, (7tq), 7zb, 7zm, 7zo, 7zu, 8bdu, 8bk, 8bx, 8cf, 8qk, 8zz, 9ac, (Can.), 9amb, 9asf, 9aul, 9aw. 9awm, 9ayu, 9bey, 9bji, 9cde, 9cfy, 9cns. 9dfb, 9dtm, 9ii, 9kp, 9pi, 9zaf. Would be pleased to get a card from anyone hearing my 5-watt C. W.

By 6CAE, Anaheim, Calif., on one tube

5xd, 5zax (fone, c. w.), 5zm, 6's too numerous, 7ait, 7lu, 7mf, 7aw, 7aiu, 7yg, 7tq, 7zk, 8fk, 8afs, 8afd. 9aml, 9dtm, 9zaf (fone, C. W.), 9bun, 9aul, 9bji, 9cns, cl8, bq-3, Can. 9bd.

BY 7MF, EUGENE, OREGON

Spark—(6cc), (6ex), 6fk, 6gf, 6gr, 6gt, 6ib, (6ic), 6im, 6kc, (6km), 6lo, 6oh, 6qk, 6qr, 6zu, (6ajh), 6zi, 6zq, 6zac, 7fj, 7fi, 7oh, 7ot, 7zk, 7bd, 7gd, 8zd, 9als, 5xu.

C. W.—1bfx, 3zo, 4gl, 4bq, 5kc, 5sk, 5di, 5za, 5zh, (6bf), (6cc), (6ea), 6en, 6ka, (6gr), (6fh), (6ak), 6nx, 6zx, 6rr, 6pi, (6bqc), (6bpz), 6xad, 6arb, 6cu, (6bic), (6bcj), (6bql), (6bjy), 6bfp, (6aor), 6tw, 7bs, 7ce, (7dp), 7go, 7hs, (7iy), 7lr, (7nn), (7qw), 7ts, (7th), 7tn, 7tt, 7tj, 7yj(fone), 7zs, 8bx, 8jl, 9dr, 9zn, 9aum, 9dtm, 9zaf, 9xaq, 9dva, 9aav, kdk? (music), 9amb.

Anyone hearing 7mf's C. W. please qsl.

BY 6BQG 1878 WEST 23RD ST., LOS ANGELES, CAL.

C. W.—5yq, 5di, 5zh, 5za, 5zx, 5ck, 4bq, 4bf, 5bk, (qsa), 5zaf, (6aat), (6arb) (vyqsa), 6cp, (6awt), 6gr, (6bcj), 6ku, 6ak, (6awp), 6ajh, 6ec, 6bwa, 6bqf, 6zf, (6bic), (6bjy), (6xad), (6aqw), 6atq, 6agp, 6aow, 6jt, 6tv, 6za, 6abx, 6aja, 6apw, (6bjy), 6bmd, (6acs), 6adu, (7lu), (vyqsa), 7sm, 7oz, 7oe, 7sy, 7dp, 7sc, (7zb), 7abs, 7aea, 7asu, 8bex, 9zaf, (vyqsa), 9amb, 9dtm, 9dsm, 9bd can, 9em, 9dug, 9ayu, 9aea, 9dt, 9cjj. 9xaq.

Spark—6aak, (6bju), 6ajh, 6ic, 6tu, 6ahf, 6kc, 6gr, 6tw.

By 6ZAC, Wailuku, Maui, T. H.

C. W.: 1bcg, 1xm, 2awl, 2agc, 2fp, 2gk, 2gr, 2bfx, 2nz, 2xap, 3zw, 4eh, Canadian 4bv, 5di, 5ek, 5kc, 5sf, 5tj, 5qy, 5px, 5xd, 5xv, 5za, (6ak), 6ajh, 6asj, 6avr, (6awt), 6ada, 6atg, 6bcq, (6bcr), (6bsa), 6bqg, 6bju, 6bdw, 6bvq, (6cc), 6cu, (6ea), (6en), 6eb, 6gf, (6gr), 6gx, 6ka, 6nx, 6pi, (6tc), (6ti), (6tq), 6wi, (6xj), 6xad, 6zb, (6zg), 6zh, (6zn), (6zi), (6zx), (6zy), 6zaf, 6zal, 6xaw. 7bb, 7bk, 7bj, 7adp, 7gk, 7rn, (7sc), 7sy, 7zu, 7zv, 8amm, 8apy, 8awp, 8azd, 8bef, 8cf, 8cur, 8bke, 8cuz, 8ib, 8nb, 8uk, 8xe, 8zy, 8xh, 9aw, (9awm), 9aul, 9arz, 9axm, 9ami, 9awt, 9aqe, 9ays, 9amb, 9avz, 9apw, 9aps, 9aog, 9bji, 9bbf, 9bey, 9bch, 9bri, 9bds, 9cns, 9ccv, 9cfy, 9cgk, 9dgj, 9dyn, 9dsp, 9dsm, 9dtm, 9dfb, 9gk, 9pi, 9yaj, 9yw, 9zn, 9zaf, 9zx. Every radio district represented.

Spark: (6aqu), (6ex), 6oh. 129 stations heard, 21 worked.

By 7AFH, Monroe, Wash.

C. W.: 1bdi, 2awl, 5aa, 5di, 5ek, 5fv, 5hb, 5jl, 5kc, 5kp, 5nk, 5px, 5qi, 5sk, 5xt, 5za, 5zav, 6aag, 6aat, 6aax, 6abx, 6agf, 6ahd, 6ahq, 6aiy, 6ajf, 6ajh, 6ak, 6alu, 6alv, 6alx, 6aoi, 6apw, 6aqj, 6aqw, 6arb, 6asj, 6atc, 6atq, 6auu, 6avr, 6aw, 6awp, 6awt, 6bcd, 6bcj, 6bcl, 6bcr, 6beg, 6bej, 6bic, 6bin, 6biq, 6bjc, 6bjq, 6bjr, 6bko, 6bmd, 6bnt, 6boe, 6boo, 6bpz, 6bqc, 6bqd, 6bqf, 6bqg, 6bqz, 6brg, 6bsa, 6btd, 6bud, 6bum, 6bun, 6bvq, 6bzb, 6cc, 6cn, 6cp, 6cu, 6ec, 6en, 6fh, 6ft, 6gr, 6gx, 6gy, 6iy, 6jd, 6ki, 6ku, 6lv, 6nx, 6pi, 6qm, 6rd, 6rm, 6tc, 6ti, 6uw, 6vf, 6vm, 6xad, 6xh, 6xj, 6xas, 6zf, 6zh, 6zo, 6zs, 6zx, 6zz, 7aad, 7aby, 7ace, 7ad, 7adf, 7aea, 7ael, 7aeo, 7aff-fone, 7afs, 7aft, 7afw, 7agf, 7agx, 7ahw, 7aib, 7aic, 7amp, 7anf, 7aqy, 7azp, 7bb, 7bj, 7bp, 7bs, 7dp, 7du, 7ep, (7eq), 7gk, 7hj, 7hm, 7jg, 7jm, 7jw, 7ke, 7lr, 7lu, 7mf, 7ny, 7qr, 7qt, 7sy, 7sz, 7th, 7to, 7tq, 7tt, (7uu), 7xd-fone, 7zb, 7zk, 7zo, 7zu, bq-3, 8ab, 8afd, 8apy, 8asu, 8asv, 8axb, 8azd, 8bdu, 8bef, 8bk, 8bnj, 8bum, 8bx, 8bxh, 8bxr, 8byt, 8cfz, 8cgx, 8cia, 8cm, 8cmi, 8cmx, 8csr, 8cur, 8dak, 8gf, 8ib, 8kg, 8ow, 8qk, 8vk, 8xj, 8yd, 8zag, 8zy, 8zz, 9aai, 9aau, 9abu, 9afk, 9ahh, 9aiy, 9ajh, 9ajp, 9amb, 9ami, 9ani, 9anq, 9aou, 9aps, 9apw, 9arz, 9asu, 9asv, 9atn, 9aul, 9awm, 9axu, 9baz, 9bbf, 9bds, 9bed, 9bey, 9bhd, 9bhk, 9bik, 9bji, 9bjv, 9bsz, 9bud, 9bxa, 9bxq, 9bzi, 9ccv, 9ckm, 9cmk, 9cns, 9cxp, 9dbv, 9ddj, 9ddy, 9dg, 9dge, 9dgl, 9dim, 9djm, 9dky, 9dr, 9dsm, 9dwk, 9dyn, 9ej, 9gk, 9hm, 9ii, 9kp, 9pi, 9ps, 9pn, 9rk, 9up, 9uu, 9ux, 9xac, 9xaj, 9yaj, 9zaa, 9zaf, 9zx. Can.—3co, 3dh, 3nb, 3xn, 4bv, 4dq, 5bq, 5cn, 5ct, 5do, 9ac, 9aw, 9al, 9bg.

Spark: 6acr, 6ala, 6amk, 6amw, 6ao, 6ark, 6awh, 6bip, 6btb, 6cc, 6gr, 6ic, 6km, 6qr, 6tc, 7ad, 7fr, 7ge, 7go, 7hd, (7im), 7lf, 7ot, 7tq, 7tw, 7ve, 7vf, 7vo, 7yh, 7yl, 7yr, 7zk, 7zu, bq-3, 9zc. Can.—5dx. 9bd. If interested write. Anyone hearng 7afh C. W. please QSL.

By 6BQY, 3101 S. Grand Ave., Los Angeles

C. W.: 3bq, 4by, 4jm, 5nb, 5xd, 5za, 5zy, 5zav, 6ak, 6bf, 6cc, 6cp, (6fh), 6gr, 6gx, 6km, 6ku, 6lk, 6nx, 6rd, 6tc, 6ti, 6tw, 6uw, 6vf, 6vm, 6xr, 6zb, 6zf, 6zh, 6zi, 6zx, 6zz, 6aag, 6aat, 6abx, 6ada, 6adw, 6aeh, 6ahp, 6ajf, 6ajh, 6akl, 6alx, 6aoi, 6aor, 6aqq, 6aqw, 6arf, 6asj, 6aun, 6awt, 6bcj, 6bcr, 6bic, 6bin, 6biq, 6bjy, 6bkb, 6bmd, 6bnv, 6bnw, 6boe, 6bql, 6bsa, 6bum, 6bur, 6bwp, 6bwy, 6xaf, 6xav, 6zac, 6zaf, 7bj, 7bk, 7lr, 7mf, 7ot, 7sc, 7tq, 7tw, 7xc, 7xi, 7aic, 8bk, 8dc, 8lt, 8qk, 8bef, 9xm, 9amb, 9bji, 9cns, 9dtm, 9zaf, kzn, kdym, kfad, kfay.

Spark: 6ds, 6ex, 6fh, 6qr, 6vx, 6zh, 6ahf, 6ahu, 6ajh, 6ajw, 6amw, 6atr, 6atu, 6aud, 6bju, 6bke.

Anyone hearing C. W. sigs of 6BQY pse. QSL.

Continued on page 44

CALLS HEARD

Continued from page 42

By 6BPB, 1254 10th St., Santa Monia, Calif.
C. W.: 5za, 6ax, 6aat, 6zh, 6cc, 7tg, 6xh, 6ku, 6aor, 7zo, 7ot, 9amb, 6ex, 9bji, 7jw, 9ii, 9bbh, 6aur, 7bj, 8zy, 8bo.

By 6BCD, Salida, Calif.
C. W.: 5za, (6ea), (6eb), 6ek, (6ft), (6gd), 6gp, 6gt, 6iu, 6iv, (6ka), 6kd, 6kc, 6ku, (6ky), 6lc, 6ld, 6lk, 6mh, 6ng, 6od, 6ol, 6om, 6ot, 6rr, 6tw, 6uo, 6up, 6vt, 6aag, 6aah, 6aak, 6ack, 6acy, 6ada, 6aef, 6aeh, 6afd, 6agf, 6agp, (6ahp), 6aib 6aic, (6aif), (6aio), 6aix, (6ajh), (6ajr), 6akl, 6akw, 6ald, 6alo, 6alu, 6amn, 6ant, 6aoa, 6apd, 6apw, 6aqu, 6aqw, 6aqw, 6aqy, 6ari, 6ark, 6ars, 6arv, (6as), 6atf, (6atq), 6aud, 6avn, 6bdw, 6beo, (6bf), (6beg), (6bjc), (6bju), (6bkb), (6bpz), (6bqc), (6bqd), 6bv, 6cu, 7bh, 7bj, 7bk, (7dp), 7ge, 7ih, 7jd, (7ke), 7kj, 7ll, 7lu, (7ly), (7mf), 7na, 7nf, (7nw), 7nz, 7oh, 7ot, (7qt), 7sc, 7sy, 7tn, 8asv, 8cop, 9ac, 9amb, 9dtm, 9gk, 9lq, 9wu.

By 6IY, Arcata, Calif.
C. W.: 5nc, 6xd, 6zav, 6av, 6bz, 6dd, 6ef, 6gf, 6iv, 6km, 6lo, 6om, 6pd, 6qm, 6rr, 6tc, 6ti, 6to, 6tw, 6vm, 6zh, 6zi, 6zr, 6zo, 6aau, 6aav, 6abq, 6acb, 6ada, 6agh, 6ahh, 6ahq, 6aiy, 6akl, 6alv, 6amn, 6aoi, 6aor, 6arf, 6ave, 6avr, 6bbh, 6bcl, 6beq, 6bfy, 6biq, 6bjb, 6bjr, 6bjx, 6bnt, 6bnu, 6bod, 6boo, 6bqr, 6bsj, 6bun, 6bvg, 6bvq, 6bvw, 6bwp, 6bwy, 6xav, 6xaw, 7bb, 7bk, 7cg, 7gp, 7hj, 7hm, 7jd, 7ke, 7ks, 7lc, 7oo, 7qe, 7qt, 7ri, 7to, 7ud, 7uu, 7wx, 7xf, 7zo, 7zu, 7zv, 7adf, 7adp, 7aem, 7afs, 7agv, 7agx, 7ahi, 7ahw, 7aic, 7air, 7bke, 9ii, 9pi, 9yb, 9amb, 9ami, 9ani, 9asf, 9avz, 9bie, 9ccv, 9cfy, 9cns, 9dtm, 9xaq. Can.—4bv, 5cn, 5ct, 9bd; be-1, bq-3, bt-3, cl-8; phone—6xd, 6xy, 6aat.

By 6PL, Hollywood, Calif.
Spark: 6ark, (6ahu), 6ahg, 6akt, 6bjr, 6km, 6gr, 6ul, 6qju, 6tu, 6ic, 6agu.
C. W.: 4ha, 4ia, 5za, 5zh, 6gk, 6awt, 6ajh, 6he, 6xh, 6atu, 6bcj, 6tw, 6anp, 6ic, 6aat, 6abx, 6xad, 6zf, 6cc, 6cp, 6ac, 6rm, 6aeh, 6aak, 6rt, 6bgd, 6rd, 6ahg, 6xr, 6ak, 6ava, 6ti, 6awh, 6bcr, 6ada, 6dd, 6kc, 6asj, 6aqw, 6bnw, 6zk, 6zx, 6akl, 6tc, 6zh, 6za, 7asu, 7lu, 7aem, 7tg, 7rf, 7su, 7lr, 7zo, 9amb, 9zaf, 9dtm, 9ha, 9amb, 9yw, 9doz, 9bji.

By 2BNK, 1284 Halsey St., Brooklyn, N. Y.
C. W.: 1aw, 1cc, 1ck, 1cn, 1dv, 1es, 1ft, 1gg, 1gu. 1gv, 1ix, 1jt, 1ki, 1lp, 1mv, 1qn, 1rd, 1sd, 1sk, 1xm, 1xo, 1xp, 1xu, 1yk, 1aao, 1aby, 1acm, 1agh, 1ahh, 1ais, 1aju, 1akl, 1all, 1amd, 1anc, 1anq, 1aod, 1aok, 1ard, 1arg, 1arq, 1ary, 1asp, 1asv, 1atj, 1aua, 1awf, 1awx, 1ayq, 1ayz, 1azl, 1azu, 1azw, 1baj, 1bet, 1bjn, 1bka, 1bkg, 1bnt, 1boq, 1bqd, 1bqe, 1bqk, 1brq, 1brr, 1bsj, 1btt, 1bwj, 1bwn, 1bwp, 1byk, 1byn, 1bzp, 1cac, 1cbs, 1ccl, 1cdo, 1cgn, 1cgr, 1cja, 1cjh, 1clh, 1cmk, 1cnf, 1cnj, 1cor, 1coz, 1cpm, 1cpo, 1ctp, 1cwj, 1ddy, 1djn.
Spark: 1aja, 1ava, 1cna, 1cni, 3ay, 3bg, 3bs, 3bo, 3bp, 3bv, 3by, 3bz. 3cc, 3co, 3ef, 3ev, 3ec, 3gh, 3hd, 3hg, 3hn, 3hw, 3io, 3me, 3nb, 3nr, 3od, 3oe, 3ot, 3oy, 3pz, 3rf, 3rh, 3sp, 3su, 3tb, 3tj, 3yo, 3xm, 3abw 3afb, 3agz, 3ajj, 3anj, 3ans, 3aoi, 3ary, 3aso, 3asp, 3asy, 3avc, 3axb, 3bai, 3bfq, 3bhv. 3bal, 3bis, 3bnu, 3bnv, 3 bof. 3bsb. 3buc, 3buv, 3bva. 3bvc, 3chr, 3coe, 3cor, 4bq, 4bx, 4cx, 4ea, 4ed, 4ft, 4gh, 4hk, 4jh, 4jy, 4ml, 4nt, 4nv, 5eg, 5cx, 6ale, 8ck, 8cr, 8dc, 8dl, 8dy, 8eh, 8er, 8fi, 8gt, 8hk, 8hs, 8ju, 8kg, 8lm 8nn, 8py, 8ok. 8rs, 8ue, 8vf, 8xe, 8xg, 8xv, 8yn. 8zq, 8aaq, 8abn, 8adh, 8adn, 8ado, 8agu, 8aio, 8alt. 8amo, 8amp, 8amq, 8anj, 8ano, 8aol. 8ask, 8asl, 8asu, 8asv, 8atn, 8atu, 8awz, 8axb, 8axl, 8axn, 8ayl, 8bbt. 8bdo, 8bef, 8beo, 8bfm. 8bfx, 8blt. 8bnc, 8bnj, 8bny, 8bpl, 8brg, 8btj. 8bvt, 8bxh. 8car, 8caz, 8cbt, 8cgu, 8cjz, 8cmi, 8cnj, 8cnn. 8cnw, 8coi, 8crd, 8ctz, 8cyt, 8dnj, 8xae, 9al, 9ay, 9bd, 9di, 9ex, 9ib. 9ii, 9io, 9kp. 9nf, 9ot. 9tb, 9uu, 9xn, 9aae, 9age, 9aio, 9aix, 9ami. 9anq. 9anz, 9ans, 9arb, 9arc, 9ark, 9bcb, 9bhd, 9bld, 9cns, 9ctp, 9dby, 9dfb, 9dgy, 9dyn.

By 6ZT, Box 772, Salt Lake City
C. W.: 4dq, 5px, 5qi, 5za, 5zh, 5zu, 6aat, 6abx, 6ada, 6ahp, 6ahq, 6aiy, 6ajh, 6ak, 6aoi, 6apw, 6aqq, 6aqw, 6atg, 6atq, 6auu, 6avd, 6avr, 6bbc, 6bcr, 6bdw, 6bin, 6bjc, 6bjq, 6bjr, 6bjy, 6bkb, 6bnw, 6bpz, 6bqg, 6bqr, 6bqz, 6brg, 6brk, 6btb, 6bum 6bun, 6bvg, 6bzl, 6cc, 6cp, 6cu, 6ea, 6ft, 6gd, 6gf, 6gr, 6jd, 6ka, 6lv, 6pi, 6rr, 6tc, 6ti, 6uw, 6vf, 6vm, 6wi, 6xad, 6xas, 6xav, 6zf, 6zh, 6zx, 7abh, 7aem, 7bk, 7bj, 7gk, 7hm. 7lu, 7mf, 7ny, 7ot, 7sc, 7tq, 7zb, 7zo, 9ahh, 9amb, 9ami, 9aog, 9apw, 9arz, 9aul, 9avz. 9awm, 9axm, 9axu, 9bey, 9bgh, 9bji, 9bly, 9bri, 9bun, 9bvo, 9bxq, 9cfy, 9ckm, 9cmk, 9cns, 9dge, 9dky, 9dr, 9dsm, 9dte, 9dtm, 9ew, 9fm, 9fv, 9gk, 9pi, 9pm, 9pn, 9ps, 9xaq, 9yaj, 9zaf, 9zx. Can.—4bv, 4hh; ad7. Spark: 5zh, 6aau, 6afq, 6agk, 6amw, 6btb, 6ex, 6lu, 7wg, 7zu, 9yak. Voice—9cnn.

Continued on page 46

Adds 1000 Miles with Bradleystat!

Allen-Bradley Co.:

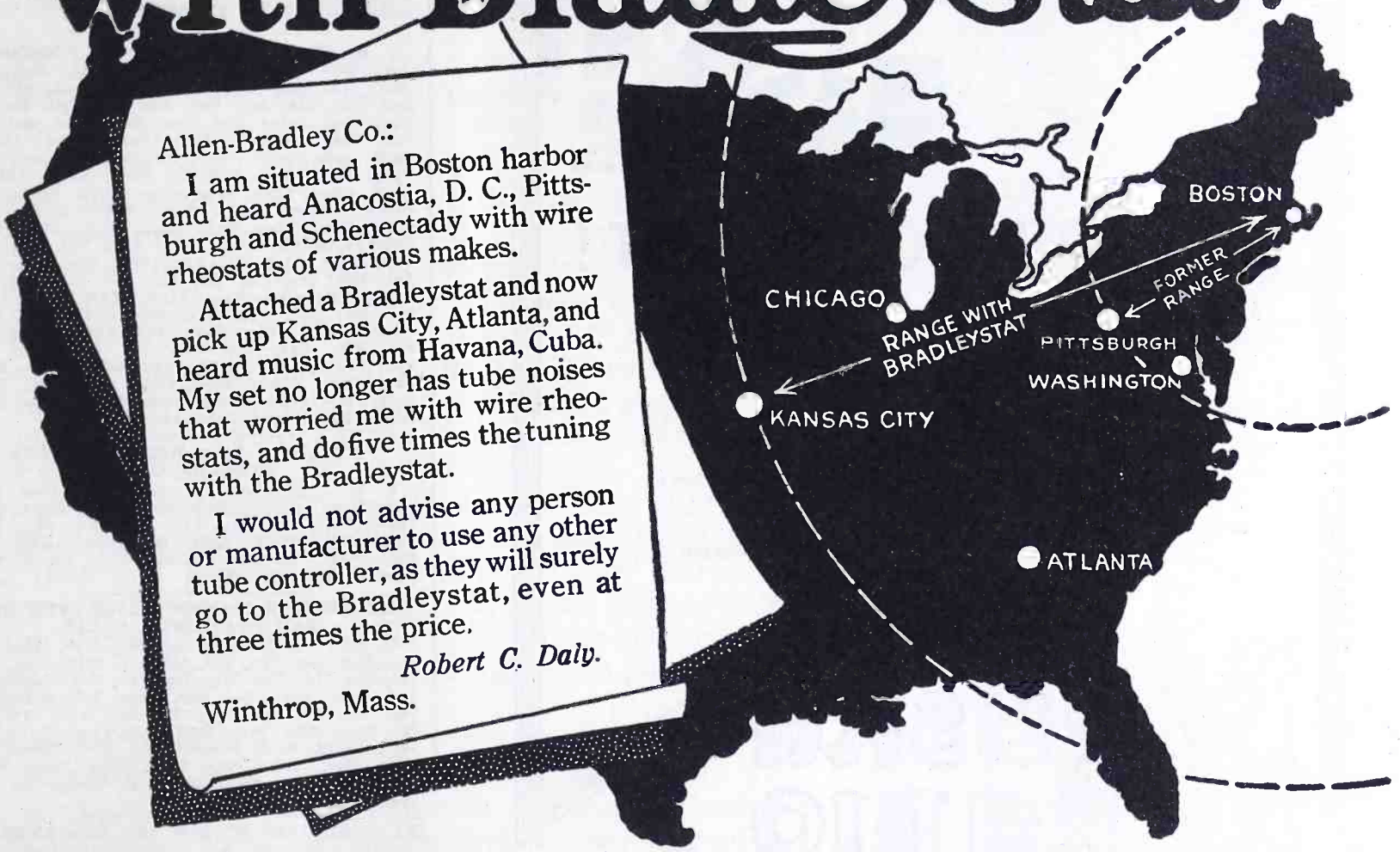
I am situated in Boston harbor and heard Anacostia, D. C., Pittsburgh and Schenectady with wire rheostats of various makes.

Attached a Bradleystat and now pick up Kansas City, Atlanta, and heard music from Havana, Cuba. My set no longer has tube noises that worried me with wire rheostats, and do five times the tuning with the Bradleystat.

I would not advise any person or manufacturer to use any other tube controller, as they will surely go to the Bradleystat, even at three times the price.

Robert C. Daly.

Winthrop, Mass.



Retail Price

$1.85

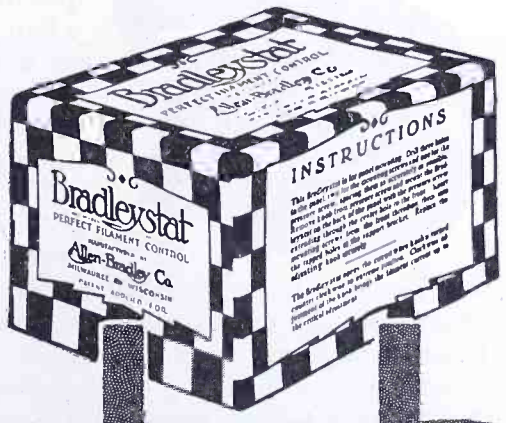
P. P. 10c Extra

Fully Guaranteed Against Defects

Extend your receiving range, too!

Mr. Daly's letter is one of hundreds received from enthusiastic Bradleystat users. The improvement in range, clearness and speed of tuning surprises everyone. Try a Bradleystat, tonight.

Another Allen-Bradley product is the Bradleyometer, the perfect potentiometer. If you use a potentiometer in your set, write for latest Bradleyometer bulletin.



Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Ave., Milwaukee, Wis.

MEMBER OF
National Radio Chamber of Commerce

Bradleystat

REGISTERED U. S. PAT. OFF.

PERFECT FILAMENT CONTROL

Tell them that you saw it in RADIO

CALLS HEARD

Continued from page 44

By 9ABV, 226 East 6th St., Hutchinson, Kans.

C. W.: 2el, 3afb, 3bvc, 4dc, 4eb, 4ft, 4gh, 4id, 4kf, 4km, 4fg, 5ek, 5ba, 5nk, 5kp, 5pf, 5gk, 5pv, 5nv, 5nn, 5ok, 5tm, 5sm, 5uc, 5aec, 5anv, 5za, 5xa, 6ao, 6cu, 6ka, 6kl, 6ani, 6abx, 6avd, 6avr, 6bun, 7gk, 7zo, 8cf, 8cp, 8ju, 8qk, 8zx, 8zz, (8tj), 8zy, (8axb), 8azr, 8asv, 8axc, 8awz, (8awu), 8bep, 8bgt, 8bxc, 8bvx, 8bxh, 8cgx, 8zag, 9pn, 9nu, 9zx, 9zn, (9abm). Anyone hearing 9ABV please QSL.

By 6BQL, 575 21st Ave., San Francisco

C. W.: Can. 4bv, 5ek, 5fv, 5kc, 5my, 5nb, 5nn, 5px, 5sm, 5uo, 5za, 5zaa, 5xad, 6bf, 6cc, 6cu, 6ea, 6eb, 6ec, 6eo, 6en, 6ft, 6gd, 6iv, 6jd, 6ka, 6ku, (6lo), 6pi, 6pt, 6tw, 6wr, 6zf, 6zn, 6zz, 6aag, (6abx), 6ada, 6aeh, 6ahp, (6ahq), 6ajh, 6alu, 6amt, 6aoi, (6apw), (6aqw), 6atg, 6atq, 6avd, 6avn, (6avr), 6avv, 6bbc, (6bdw), 6beg, 6beq, 6bes, 6bjc, 6bjy, 6bkb, 6bko, 6bki, 6bmd, 6boe, 6bpj, 6bpz, 6bqc, 6bqd, 6bqf, 6bqg, 6bqp, 6bqz, 6brf, 6brk, 6bum, 6bun, 6bvg, (6bwy), 6xad, 6xas, 6xav, 7ad, 7bj, 7bk, 7dp, 7du, 7hm, 7iv, 7jf, 7jw, 7lu, 7ng, 7nn, 7ny, 7ot, 7qk, 7ra, 7sc, 7sf, 7sq, 7sy, 7th, 7tq, 7uu, 7wm, 7zb, 7zk, 7zu, 7aem, 7aft, 7afw, 7aic, 8cf, 8ib, 8ml, 8on, 8qk, 8xe, 8yd, 8aim, 8aks, 8amt, 8anb, 8asv, 8bke, 8ea, 8bxa, 8xae, 9av, 9cr, 9fm, 9gk, 9kp, 9pn, 9qf, 9xm, 9yf, 9zn, 9zx, 9aap, 9afk, 9amb, 9anq, 9aon, 9aps, 9apw, 9aul, 9avz, 9awm, 9ays, 9bds, 9bed, 9bji, 9bun, 9cfi, 9cfy, 9cmi, 9cmk, 9cns, 9dhb, 9doz, 9dtm, 9dum, 9dyn, 9yaj, 9zaf, 9xac, 9xaq.

BY 6BVG, 1926 DELTA ST., LOS ANGELES, CALIF.

C. W.: 5xd, 6cc, 6zh, 6aat, 6akb, 6aqa, 6bkb, 6avr, 6aag, (6bcr), 6btb, 6awt, 6bjq, 6bnw, 6xav, 7aem, 7bjz, zrn, 7aq, 7tq, 7zb, 8yd, wkg, 6xad, 9aul, 9bji, 9bey, 9cns, 9pi, 9zaf, kzn, wgg, broadcast. Anyone hearing 6bvg on 20-watts pure C. W. pse. QSL.

BY ARTHUR MARTINI, 3948 26TH ST., SAN FRANCISCO, CALIF.

C. W.: bt-3, 4bv, 5di, 5eg, 5ek, 5kc, 5uj, 5xa, 5xd, 5za, 5xv, 5pb, 5sf, 6zz, 6ajh, 6atq, 6zac, 7bj, 7jw 7lu, 7rn, 7tn, 7tq, 7zo, 7zu, 7aem, 8lv, 8yd, 8adz, 8cgx, 8cf, 8ab, 8bke, 8nb, 8bfm, 8cf, 9ac, 9cr 9ej, 9gk, 9hr, 9ii, 9kp, 9pi, 9yi, 9yu, 9zn, 9aau, 9afd, 9ami, 9anq, 9aon, 9aps, 9apw, 9arz, 9aul, 9aum, 9avz, 9awm, 9ays, 9bct, 9bhd, 9bji, 9bkp, 9bxq, 9cfy, 9cns, 9cow, 9doz, 9dtm, 9dwk, 9yaj, 9zaf, kwh, kfc, kzn, kn4, kfay, wpa, cfcn (Can.), kfi.

BY 6BQI, 1878 W. 23D ST., LOS ANGELES

C. W.: 2fp, 4bq, 4bv, 5ct, 5ck, (5za), 5di, 5yq, 5zh, 5yr, 5kc, 5xy, 5acf, 5fa, 5ul, 5qi, 5rh, 5egx, 5xd, 5px, 6aiv, 6asc, (6atq), (6ak), 6asu, (6cc), 6cp, (6byj), 6arb, 6bkh, 6zx, 6bqf, (6rd), 6zac, 6aya, 6bic, 6vw, 6zz, (6ajh), 6auu, 6rg, 6rk, 6avr, 6bqm, 6bum, 6uw, 6aat, 7dp, 7oz, (7lu), (7tq), 7jf, 7ll, (7zb), 7jo, 7ax, 7lr, 7sm, 7sy, 7zaa, 7wm, 7ba, 7aem, 7zo, 7zu, 7oi, 7ot, 7jw, 7bu, 7ud, 7mf, 8awp, 8zx, 8asv, 9xaq, 9amb, 9cjj, 9ayu, 9dtm, 9acg, 9bji, 9avq, 9cuc, 9pi, 9awm, 9xay, 9dsm, 9dug, 9ccv, 9cow, 9zaf, 9dky, 9arz, 9zn, 9ps, 9bey, 9gd, 9com, 9cnx, 9ajx, 9bd, 9can, 9bed, 9cfy, 9cry, 9qt. 9aw, 9anq, 9avz, 9xm, 9ag, 9zx, 9zv, 9cns.

BY 6BWU, SEBASTOPOL, CALIF.

C. W.: Can. 4bv, 5aa, 5cy, 5di, 5eb, 5ek, 5fv, 5kc, 5nk, 5pb, 5px, 5sk, 5uj, 5za, 5zav, 7bj, 7bk, 7dp, 7jw, 7ln, 7lr, 7mf, 7ng, 7oe, 7oi, 7qt, 7ri, 7rn, 7sf, 7si, 7sy, 7vf, 7we, 7zo, 7adp, 7aea, 7aem, 7aft, 7afw, 7ahw, 8an, 8bk, 8bx, 8qk, 8sw, 8yd, 7yn, 8zk, 8zz, 8aim, 8amn, 8apw, 8asv, 8cgp, 8vae, 8zag, 9aw, 9bj, 9dn, 9ei, 9qk, 9ii, 9xr, 9amb, 9anq, 9aou, 9arz, 9aul, 9avu, 9avz, 9awm, 9bds, 9bji, 9ccv, 9cfy, 9cgp, 9cns, 9dtm.

BY 6BWE, 3081 W. PICO ST., LOS ANGELES, CALIF.

C. W.: 2xy, 3mb, 3aln, 5au, 5un, 5mn, 5za, 5zh, 6atq, 6boe, 6zz, 6bnw, 7ac, 7mf, 7na, 7lu, 7ot, 7tq, 7aea, 7afw, 7zb, 7zu, 7bu, 7sy, 7ke(?), 8zy, 8zz, 9aja, 9amb, 9apw, 9anq, 9bui, 9bxq (dalite), 9dsm, 9dte, 9dtm, 9cfy, 9yaw, 9zn, 9zx, 9xaq, 9zaf, Can. 9aw.

BY 6AVR, FULLERTON, R. D. NO. 3, CALIF.

C. W.: 3ot, 4eb, 4eh, 4by, Can. 4bv, 5fa, 5ek, (5ir), 5kc, 5nk, 5nn, 5px, 5qy, 5sm, 5un, 5vo, 5xa, (5xd), 5xk, 5xu, 5xy, 5xad, 5xaj, 5za, 5zap, 5zav, 7bk, (7bj), 7dp, 7gk, 7hj, 7jw, 7lr, 7lu, 7ny, (7ot), 7qn, 7qt, 7sc, 7sf, 7th, 7tq, 7ud, 7aem, 7afw, 7xi, 7zb, 7zk, 7zo, 7zu, 7zv, 8cf, 8ib, 8ml, 8qk, 8vy, 8aim, 8aqo, 8asv, 8bpl, 8byf, 8cmi, 8xe, 8xae, 8yd, 8zy, 9ac, 9gk, 9ii, 9kp, 9ox, 9pi, 9ps, 9ql, 9afd, 9aix, 9ajp, 9ajw, 9aku, 9amb, 9ami, 9ani, 9anq, 9aog, 9aps, 9apw, 9arz, 9aul, 9avz, 9awl, 9awm, 9bds, 9bed, 9bey, 9bie, 9bik, (9bji), 9bri, 9brk, 9bun, 9bxq, 9bzi, 9ccj, 9ccm, 9ccv, 9cfb, 9dky, 9dsm, 9dte, 9dtm, 9dwk, 9cfy, 9cns, 9cow, 9xaq, 9yah (spk), 9yaj, 9zn, 9zx, 9zaa, 9zaf, ad7 cy1. Above heard on Groves Coils and 1 step A.F. Anyone hearing my C. W. pse. QSL.

Continued on page 48

Don't Blame It On Static!

The Real Explanation of Much of the Trouble You Have with Your Radio Set

ONE of the things which the radio world is rapidly learning is that the term "static" has been very loosely used to cover a multitude of radio sins for which static is really in no way responsible.

It is discovering that many of the frying, crackling noises and much of the so-called interference laid at static's door are due to nothing more or less than *the use of batteries of the wrong kind or that leak an excessive amount of electricity*.

Any one of these battery faults can undo the most careful work in construction of set and aerials, and usually not only one but two or three of them are present in the same place.

Radio operators should remember particularly that "B" batteries are in series with the phones or amplifying horn and that any noises set up within the "B" batteries themselves will come in strong. You can demonstrate this to yourself by scratching your "B" batteries with your finger-nail. The noise you get through your phones will surprise you.

A growing understanding of these facts is leading to much greater care in the selection of batteries and to the use of high grade storage batteries for both A and B work, since such storage batteries have just the characteristics needed for both efficiency and economy in radio service.

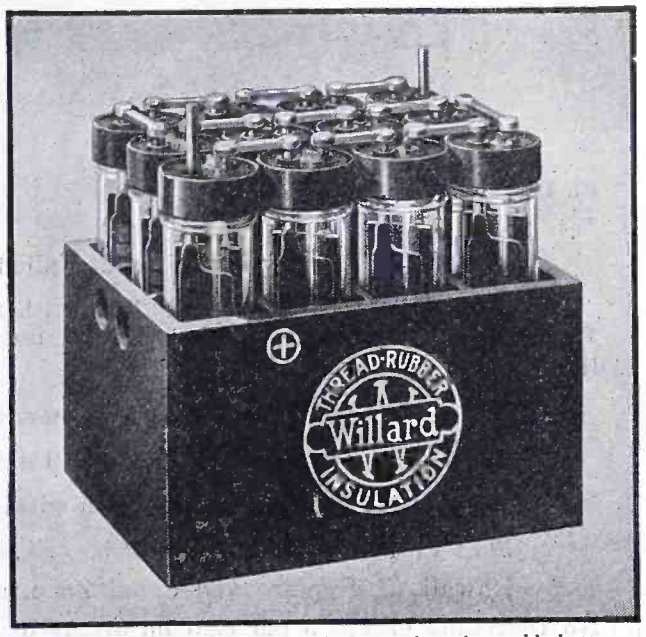
An interesting development in this connection is the new type of "B" battery and an all-rubber "A" battery put on the market by the Willard company. In these batteries, electrical leakage, which is present to such a great extent in the ordinary battery and which accounts for so much noise, is to a great extent ingeniously overcome.

The "B" battery cells are cylindrical glass jars with hard-rubber, screwed-on covers. These are so spaced that the only contact between cells is through heavy, burned-on connectors. No sealing compound is used and the box is cut down so that the sides reach up only about half way to the tops of the jars.

These features and the use of threaded-rubber insulation, operators find, result in a battery which holds its voltage, is never sluggish and, with occasional recharging, lasts for years.

Inasmuch as this big improvement can be effected at an actual saving of money because of the long life of a really good storage battery, there is no question that this type of battery will rapidly be adopted for a great majority of sets. When this is done, the bugaboo of "static" will lose much of its terror.

Willard Storage Battery Co., Cleveland, Ohio



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

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

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

Tell them that you saw it in RADIO

CALLS HEARD

Continued from page 46

BY 5CD, 1439 COMOX ST., VANCOUVER, CANADA

C. W.: 4br (Can.), 4hh, (Can.), 5be, 5sm, 5xad, 5qy, (Can. 5s too numerous), 6awt, 6ak, 6oh, 6arb, 6agp, 6ah, 6atc, 6aoi, 6alu, 6aqw, 6zx, 6xp, 6zf, 6ku, 6ft, 6rr, 6bj, 6zs, 6xad, 6bu, 6ajh, 6ber, 6zh, 6bc, 6qh, 7aea, 7sf, 7sc, 7zk, 7qn, 7ce, 7ha, 7vf, 7eae, 7vt, 7wm, 7zb, 7aft, 7jw, 7bm, 7sy, 8cur, 8qt, 8ow, 9ac (Can), 9awm, 9aua, 9zaf, 9cns, 9ani, 9zk, 9ays, 9xaq, 9sk, 9yaj,9yat, bq3.

Spark: 6qr, 6acr, 6cc, (7bk), 7oz, 7ge, 7wg, 7nn, 7nw, 7fr, 7mu.

Anyone hearing 5CD quarter kw. spk. pse QSL.

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

C. W.: 1bas, 4ak, 4iv, 5di, 5ek, 5is, 5kb, 5la, 5ul, 5za, 5zw, 6cc, (6cu), (6ea), (6eb), (6en), (6fh), (6gf), (6iv), 6jd, (6ka), (6ku), (6lo), (6pi), (6rd), 6tw, 6zg, (6zh), (6zs), (6zx), (6zw), 6zz, (6aat), (6abx), (6agp), (6atz), (6bjc), (6bit), (6ajh), 6avd, 6awp, 6bcj, (6zac), 7af, (7bb), (7bk), 7cu, 7dp, 7gk, 7hy, 7ic, 7iy, 7lf, (7lr), 7lu, 7mf, 7ny, (7ot), 7oz, 7pf, 7sc, 7sn, 7th, (7tq), 7zb, 7zk, 7zp, 7aad, 7aaw, (7aea), (7adp), 7ahw, 8cc, 8cgp, 9ay, 9gk, 9pi, 9zn(voice & C. W.), 9aab, (9amh), 9aif, 9ani, 9anq, 9aog, 9aqi, 9awa, 9awm, 9aya, 9bji, 9bsq, 9caj, 9cns, 9dgi, 9dte, 9dtn, 9xac, 9xja, 9yaw, 9zaf, Can. 9ac.

Spark: 4le, 5ar, 5hk, 5kc, 5la, 5tc, 5tk, (6eb), (6ke), (6oh), 6qr, (6aak), (6ahp), 6ajh, 7ac, 7aw, (7bb), 7bk, 7bj, 7dp, 7ed, 7qa, 7hf, 7in, (7iw), 7ka, 7kj, 7ly, 7mf, 7mi, 7pr, 7qk, 7qt, 7qu, 7tj, (7to), 7ya, 7yg, 7ze, 7zn, (7aea), 8acf, 9nn, 9hi, 9xu, 9bss, 9dva, Can. 9bd, cl8. All hearing my C. W. pse qsl.

BY 6AFS, 2007 N. VAN NESS AVE., FRESNO, CALIF.

3co, 3nb, 4bv(Can.), 5aa, 5aw, 5dd, 5ek, 5la, 5nk, 5xd, 5kc, 5zh, 5cc, 5za, 5xad, 6zb, 6zz, 6ada, 6bal, 6bjy, 6bip, 6atq, 6zh, 6bkh, 6ack, 6ku, 6awh, 6bbh, 6akl, 6xz, 6aeh, 6tw, 6rm, 7bj, 7dl, 7jf, 7la, 7lu, 7lz, 7mf, 7nw, 7pf, 7rv, 7sy, 7tq, 7xd, 7xj, 7zb, 7za, 7zk, 7zo, 7zu, 7zf, 7adf, 7ot, 7gk, 7sf, 7we, 7xf, 7hm, 7ny, 7aem, 7aft, 7jw, 7af, 7ad, 7nb, 7th, 7afw, 7hy, 7rn, 8cf, 8sp, 8vy, 8aqo, 8bnj, 8axn, 8ow, 8yd, 8ml, 8bf, 8zn, 8xad, 8zy, 9xj, 9afo, 9amb, 9aob, 9aps, 9apw, 9arz, 9aul, 9awm, 9awq, 9cns, 9bji, 9cfy, 9dte, 9dtm, 9hji, 9xaq, 9zaf, 9aw, 9cow, 9bbf, 9yaj, Can. 9al, 9dn, 9bun, 9bag, 9bds, 9kp, 9anq, 9cf, 9ac, 9au, 9bx, 9gk, 9kt, 9pi, 9xa, 9xm, 9ql, 9dky, 9dg, 9bed, 9ci, 9ya, 9yah, 9bi, 9bxq, 9ami, 9afd, 9zac, Can. 9bd, 9aap, 9ii, 9bju.

BY 6BEQ, ROUTE 1, BOX 76A, PUENTE, CALIF.

C. W.: 2fp, 2lo, 3blf, 3nb(Can.), 3cd(Can.), 4bq, 4eb, 4bv(Can.), 5ae, 5di, 5fa, 5kc, 5ek, 5nk, 5px, 5sk, 5sm, 5qy, 5un, 5uj, 5xa, 5xb, 5xy, 5xad, 5xd, 5zh, 5za, 6cp, 6ex, 6gr, 6gx, (6nx), (6lu), (6uw), 6asj, (6aat), 6arb, (6abx), 6aoi, 6atc, (6atq), 6aor, 6auu, 6awt, (6bcj), 6bql, 6bqy, 6bum, (6bsa), 6ze, 6zf, 6zb, 6zh, 6zx, 7ad, (7bj), 7bk, 7gk, 7lu, 7ng, (7mf), 7jw, 7ot, 7sc, 7sy, (7tq), 7wm, (7aem), 7aft, 7xf, 7rn, 7zb, 7zg, 7zo, 7ya, 8cf, 8ib, 8qk, 8yd, 8zx, 8zz, 8agz, 8ani, 8asu, 8axn, 8bdo, 8bke, 8bpl, 8bxa, 8bxh, 8bgg, 8xk, 9dn, 9dr, 9ei, 9ew, 9gk, 9lz, 9nu, 9nx, 9pi, 9pn, 9ps, 9wd, 9xm, 9ye, 9amb, 9ani, 9anq, 9anz, 9aog, 9aqm,9aqs, 9arg, 9aul, 9auz, 9awm, 9axa, 9ayu, 9bds, 9bed, 9beq, 9bex, 9bey, 9bie, 9bjv, 9bji, 9bri, 9bax, 9bxq, 9cde, 9cfy, 9cns, 9com, 9cow, 9dsm, 9dte, 9dtm, 9xaq, 9yaj, 9zaf, 9dky, 9bik, 9xac, 9ami, Can. 9al. Anyone hearing my C. W. please qsl.

BY 6BVA, SAN MARCOS, CALIF.

C. W.: 5zh, 5za, 6cc, 6bic, 6apw, 6gr, 6aw, 6bjy, 6bjk, 6zf, 6bu, 6abw, 6gx, 6bej, 6auu, 6zx, 6bum, 6bko, 6bdw, 6vr, 6rk, 6vf, 6uw, 6buc(phone & C. W.), 6ku(phone & C. W.), 6atj, 6bjx, 6av, 6gf, 6atc, 6avr, 6bjk, 6bcq, 6ti, 6amn, 6bjq, 6up, 6ak, 6bcj, 6boo, 6ajf, 6awt, 7tq, 7lu, 7gk, 7jw, 7zo, 7ow, 8aqo(not verified yet), 9bxq, 9bey, 9bji, 9cfy, 9cns.

Spark: 6gr, 6kc, 6ala, 6aw, 6za, 6aau, 6qk, 6ark, 6iv, 6tu, 6nv, 6amk. All heard on regenerative set with one tube.

BY ROLAND SMITH. 113 ULULANI ST., HILO, HAWAII

C. W.: 6brk, 6xac, 6bko, 6aer, 6cp, 6xwi, 6ki, 6xp, 6aav, 6xad, 6ajh, 6lq, 6ag, 6ec, 6atg, 6zx, 6zg, 6ada, 6aag, 6abx, 6tq, 6en, 6cc, 6alu, 6bdw, 6gr, 6ka, 6bpm, 6apw, 6brj, 6zr, 6ak, 6bun, 6akt, 6ajf, 6xj, 6zi, 6zz, 6bqp, 6aqw, 6baf, 6bjr, 6bbc, 6zf, 6avd, 6gf, 6zh, 6bqz, 6bvg, 6te, 6eo, 6bq, 6zs, 6zb, 6bjy, 7zm, 7sc, 7tq, 7xig, 7zo, 7aiy, 7wm, 7xd, 7zu, 7scm, 8xe, 8yd, 8bk, 9zaf, 9akb, 9ps, 9bji, 9awm, 9ac, 9cuc, 9bzi, 9afd, 9yaw, 9gk, 9dky, 9zac, 9ays, 9wei, 9cns, 9ck, 9apw, 9anq, 9cmk, 9dsm, 9pi, 9bey, 9zx, 9bzi, 5ga, 5sf, 5xad, 5bbc, 5xd, 5pb, 5acf, 5za, 2brb, 2nz, 2zk, 3cc, 3yo, 3afb, 3ot, wvba, nrrs.

Spark: 6aqu, 6bju, 6ald. 6aic.

Phone: 9zm, kdn, kfc, kfi, kgu, kgw, khj, klp, klx, kog, kpo, kre, kuo, kuy, kvq, kwg, kwh, kyg, kyj, kzn, kdpt, kdyn, whb, wbap, & whab.

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From the most humble home to the elaborate drawing room, Crosley Instruments are preferred. Regardless of the many higher priced instruments on the market, the man who knows—even if he can afford to pay more—will choose Crosley.

There is no secret in this. Crosley Instruments are the acme of efficiency and simplicity and their construction is based on sound fundamental principles. Numerous tests by disinterested parties all over the country will bear us out in this statement.

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If you are a Jobber or Dealer and do not already handle Crosley Instruments, you will be wise to satisfy the demand that our national advertising has created.

Complete sets from $25 up, all kinds of parts and experimental units.

CROSLEY
BETTER-COST LESS
RADIO

Write for Catalog

CROSLEY MANUFACTURING CO.
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CROSLEY RECEIVER MODEL X

A four tube outfit the same as shown in the above scene. It consists of tuner, one stage of Tuned Radio Frequency Amplification (the feature that has made this set so popular) Detector and two stages of Audio Frequency Amplification in a beautiful mahogany cabinet. It will bring in distant stations loud and clear. With this set, listeners in Florida have heard Winnipeg, San Francisco and Honolulu. Price without phones, batteries or tubes..... $55.00

Tell them that you saw it in RADIO

THE FIRST SHIP

Continued from page 14

associating indiscriminately with the ship's crew. How many thoughtless youths are "all over the ship," spending their leisure time in the company of the sailors, wipers, and coal-passers; how many make a firemen's and watertenders' lounging parlor out of the wireless room; and how many have been catapulted from the forecastle poker-table with the well-aimed assistance of the foot of a wrathful shipmaster—and then wonder why they are held in no regard by their fellow officers! Some may retort that there are just as good fellows in the forecastle as there are in the cabin; and in this I heartily agree—some better perhaps;—but, nevertheless, there is a discipline aboard ship which time and experience have proved necessary; and it is this discipline that is violated when anything more than the most casual relations exist between the officers and the crew.

Except when some one has a message to send, members of the crew therefore should not be permitted in the wireless room; unnecessary conversation with them is to be avoided, or at least circumscribed; and neither room-stewards nor any one else—unless the officer—should ever be permitted to listen-in at the wireless set. Some of the crew may attempt to come in and sit around in the wireless room, because other operators have encouraged them to do so; in which case they should be told a courteously as possible, but frankly, that they are not desired in the radio cabin unless on business.

During the war the wireless service companies were forced to employ some pretty low grade operators—it is a mystery how they came to take up radio; they were not amateurs—who spent so much of their time in the company of the crew that the United States Shipping Board issued a special circular-letter to the effect that this sort of men was not wanted in the merchant marine and that they would be permanently discharged as quickly as self-respecting operators could be obtained to fill their places.

The radio operator is rated as an officer aboard ship; he is furnished with an officer's accomodations and he eats in the officers' mess or with the captain; therefore, let him *be* an officer. It is hoped that this advice will not be mistaken as snobbish; every experienced radio operator and every steamship commander will testify that it is not in the least so. I myself have done some of the things here criticized; so it may be deduced that what I have written is from experience. Ship discipline must be respected, or the violator of it will not be.

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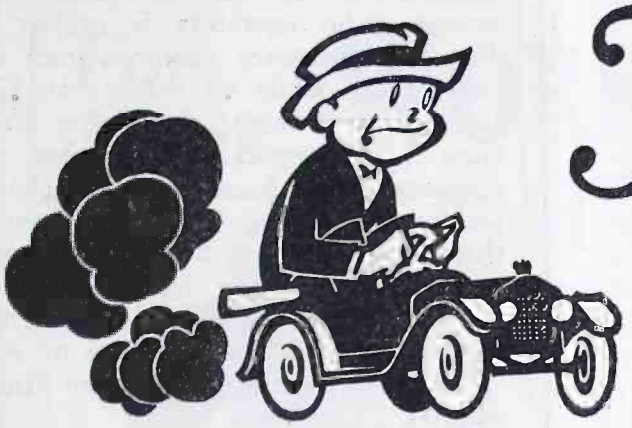

For the money the Ford is a very good car

You get a place to sit between four wheels that keep going. You don't expect quality-car looks, finish, comfort or smoothness of operation. You get about what you pay for.

It is not otherwise with radio apparatus. There are single-circuit receiving sets that sell for less than the Paragon three-circuit receiver. All single-circuit receivers will let you listen in, after a fashion, on radio programmes. You will, of course, get mixed messages, discordant music and general jamming between the numerous powerful broadcasting stations that are all operating on one narrow wave band.

If you want to get real service, pleasure and satisfaction out of radio, you will be well advised to buy a receiving set that is something more than a make-shift. Ask some experienced radio amateur what he knows about

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

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

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

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

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

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

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

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After improper bearing toward the ship's crew, the next commonest fault among radio operators is neglect of duty. Unnecessary absences from the radio room while on watch; working shifts slept through; clandestine flirtations with vampish maidens when the operator should be wearing the phones and keeping his log,—these are some of the things that have brought into existence that extremely humiliating rule on some of the passenger ships that the operator on watch must report or ring up on the bridge telephone every fifteen minutes.

On the smaller passenger ships, where mingling with the passengers by the officers is not objected to, there is perhaps no harm, when off duty, in competing with the chief engineer for the favors of the prettiest girl on the promenade deck—but let the watches be religiously observed. An excessive proneness to take charge of every passing "dame," "baby," and "doll" has landed more than one operator ignominiously on the pier astraddle his pasteboard suitcase—including the writer.

On the cargo ship of course there are no pretty blondes or brunettes to distract the operator's mind (fortunately or not, according to one's view of the matter) and here there are no strict hours of watch to be observed; but still the operator is wise who sticks pretty close to the wireless room, even when not actually listening in. Every captain is irritated when he sees the radio operator hanging around in every part of the ship except in his own quarters.

The cargo-steamer operator should plan to put in from seven to eight hours out of the twenty-four actually at the radio set, in ordinary weather; and when fog set in or when a heavy gale is blowing, the conscientious operator will listen-in intermittently at all reasonable hours for possible distress signals. The radio operator is indirectly responsible for the lives of those on other ships within his immediate range; in case of disaster his attention to duty may mean the saving of many. If he is not concerned about this, then let him at least think of the possibility of salvage money, since he is of the type who can look no higher—or let him picture his own ship doomed and himself broadcasting S-O-S signals upon a vacant ether.

Surrounded by plenty of magazines and good books, the wireless operator can make of his radio room the pleasantest place on the ship. If he craves company, he can occasionally seek that of his fellow officers; but it is especially well on shipboard always to keep in mind that saying in the Wise Old Book about not busting in on your neighbor too often, lest he at last gets sick of

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you and throws you out. Seeing the same small circle of faces day after day on a long ocean voyage is harrying to even the mildest temper.

The cargo-ship operator has a splendid opportunity for study and self-improvement; and if he fails to avail himself of this opportunity, it is pretty safe to say that he will some day remember and regret not having done so. I am acquainted with several tramp-steamer brasspounders, good enough operators all of them, whose philosophy of life is quite similar to that of the indolent Filipino boy into whom the American teacher was trying to instill a desire for study.

"Study?" blinked the brown-skinned son of Luzon, basking luxuriously in the drowsy summer shade of a coconut tree. "Why for, study?"

"Don't you want to learn to read and write; and get up in the world?" returned the government teacher. "Perhaps you might become a smart business man, and make a lot of money,"

"Business man—money," mused the young native, resting his head lazily on his elbow and digging his toes into the warm sand. "Why for, money?"

"For goodness sake!" exclaimed the teacher, somewhat taken aback. "Why when you have plenty of money, you won't have to work any more."

"Oh, I don't have to work now," yawned the bronze-hued child of the sunny Philippines; and he lay down again on his palm leaf and went back to sleep.

A frequent and a very serious fault among radio operators is the habit of divulging the contents of ship-business telegrams to those who have no right to the information. When the captain puts a message into the hands of the radio man he expects it to be transmitted—not published all over the ship; —and, likewise, when special orders are received in mid-ocean or elsewhere pertaining to the movement of the ship, the message should be delivered to the commander, and never a word of it divulged to anybody else, neither crew nor officers.

It is the captain's prerogative to disclose ship's orders; and he resents it when the operator forestalls him, even though it be in connection with something of a trivial nature. Not only this, but in revealing the contents of a message, the radio operator is guilty of a violation of the oath of secrecy on his certificate, and he is therefore liable to suffer the revocation of his license, or he may be prosecuted even. When anybody asks about things which are none of his affair, it is not hard to say "I don't know."

The operator is at liberty to give out press reports and similar general dead-

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(That's Wireless for "Attention!")

LISTEN IN, everybody. This message is for YOU. Radio promises more than ever for the coming season. Are you going to get your share of the fun, the entertainment, the culture, and the many other advantages Radio now offers?

Then it's time to think of Radio equipment. When buying Radio parts or sets ask these questions:

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If it's SIGNAL equipment you'll find that it was produced by a plant and an organization whose experience in making small electrical goods goes back over a period of 35 years—that it grew up with "wireless"—that men there have grown gray in their service and take old-time pride in seeing that nothing but the best in materials, workmanship, and finish leaves the SIGNAL plant.

And you'll find that it is used largely for commercial purposes, by the army and navy, by the professionals in Radio, as well as by the semi-professionals and the amateurs—most successfully and most satisfactorily.

Buy SIGNAL Parts or Sets and you will buy Radio Service and Radio Satisfaction.

SIGNAL Electric Mfg. Co.

Factory and General Offices:
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You'll find our local address in your Telephone Directory

SIGNAL--- Hulbert Battery Charger

Charge **2** batteries in your home at the same time for **5¢**—from any 110 volt A.C. lighting socket.

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(2054)

Coupon for guide to Radio Satisfaction

Signal Electric Mfg. Co.,
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Please send, without obligation to me, your interesting book about SIGNAL Parts and Sets, to the name and address written on the margin of this page.

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head matter, such as the movements of others vessels and the weather conditions ahead; but the operator is wise who will see that the captain has all such information *first*. When a typewriter is available, three copies of the press reports are usually made out, the original for the captain, one for the officers, and one to be sent down to the crew. Press news should never be posted in the radio room, as this practice brings others into the place unnecessarily.

It will be remembered that in the early part of this discussion on operators' conduct, there was given an admonition suggesting that the young operator be careful of his speech aboard ship, lest he unwittingly say something displeasingly amiss.

This rather peculiar bit of advice is especially applicable to one thing that I particularly have in mind—sailors' superstitions. There is no quicker way permanently to incur an old tar's dislike than by smiling at his superstitious beliefs. If is a fact, too (as I have learned from experience), that quite frequently some of the officers and once in a while, even the captain, though unwilling to confess it, half subscribe to some of these superstitions; of which a few are amusing, nearly all of them absurd,—but none of them to be ridiculed. It is the mariner's privelege to believe that sea chickens are old sailors; that meddling with gooneys will bring disaster; that sleeping in the moonlight will cause your mouth to be drawn up behind your ear; and that women and preachers are hoodoos.

The Radio Operator and the Captain

As a result of stringent disciplinary measures which steamship captains have sometimes been forced to take in dealing with obstreperous young schoolboy wireless operators, shipmasters in general have come to be looked upon by more than one operator as belonging to a race of ogres. While it is true that in a good many instances radio operators are treated by steamship commanders with unjustifiable asperity, still it would seem that in the majority of cases it is not the master who is so much at fault as it is the operator. When the latter carries himself in a manner absolutely contrary to every one of the suggestions which have already been discussed—as a few operators do—is it any wonder that captains are bearish?

I once read an article written for radio operators in which it was declared that some captains were virtually gorillas; and that the best way to handle them was to "kid them along."—in other and plainer words, to knuckle down to them like a grovelling vassal. This is erroneous advise. I should say

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that rather than cringe like a Jap coolie before a steamship captain or any one else, it were better for the operator to carry himself like a man, fearing no one, and attend strictly to his work;—and if he finds that he can not get along with the commander, he had best quit.

A few captains are indeed downright brutes. Several years ago a notorious bully of a shipmaster insulted an operator and struck him in the face without any justification; but that particular brasspounder, happening to be of highly pugilistic tendencies himself, turned upon the shipmaster and pounded him into the consistency of a chunk of liver. The fighting key-puncher was hailed into court; acquitted; and has ranked ever since as a hero on the San Francisco water-front.

This procedure, however, is seldom possible, and never advisable. When an operator finds himself sailing with a bullying tyrant, the best thing he can do is to look for another ship. This sort of captain is becoming rare nowadays, anyway; more numerous are those who are good at heart, but are simply misunderstood.

If the operator knows his business and attends strictly to that, he may usually be assured of fair treatment wherever he goes.

RADIO FOG SIGNALS AND LIGHTSHIP SERVICE

The greatest peril to shipping is fog. Until recently the captain of a ship has had no practicable means of accurately locating in a fog either his own ship or other ships which he is meeting. The radio fog signal and radio compass give the navigator accurate bearings in fog just as well as in clear weather. In his annual report to Secretary Hoover, the Commissioner of Lighthouses states that several additional radio fog signals have been installed during the past year, including one on the new lightship off Cape Hatteras, and one on San Francisco lightship. This country now has five such stations regularly in operation, and six more will be installed in the near future.

The lightships are the outermost signal stations of the country, many of them being anchored in the open sea, miles off the coast. Arrangement has been made this year between the Navy and Commerce Departments, for the Lighthouse Service to take over the radio communication equipment on the lightships, placed there mostly during the war. Hereafter regular radio service will be maintained with 20 of the outside lightships off the Atlantic, Gulf and Pacific coasts; this will be of great value both in safeguarding and operating the lightships themselves, and in reporting the needs of other vessels.

TALK ON FILTERS

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The success of filter, and we mean by success its ability to rid the circuit of all conflicting noises without inflicting losses on the currents we wish to use, depends largely upon the proficiency with which inductance coils can be made as the resistance of the coil must form a very small part (about 1%) of the total impedance offered by the coil in the circuit. It was necessary at one time to use very large coils wound on wooden rings for high frequencies as there was no magnetic material that would not cause high resistance by its absorption of power. However, in recent years a new core material has been developed composed of small insulated particles of iron packed solidly together and this has made it possible to reduce considerably the size of the coils. Its finely divided condition prevents power from being lost, at the same time retaining the magnetization properties which make the iron core so desirable. Finer coils have also been produced by a careful selection and sizing of the iron particles from which the cores are made, so that now we have as a result of the need for filters to carry large currents, produced inductance coils of a grade hitherto unequalled.

Filters find their most extensive use in the carrier or multiplex telephone system. This system makes use of a single pair of wires for several conversations. The wires used for the ordinary voice currents may at the same time, by the use of carrier senders and filters, be made to carry the voice currents of other conversations which have been raised to higher frequencies. These conversations are unscrambled at the other end by filters and reduced to voice frequencies by carrier receivers then passed along to the various subsets.

Filters are also used in radio work permitting several different kinds of entertainment to be broadcasted by a station from the same antenna, as for instance a lecture, opera music and jazz, each at a different frequency or wave length and the radio fan can pick off whichever seems to suit his mood at the time by tuning his receiving set.

Then, there is the composite set, a filter for frequencies from zero to 100 cycles, by which from one to four telegraph messages may be imposed on telephone circuits. This sort of a filter is in use quite extensively on toll lines throughout the country.

Filters may also be used when direct current is desired without a ripple or noise. As a rule the current used in telephone work comes from a battery and is, therefore, noiseless. But, when it is generated by a dynamo there are quite bothersome noises caused by the

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commutator and the armature coils, which must be eliminated. The difference between a filter for alternating current which rejects certain frequencies and one for direct current is that the latter must reject all alternating currents. This requiries a very simple filter made up of inductance and capacity and the more of each the better.

Radio engineers employed by the Post-Intelligencer of Seattle to discover the cause of the erratic transmission from that newspaper's broadcasting station finally discovered a spider's web near the top of one of the poles—a spider's web covered with carbon from soft coal. Swayed by the wind, the web had been swinging against the antenna wires, causing momentary short circuits which had disturbed the transmission.

DETECTORS AND RECEIVERS

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ASSIGNMENT 8
TELEPHONE RECEIVERS

IN all of the preceding assignments which have touched on receiving circuits, we have had occasion to refer to the head telephone receivers which are used to make audible the sounds—either speech, music, or telegraph signals—which we desire to hear. These receivers are similar in principle to the common type of receiver supplied with the wire telephone in your home. The currents which they are required to make audible are, as a rule, very weak in comparison with those common in telephone circuits. Consequently, the telephone receivers used for radio purposes are constructed so as to be very much more sensitive than the ordinary wire telephone receiver. In addition, for the sake of convenience, they are made of lighter weight and in such form that they may be worn on the head for hours at a time without discomfort.

Fig. 51. Radio Head Set

Fig. 51 shows a common type of radio head set. It will be noted that it consists of two receivers of the "watch case" type, mounted on a headband and supplied with a cord which connects the two receivers of the set in series with each other.

Fundamentally, a telephone receiver is a device which makes use of the fluctuations of a current flowing through a small electromagnet so as to cause similar fluctuations of a diaphragm. This diaphragm, by its vibration, causes sound waves to be set up in the air contiguous to it. If the current has originally been varied according to the vibrations of the human voice, the diaphragm, and the sound waves which it sets up, will thus reproduce the human voice.

Fig. 52 shows the schematic diagram of the type of receiver employed with the ordinary wire telephone. Through the center of the receiver "shell," ordinarily moulded of insulating material,

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is inserted a permanent steel magnet, whose North and South poles are shown. This magnet serves to maintain a constant pull or attraction on the iron diaphragm held in place at right angles to it.

Around the end of the magnet nearest the diaphragm are wound many turns of insulated wire, forming a small electromagnet. It is this coil which carries the current which previously has been modulated occording to the vibrations of the human voice. The effect of the permanent magnet is to make the fluctuations of the iron diaphragm exactly proportional to the variations of the current in the electromagnet. The diaphragm, being made of magnetic material, is thus affected by the electromagnet.

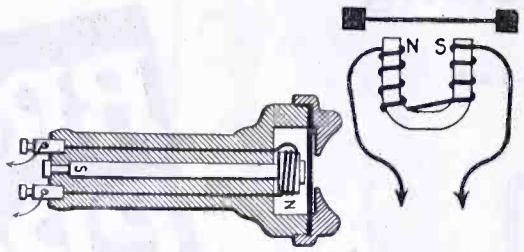

Fig. 52. Schematic Diagram of Telephone Receiver

Fig. 53. Watch-Case Receiver

This form of receiver has the advantage of applying the electromagnetic impulses directly at the center of the diaphragm where the vibration is the greatest. A maximum response of the diaphragm is thus produced. It has the disadvantage, however, of producing a magnetic path of high *reluctance*. Reluctance in a magnetic circuit is similar to resistance in an electrical circuit. That is to say, the lines of force generated by the electromagnet must flow from the north pole to the iron diaphragm and from the diaphragm back to the south pole of the magnet through a long, non-magnetic path of air. In addition, such a receiver is relatively heavy and cumbersome and cannot be mounted so as to be worn on the head.

Fig. 53 shows the watch case form of receiver. The permanent magnet in this type consists of a U shaped steel magnet in place of the bar magnet of Fig 52, and there are two electromagnets connected in series.

The watch case receiver has a low reluctance magnetic circuit since the lines of force flow across the minute air gap between the north pole and the diaphragm, through the diaphragm for a short distance, and back across a small air path to the south pole of the U magnet. This type of receiver, however, has the disadvantage of not applying its magnetic impulses to the diaphragm at its center, where the greatest mechanical movement can be set up. Its light weight and small size make it convenient for headband mounting, however,

Continued on page 68

Continued from page 66

and we find this type of receiver used by practically all manufacturers whose receivers contain magnetic diaphragms. It is usually assembled in the form shown in Fig. 54.

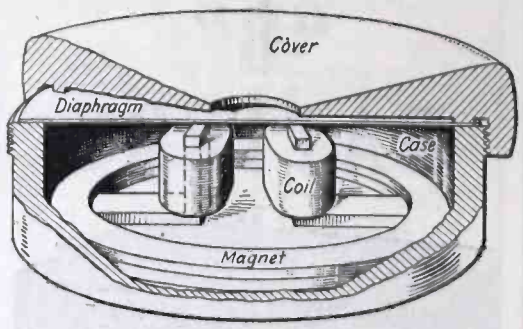

Fig. 54. Watch Case Receiver Assembly

A relatively new type of receiver invented and manufactured by Nathaniel Baldwin of Salt Lake City, and known as the Baldwin receiver, incorporates the advantages and eliminates the disadvantages of the two types just described. It is shown in Fig. 55.

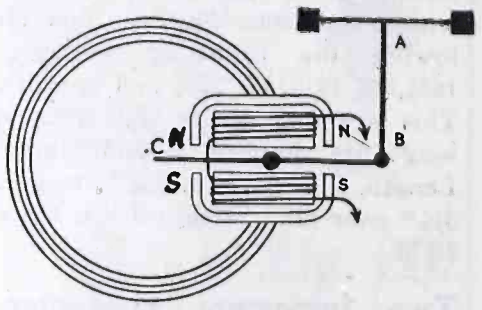

Fig. 55. Baldwin Receiver

In this receiver there are two north and two south poles whose attraction is evenly exerted on a pivoted iron lever in such a way that it is exactly balanced between the four poles. This magnetic lever is connected to a pin at the point *B* which, in turn, is connected to a thin mica diaphragm at the point *A*, as shown.

The advantages of this type of receiver are many. The reluctance of the magnetic circuit is as low as with the watch case type, since the lines of force have only to traverse the minute air gaps on each side of the lever. The impulses are imparted to the diaphragm exactly at its center as with the bar magnet type. A mechanical amplification is secured by means of the long lever action at the point *B*. The diaphragm, being non-metallic, gives a more faithful reproduction of the human voice and music. (Metallic diaphragms are apt to give a "tinny" or metallic sound). The Baldwin receiver is thus a very popular type but is somewhat more expensive than other makes.

It is obvious that a maximum vibration of the diaphragm in any type of receiver will be due to the generation of a maximum number of lines of force by the electromagnet. Ohm's Law, $I=E/R$, may be applied, with the necessary substitutions, to magnetic circuits. We have already defined the reluctance of

Continued on page 70

Continued from page 68

a magnetic circuit as being similar to the resistance, R, of an electrical circuit. The lines of magnetic force correspond to the electrical current I. E., the electromotive force, is replaced in magnetic circuits by the *magnetizing force* which sets up the lines of magnetic flux. It is called the *magnetomotive force,* and is represented by the abbreviation $M.M.F.$, or M. It is given by the formula:

$$M = 1.257\ n\ I$$

where 1.257 is a fixed constant, n, is the number of turns of the inductance (in the case of the telephone receiver, n is the number of turns of wire on the electromagnet), and I is the current in amperes (or fraction thereof) flowing therein.

The expression nI is termed *ampere-turns* and is generally considered as a single quantity. At first glance, it would appear that the greater we make the number of turns of a receiver, the greater will be the value nI and the greater will be the response of the diaphragm. There is a practical limit, however, because as we increase the number of turns, we increase the resistance of the magnet and hence decrease the value of the current, I, which flows in it. Beyond a certain limit, therefore, an increase in the number of turns of the electromagnet does not increase the sensitiveness of the receiver. In fact it may decrease it.

Certain detectors such as the crystal detector and the vacuum tube possess very high resistance. Consequently, they will pass but a very small value of current, I in equation (3), through them. This means that with a small value of I, we must have a large value of n, in the expression nI, in order to obtain a receiver of sufficient sensitiveness. Receivers for use in conjunction with such high resistance detectors, therefore, are wound with a great many turns of wire.

In order that the winding on the electromagnet may be encompassed in as small a space as possible for both mechanical and electrical reasons, the size of the wire must be very small, from No. 36 to 50 B. & S. gauge. Such wire, of course, imparts a high resistance to the telephone receiver, and consequently it is not uncommon for a single receiver to have a resistance of from 1000 to 1500 ohms.

In order that extraneous noises may be eliminated and that additional sensitiveness may be provided, it is customary to have a receiver for each ear, and since, as we have seen, these receivers are connected in series, the total resistance of the head set may vary from 2000 to 5000 ohms.

While we shall not have occasion to study them on account of the fact that they are little used in modern practice,

Continued on page 72

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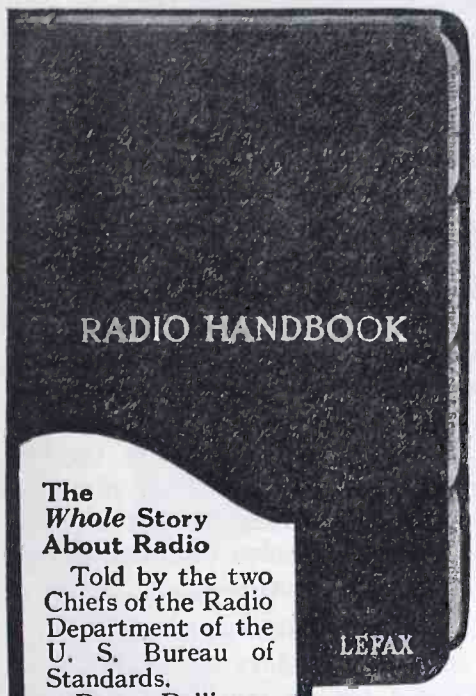

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Continued from page 70

there are two types of detectors of low resistance—the *magnetic* detector and the *tikker*. Since these detectors pass a relatively large current through them, a much smaller number of turns on the receiver electromagnet are required. Consequently, we find receivers of as low as 150 ohms resistance used in conjunction with such detectors.

It is customary to rate a telephone receiver as to sensitiveness according to its resistance, since the latter is indicative of the number of turns of wire used on the electromagnet. Unscrupulous manufacturers in the past, however, have wound receivers with German silver, high resistance wire instead of copper wire, in order that on test such receivers might show a high resistance, although only comparatively few turns were actually employed. It should be borne in mind, therefore, that the resistance of a telephone receiver plays no part in its sensitiveness except as it is indicative of the number of turns of copper wire on the electromagnet.

LOUD SPEAKERS

In the pioneer days of radio, little need existed for an indicating or auditory device other than the head receivers. This was because the early detectors were not particularly sensitive so that it was necessary to eliminate all extraneous noises by wearing double head 'phones in order to receive messages over any considerable distance. In addition, the radio telegraph was the only method of radio communication, and since signals were exchanged in the Continental Morse code, it was usually necessary for only one person, the operator, to receive the messages at any one receiving station.

It was not until the advent of the radio telephone, therefore, that the need arose for making audible the received radio music or speech for the benefit of more than one person. In addition, it was the same device, the vacuum tube, that made the radiophone transmitter possible which made it possible to amplify the received currents to such an extent that they could be thrown out in sufficient strength to be audible to a group of listeners. These developments coincided with the development of the *loud speaker*, a device which has widely replaced the telephone receiver.

The simplest form of loud speaker consists of a horn or megaphone, made of pressed paper or wood, or of metal, fastened to a single head receiver. The horn, like any megaphone, serves to concentrate the sound waves and thus to propagate them with less loss in a given direction.

It is often possible, however, through the amplification which can be secured in modern vacuum tube receiving sets, to pass more energy through a single

Continued on page 74

Tell them that you saw it in RADIO

Continued from page 72

telephone receiver than can be efficiently handled by it. The result is that the diaphragm of the receiver tends to "rattle," due to the overload to which it is subjected.

The Radio Corporation markets a device known as the *"Vocarola"* in which this weakness is overcome. It consists of a Baldwin receiver connected through a rubber gasket (to eliminate reverberation) to a convoluted horn. The ordinary mica diaphragm, however, is replaced with an aluminum diaphragm of greater strength so that "ratling" is effectually prevented. In addition, the diaphragm is fluted in concentric circles. This serves to make the diaphragm *aperiodic;* that is to say, it has no resonant pitch of its own but responds equally well to the common musical and voice frequencies. The average receiver has a distinctive pitch so that it will respond with great intensity when it is subjected to the particular audio frequency with which its diaphragm is in resonance.

The Radio Corporation also supplies the same device without the horn so that it may be attached to the tone arm of a standard phonograph in order that the sound chamber of the phonograph may be used as the horn. Since phonograph horns are as a rule scientifically designed and excellently constructed, this device serves to supply an excellent loud speaker at moderate cost.

Other devices are on the market which are intended to be used in conjunction with standard head sets, both receivers being clamped to a double vent horn. Such a loud speaker is shown in Fig. 57.

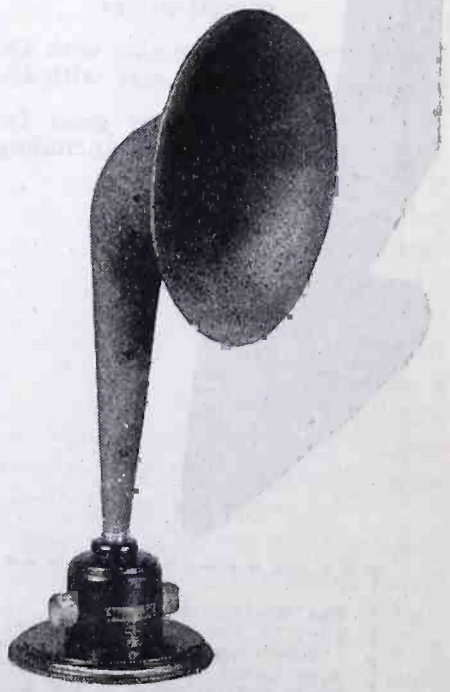

Fig. 57. Trutone Amplifier

The loud speakers described above, since they incorporate either one or two watch case receivers, may be employed with crystal detector receiving sets when the signal strength is sufficiently

Continued on page 76

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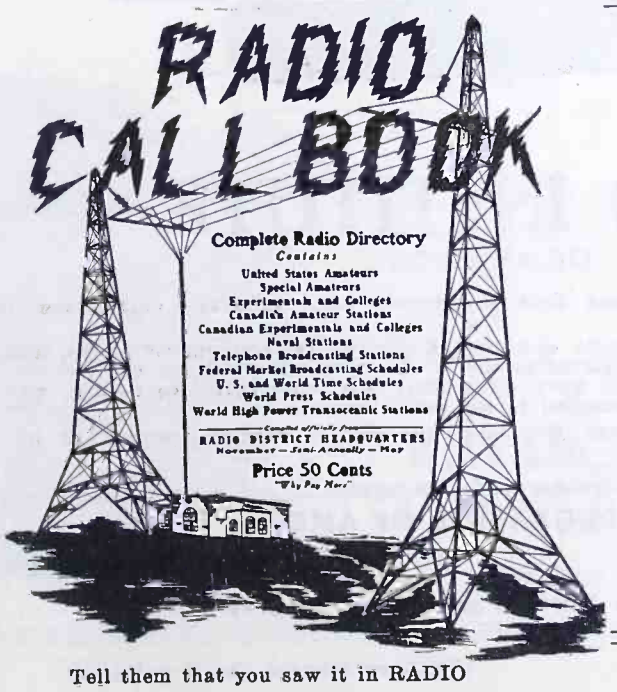

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Continued from page 74

strong. For the reception of radio music, this requires that the receiving station be equipped with an efficient antenna and be located in the immediate vicinity of a broadcasting station. As a general rule, than, loud speakers are not effective when operated with crystal detectors.

Other types of loud speakers are on the market in which the intensity of reproduction is not due alone to the use of a horn, as with the types described

Fig. 58. Magnavox

above. Such types, however, require relatively a large amount of energy to be delivered them—an amount which the telephone type of loud speaker would not be able to handle.

The earliest of these *power loud speakers* was the "Magnavox," manufactured by the Magnavox Company of Oakland, Calif. The Magnavox is shown in Fig. 58.

In place of the small permanent steel magnet of the watch case receiver, the Magnavox employs a large and powerful electromagnet which is energized from a 6-volt storage battery. The current supplied by the storage battery is also used to light the filaments of the vacuum tubes with which the Magnavox must be employed.

Suspended between the poles of the electromagnet is a coil of small wire through which the rectified audio current from the radio set is passed. Actually, the audio current is passed through a small transformer so that voltage of the circuit is reduced and the current is increased. This is effected by winding the primary of the transformer, through which the received current is passed, with a great many turns of wire, while the secondary, which is connected to the movable coil of the Magnavox, is composed of relatively few turns. (See Problem 1 of

Continued on page 78

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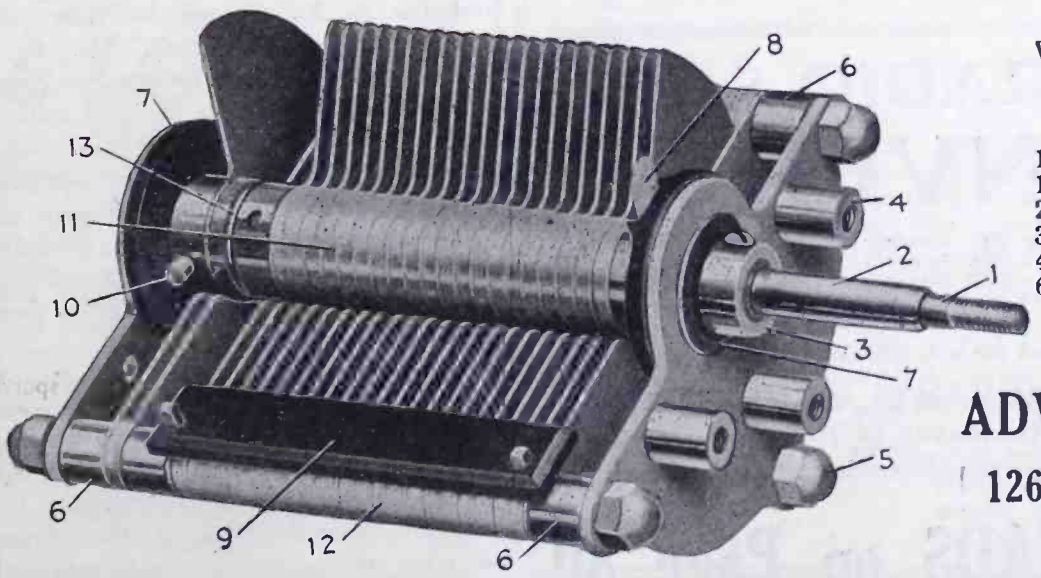

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See Classified RADIOADS on Page 80

the fifth assignment). This movable coil is connected to a substantial, metal diaphragm, which generates powerful sound waves that are thrown out through a horn of suitable design.

Used in connection with vacuum tube amplifiers, particularly those of the power type which produce relatively heavy currents, the Magnavox can be employed to throw sound waves from a distance of a few feet to a half mile or more. The Magnavox is in very general use, therefore, and constitutes a very effective type of loud speaker.

Working on the principle of producing a telephone receiver of generous proportions for loud speaker work, other manufacturers have developed loud speakers employing exceptionally large permanent magnets, with diaphragms and electromagnets of proportional size. Such loud speakers have the advantage of requiring no direct current for setting up the steady, fixed magnetic field. They do require, however, the use of vacuum tube amplifiers of the power type for most effective operation. The Cory loud speaker is one of the latter type.

The latest and one of the best loud speakers on the market is that manufactured by the Western Electric Company. This relies for its intensity as much, perhaps, on the special power amplifier tube circuit with which it is supplied, and must be used, as on the loud speaker itself. Since its operation is so intimately connected with the special vacuum tube circuits with which it is employed, it will not be described in this assignment. The Western Electric loud speaker is noted for its excellent reproducing qualities as well as for the intensity of the sound waves which it generates.

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RADIO ON MISSISSIPPI RIVER

Continued from page 32

charted and filed so that they are able to tell position of any boat almost any time of day. Much money is saved through this system and plans for the movements of the boats are safely worked out.

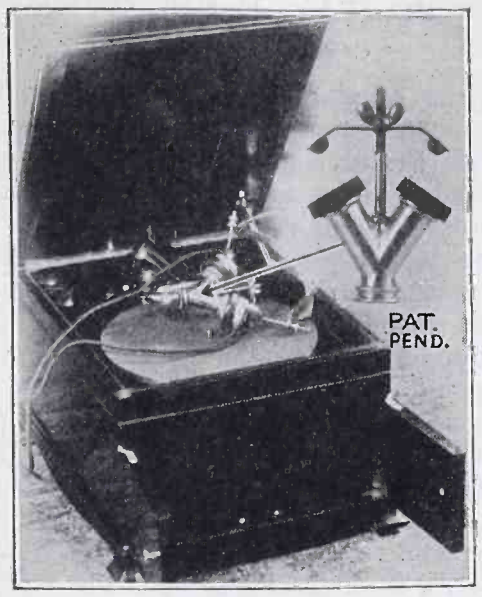
The Mississippi is a treacherous body of water. At certain times of the year it is high, and other times it is very low. When the water is high radio can be used to summon aid in case of a break in the levee. When the water is low, radio proves to be invaluable. Going aground with a tow is almost an everyday affair on this river. Many times the assistance of a dredge is needed to dig out a boat or barge hard aground, and when twenty, thirty or even fifty miles from the nearest town, radio is found to be very handy.

One incident occurred last summer, although it very seldom happens, which alone saved enough money for the line to buy a complete installation on the boat. The Str. *Choctaw* took 2 barges from Cairo to St. Louis. We on the *Cairo* came up the next day. Through some misunderstanding the barge intended to be unloaded at St. Louis was ordered south. Leaving St. Louis I reported barges in tow, giving their numbers and other data. On next report was advised we took wrong barge. The Str. *Choctaw,* which left before us with one barge for Cairo, was told to drop her one barge, we were to drop the wrong barge for her to take back to St. Louis and proceed south, adding her barge to our tow. Steamboat men will realize the money saved in this incident where, without wireless, the heavily loaded barge would have been brought to Cairo and back. Holding of freight is no joke. Thus did radio save the day.

Because of the part played on this river, Capt. C. E. Patton, general superintendent of the line, has ordered radio be installed on all river boats in the line on the Warrior River between Birmingport about 20 miles south of Birmingham and Mobile. They are also working the same schedule as the Mississippi River boats, thus making the atmosphere at WYDB look like old NAR. I agree with the fellow ops. who say it won't be long before they will be crowding us on the rivers.

A. Monteilhet, Pat. No. 1,434,064: Oct. 31, 1922. Method of and Apparatus for Facsimile Telegraphy.

In order to transmit photographs or the like telegraphically, an arrangement *A* at the transmitting station is provided that permits exploration of successive small regions of the document or photograph or the like. This arrangement may be any well known photoelectric circuit, and is arranged in a local circuit including a relay *R* for rendering the transmitting station active. This relay is arranged so that it will operate only when the resistance in its circuit becomes less than a definite value. The variation in resistance to render this relay active is produced by two factors: the periodic variation of resistance *C* and by the variation in resistance due to the exploration of the document. Thus when the relay operates it maintains the transmitting circuit closed for a time that is a function of the tonal qualities of the explored point, and at a constant rate is transmitted for that period. At the receiving station a similar arrangement is utilized, there being a resistance *C′* varied synchronously with the transmitter resistance C_1 and an optical receiver *E*.



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NEW PRICE $3.00

An Attachment of highest quality for making a Radio loud speaker of your talking machine and a pair of head phones. At your dealer or post paid on receipt of price. State make of talking machine when ordering.

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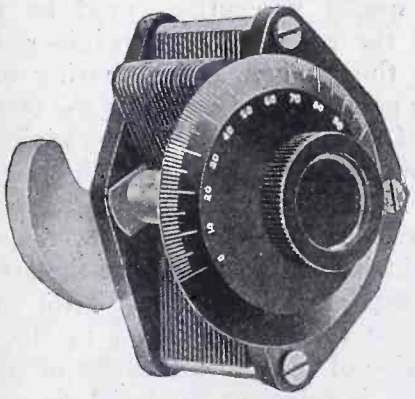
CHELSEA CONDENSERS



No. 1

PRICES:

No. 1 Table	.001	$5.00
No. 2 Table	.0005	4.50
No. 3 Panel	.001	4.75
No. 3a Panel without dial		4.35
No. 4 Panel	.0005	4.25
No. 4a Panel without dial		3.85
No. 5 Panel	.00025	3.75
No. 5a Panel without dial		3.35
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No. 6a Panel without dial		2.50
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No. 8 Panel with vernier		6.50

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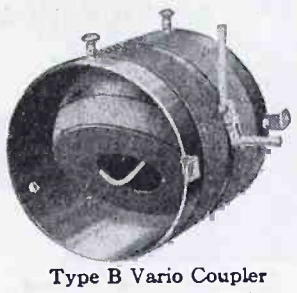
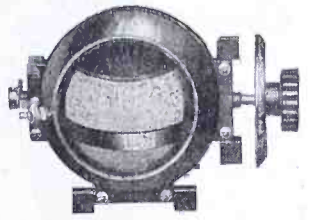


Type B Vario Coupler

Dayton Phone Receiving Set



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Schwarze Electric	3000 ohm	5.50
Elwood Electric	2000 ohm	5.50
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Brown phones (English Make —adjustable	8000 ohm	22.00
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Attractive price also offered on one No. 10-A Westinghouse Loud Speaker complete with power amplifier, tubes and horn. One R-2 Magnavox Loud Speaker with A.C. -3 power amplifier, tubes and horn.

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"RADIO"

Be Sure and Read the Radioads on Page 80

Tell them that you saw it in RADIO

PORTABLE RECEIVER

Continued from page 17

writer countersunk the bakelite, so the dials on the variable condensers set flush with the surface. A pointer was provided on the secondary condenser, which moves up and down across this dial as the inductance switch is moved, thus allowing markings of the wavelength on the secondary condenser, giving a calibrated receiver. The pointer is moved up and down over the dial by means of a cam attached to the shaft of the switch. The pointer is held against the cam by a spring, and as the inductance is increased, the cam rotates, and allows the pointer to move upwards, or downwards, as the case may be. The end of the pointer should be raised high enough above the secondary dial so that it will not touch the latter as the condenser is rotated.

As before stated, copper wire should be used to connect the various parts of the apparatus. The actual diagram of connections is shown in Fig. 1. The coupling coil should be connected, and after the rest of the circuit is found to be operating properly, its terminals should be reversed, as it will be found that one side gives louder signals than the other when connected to the grid. No special precautions need be taken with the rest of the connections, other than those taken in any wiring of the same general type, except in the connecting of the variometer. If the variometer is not "poled" properly, it will be found that no oscillations can be produced, so it will be necessary to reverse these terminals if it is found that the set will not oscillate. The plate circuit of the detector tube is connected to the positive side of the 32 volt source of supply, as this is sufficient potential to operate this tube with good efficiency. Jacks are connected as shown in the diagrams. As the tubes are all connected in series, it is not possible to use the so-called "filament control" type of jacks, so ordinary jacks are used.

As built by the writer, two sources of battery are required, one a 32 volt d.c. supply, as is very common on farms, and a 100 volt supply for the plate circuit. The latter was supplied by standard block type B batteries, the smallest size being used. A storage B battery should be used if the set is used for station work. All external connections were made to regular terminal blocks in the rear of the cabinet (not shown) and no binding posts are visible on the front of the panel. The only external connections visible on the panel front are the jacks, which are mounted on the bottom of the amplifier panel.

No cabinet is shown, but a cabinet of hardwood was provided, large enough to house the entire set. The panel was set back from the front of the cabinet,

and a separate wooden front provided, which could be fastened to the cabinet proper by means of trunk fastenings, and enough space was left between the panel and the front board to allow the telephones to be slipped into leather straps provided for them.

MANIPULATION

For the sake of simplicity, it will be assumed that the operator wishes to receive from a broadcasting station. The tubes are lighted, and brought to their proper filament current value, and the phones inserted in one of the output jacks. The tickler is increased in value until the set is oscillating. A shorting switch is provided across the variometer, which short-circuits the same when the button on the panel front is pressed. This is the oscillation test button. When the set is oscillating a "plop" can be heard when the button is pushed in, which stops oscillation, and when the button comes out again, another "plop" will be heard, which indicates that the tube is again oscillating. Now, set the inductance switch on point 3, and move the condenser over the entire scale. The coupling should be set at a medium position, and the primary switch on tap 2 or 3, and the condenser about half way in. A whistling note will be heard when the carrier wave of the broadcasting station is crossed, and there the condenser should be stopped. Now adjust the primary circuit until there is a point found where the same sound is heard as if the oscillation test button was pushed in. This is the approximate point of resonance of the primary. Now loosen the coupling and increase the tickler until the station desired comes in loud and clear, and with a minimum of distortion. If the tickler is increased too much great distortion is liable to occur, and the set will again be brought to the oscillating condition. This is, then, the optimum adjustment for the station in question. Some slight readjustment of the secondary and primary circuits may be needed when the coupling is loosened, but it will be only a very small change in the condenser capacities. Similar methods are used on other wavelengths, and the adjustment of the whole apparatus is simply the adjustment of a regular regenerative equipment.

The two lever switches are provided on both primary and secondary switches, in order to detune adjacent sections of the coils, as they may be used. Ordinary telephones are used in the output circuit. The writer used Baldwins. If trouble is found in getting the set to oscillate the most probable reasons will be: (1) Bridging condenser of too low value, (2) tickler reversed, (3) filament current too low, (4) too much capacity across secondary, (5) poor tube, (6) grid leak of improper value.

Continued on page 84

If the grid leak is of too high a value, the tube will "squeal" at audio frequency when the tickler is advanced past the oscillation point. This set can be loaded up for long waves by using a 3-coil honeycomb system, and putting the coils in series with primary, secondary and tickler, respectively.

GENERAL HARBORD NEW R. C. A. HEAD

Major General James G. Harbord will become president of the Radio Corporation of America after he retires as deputy chief of staff of the U. S. Army on Dec. 29th. Edward J. Nally, former president, has been elected managing director of international relations of the corporation and will have his headquarters in Paris.

RECENT PATENTS

Continued from page 36

creased sufficiently in frequency so as to affect the detectors *11, 12,* etc., for heterodyning. The audio frequency signals resulting from this travel back to the phase shifters and are made apparent by member *28.* Due to the low frequency of source *16,* there is no material transmission loss to the antennae *1, 2, 3, 4, 5.*

F. S. McCullough, Pat. No. 1,427,832: Sept. 5, 1922. Radio Telephony.

A radio telephone transmitting system is described in which a spark gap *5* is used to produce the oscillations. In order to smooth out the objectionable roughness of the spark, a so-called stabilizer arc tube *6* is added in series in which there are an anode *7* and cathode *8.* The tube is filled ith an inert gas such as argon, and the spark circuit is coupled to a transmitting antenna *11* by the a'd of coils *9, 10.* The modulations may be produced by the aid of a third heated electrode *23* included in a local microphone cricuit, and disposed between the other two electrodes.

F. S. McCullough, Pat. No. 1,427,833: Sept. 5, 1922. Radio Telegraphy.

A receiving system for obtaining directional effects is described. For this purpose a flat coil *8* of spiral form is connected between the filament *2* of a thermionic device *1* and a conducting band *11* disposed around the tube *1* and between the filament and the equivalent of a plate electrode. The input and output circuits are otherwise entirely similar to conventional three electrode devices. However, the field of the flat coil *8* which serves as an absorbing element, is made to affect directly the flow of electrons between the elements in the tube. It is found that maximum response is obtained with coil *8* parallel to the direction of the transmitting station.

Hanson and Jones, Pat. No. 1,429,240: Sept. 19, 1922. Radio Signaling System.

An antenna system is described, in which those portions that intercept the radiated waves are buried in the earth, so that they may be affected by those waves which are propagated near the earth's crest. In order to save as much space as possible, condensers 4^a and 5^a are buried a comparatively small distance apart, and so arranged that they may be variable. The stationary plates are in direct contact with the earth. It is thus unnecessary to use a long buried wire to obtain sufficient capacity. The system may be used either for receiving or transmitting.

H. J. etc. deBellescize, Pat. No. 1,429,572: Sept. 19,1922. Circuit Receiver.

Ordinary receiving circuits, due to the dissymmetrical arrangement of the apparatus, have parasitic currents that prevent accurate tuning, and also introduce errors in radio compass circuits. These parasitic currents are due to the electrostatic coupling between the receiving circuit inductance coil and the absorbing circuit inductance coil, as well as to the capacity effects directly between the ground and the receiving circuit elements. To nullify these effects, the absorbing circuit is made symmetrical with respect to the receiving circuit inductance L', and the midpoint M of the obsorbing circuit inductance is earthed. Finally a device D is employed, connected between earth and one side of the coil L', which is adjusted to balance exactly the effect of the elements in the receiving circuit.

W. W. Conners, Pat. No. 1,433,070: Oct. 24, 1922. Method and Apparatus for Determining the Actual Location and Actual Movement of Bodies.

In order to determine the position of a movable body with respect to two stationary points, radio waves are transmitted from each of the stationary points of different characteristics, and the amounts of energy radiated are controlled so as to have a definite ratio. On the moving body, receiving circuits are arranged to be sensitive to both sets of waves, and connected to these receiving circuits are relay circuits the quantitative effects of which are proportional to the intensities of the radiations. By comparing the relative strengths of the energies in this way, the distances from the two stationary points to the moving body may be determined and automatically plotted on a board.

A. L. Golden, Pat. No. 1,431,393: Oct. 10, 1922. Oscillator.

A vibrating magnet is described for generating sparks. The electrodes *11* and *15* are adapted to be separated by the aid of the coil *4,* and both electrodes are submerged in distilled water. Furthermore a cooling coil *16* may be used to carry off the heat developed by the sparks. Ths use of distilled water is the patented feature, as well as the use of screw threads around the electrode *11,* whereby it is stated the gases generated at the spark gap are more easily conducted away.

W. W. Conners, Pat. No. 1,432,384: Oct. 17, 1922. Method and Apparatus for Indicating the Geographical Location or Movement of Bodies.

In order to determine the relative bearing of a ship or other movable object and a transmitting station, this station may be equipped with apparatus, such as *10,* for sending a directive wave and for turning the line of the wave through an arc at a constant speed. The arc may be a definite portion of a circle for the remainder of which no radiations are transmitted. Simultaneously with the transmission of the directive wave, a uniform wave is sent from *15,* but of different wavelength. By noting when the uniform wave starts and stops (which corresponds to the starting and stopping of the directive wave also) and when the directive wave crosses the receiving station, it is a simple problem in proportion to find what part of the arc the directive wave must sweep over before it reaches the receiving station. Since the direction of the directive wave at the beginning and end of its periods is known, the bearing of the receiving station to the transmitting station may be obtained by addition or subtraction of angles.

A. N. Goldsmith, Pat. No. 1,432,455: Oct. 17, 1922. Method and Apparatus for Receiving Sustained Wave Signals.

In order to modulate at audio frequency, constant wave signals, a toothed conducting disc L is rotated between the coupled coils D and F of the antenna circuit and the receiving circuit. Bu making the disc L with numerous teeth, the speed of rotation to obtain audition is within the capability of a small electric motor Q. The rapid insertion and withdrawal of a tooth between the coils D and F cause them to be periodically in poor inductive relation and in good inductive relation. The teeth in fact form short-circuited secondaries, as well as an electrostatic screen. To eliminate the hum of the motor Q, a grounded screen S may be used, or else an insulating coupling P-P may be inserted between the disc L and the motor shaft.

J. Bethenod, Pat. No. 1,432,438: Oct. 17, 1922. Radio Telegraphic Coupling.

A high frequency alternator, coupled to an antenna A in a special manner, is described. The armature of the alternator comprises a series of independent windings C_1, C_2 and C_3, and they are each connected to the primaries T_1, T_2 and T_3 of independent transformers, so that alternator coils alternate with transformer coils. In this way, it is stated that the tension on the alternator is

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THE RADIUM BULB

Continued from page 25

man's supper was merely food that had to be eaten to pacify a noisy family. While he was eating, he wondered if the contents of his package had been harmed in shipment; what the finished article would look like; whether it would work properly; and as soon as he could get away from his family, Arthur tucked the box under his arm and retired to his radio shack.

The shack was full of experimenters' lumber. There were great shelves of wire, motors, burned-out transformers, and what-not on three walls, and along the fourth side was the work bench. Light was furnished by a window, directly over the bench, during the day, and by a shaded droplight at night. And now, when Arthur snapped on the light, it shone down on a panel-full of the most delightful maze of "junk" that Art had ever assembled. But he scarcely noticed the things on the table. Instead, he unwrapped the box, and carefully pulled out his "little scheme" from the tangles of excelsior. A bulb came to light. The thing was about six inches in diameter and filled with a smoky gas. As Art held it in his hands, reflections limned themselves on the surface for moments, and then crept, grimaced, and were gone, as the tube was moved, and the gas clouds rolled about inside the glass wall. Art stared into it for fully five minutes, and at last set it down on the bench and connected it to the "junk." "Good night! I'll hypnotize myself gazing into this thing, if I don't look out," he thought.

But when all was ready for his experiment, Art was reluctant to try the new tube, because he had a premonition that it too, like all the others he had tried, would fail. True, he had gone over the blue-print and hook-up at least fifty times, and according to everything he had ever learned, the new idea was bound to work. Then the picture of Professor Geiger shaking his head came into his mind again.

Art tried to ward off discouragement by convincing himself that the tube would fail. He tried to think how he would feel if the experiment proved unsuccessful. He did not dare to hope for anything. And then, in the next moment, he found himself full of unquenchable hope, and dreaming of a success that would startle the world. As he looked down at the refulgent globe, he became frightened. To think that he, in this little shed, might create a thing that would set the world to buzzing! Anyone might steal his scheme. Could he get it patented? Perhaps someone would invent the same thing before he could reach Washington with his idea. It did seem so simple a thing. And there were thousands of amateurs

all over the country working to improve receiving apparatus.

With all these contrary depressions and imaginations, hopes and fears fevering him, it was no wonder that Art's stomach seemed to loosen; that he felt his pulse beat with every heart-pump; and that he was almost shivering. It was with such emotions that he turned off the drop-light and pushed the telephone plug into the new receiving circuit.

The tube glowed with a greenish-purple light, and the smoky gas, inside, moved about in masses when he advanced the filament current. Over the wall roamed queer shadows, made by the bulb's light, but Arthur gave them no attention. He was watching the set, and listening to the humming in the telephones. A signal roared in, the telephones fairly sizzled, and without any objectional "howl." Feeling a thrill of success, Art tuned to other wavelengths. Turning the condenser dials, he heard many stations peeping in the receivers. He copied one for awhile. "Sweet patootie!" gasped Art, in a moment. "P.O.Z.! and coming in like a ton of bricks!" As he tuned sharply, using the verniers, the noise became deafening. Then, "Q.R.M.—Q.R.M.—I AM BEING INTERFERED WITH," chirped another arc station, and P.O.Z. came back: "B.K.—B.K.—Q.R.T."

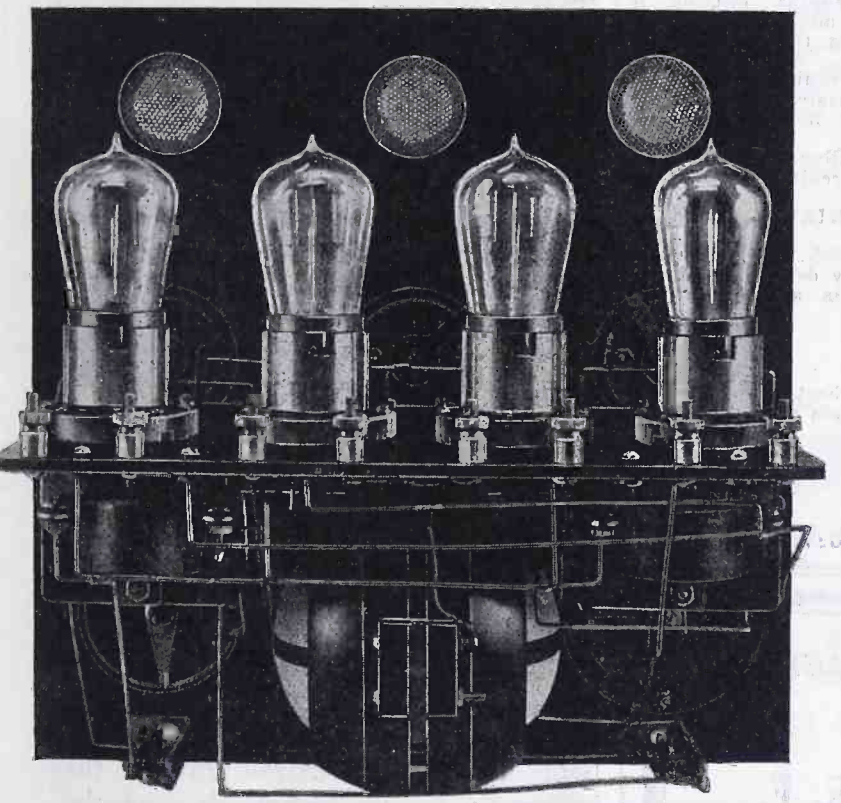
Art snapped off the filament, laid the telephones on the table, and leaned back in his chair. He had heard these squabbles between stations "hogging the air" before. But he was so overcome by success that he knew not what to do next. The young man sat with his legs crossed, wagged his foot up and down, and gave himself over to idle dreams. The scientific magazines would quote him: he could buy that new generator —Oh, he would fit the old laboratory up in gold trimmings!

And so, in this little shanty, was first used the bulb that was to prove even a greater success than Art had ever imagined; or would he have wished for.

Every evening of the next four days, Art "listened-in" on the new set, finding the peculiarities of the circuit, and making slight changes for greater efficiency. As time passed, his eyes began to bother him, and thinking he was straining them too much, he dropped one of his courses in college. His scholarly routine became monotonous, and more than once, in the college laboratory, Art caught himself dreaming of future honors, when he should better have been attending some experiment. —Just as soon as he tried a few other improvements on the set, he would get it patented; and then for fame and fortune!—But then his eyes burned and his head ached, and he stopped thinking.

Continued on page 90

Frequency Receiver



This set will enable you to hear stations that you could never get before. We fully guarantee it on a money back plan. Hear all of those long distance stations this winter. C.O.D. orders accepted if one-half of purchase price accompanies order.

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43 Plate vernier	8.00

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43 Plate	4.60

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This condenser equipped with knob and pointer.

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Paragon	$1.50
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"My Radio Gal"	10 cents
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LEFAX RADIO HANDBOOKS	$3.50
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A.B.C. OF RADIO (Leather)	.35
THE C.W. MANUAL	1.00

IF YOU WANT SERVICE AND SATISFACTION SEND YOUR ORDERS TO US. WE WILL PLEASE YOU.

Continued from page 87

One day professor Geiger showed him a letter from the Radio Inspector. "Art'ur," he said, "dis iss in your line. Dere iss somet'ing foolish wit' de air. Captain Glass want me to collaborate wit' him to find de trouble. He say dat some station break in on de traffic every night, chase over all de wavelengt's and upset all de schedule. Today he telephone me and giff to me dat he wishes dat I should listen in tonight, and he show me de matter. Perhaps you listen in at your house too, eh? I t'ink you have a better set as mine, eh?"

"All right, professor, I'll listen in." said Art. He, too, had heard a great deal of interference calls, but he had not heard the station that was interfering.

After supper, that evening, Art entered his shack and tuned up the set, as was his custom. This evening his eyes were very painful. They stung and ached at the same time, and they watered when he had tried to read the evening paper. "Well," he thought, "surely they won't be hurt any in the shed here. I'll turn off the electric light. That occulist I went to today didn't seem to know what he was talking about, but I'll go again tomorrow, anyway.—Now then, let's catch this pirate wireless station!" and he turned on the filament current. The queer light of the globe filtered through the incessantly moving gas-clouds, and the whole looked like a glass retort full of different colored vapors.

ON the top of Fiske Island there is a great mast. To this mast, converging from seven points about the hill, comes seven aerials. Occasionally the commuters, crossing the bay, see a new aerial being erected, and they remark that the place is getting to look like a veritable spider-web of aerials. They wonder what apparatus there must be in the little, olive-drab house, at the foot of the pole, that requires so many wires.

In the house, sitting at a long table, five telegraph operators "shoot" stuff to San Francisco. In another room, on Captain Glass' desk, sit four telephones. On the roof of an outhouse, colored lights blink at night, and semaphores wag during the day. And in the northern part of the house proper, sound-tight booths shelter seven radio receiving sets, with relay keys to transmitting stations about the bay district. Day and night, six of the radio operators communicate with all parts of the world. The seventh man listens for distress calls.

The moment that Art turned on the filament current, at his set in Oakland, the man in Number Seven booth, at Fiske Island, took a pipe from his mouth, straightened in his swivel-chair, and pressed a button. The other radio operators continued working, but the

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man in Number Four booth sent out a series of melancholic "B.K.'s". Number Seven touched his transmitting key lightly, with his fore-finger. In a cement house near the entrance to the bay of San Francisco, a great spark leaped between the terminals. As Number Seven's hand worked, back on Fiske Island, the words sped seaward in fingers of lightning from the cement house: "S.D.O. — S.D.O. — LONG RIDGE ISLANDS — DE S.D.I. — S.D.I. — FISKE ISLAND." And in a trice Number Seven heard a whining reply in his receivers:

"S.D.I. — S.D.I. — DE S.D.O. — S.D.O.—GO AHEAD." Again the aerial ammeter, in the house by the Golden Gate, registered, and the dots and dashes went through the night:

"S.D.O.—GET COMPASS BEARING OF STATION X. ON FOUR THOUSAND METERS—S.D.I."

While this was going on, a telegraph operator, at the long table in the Fiske Island house, ticked off: "LION ISLAND—GET COMPASS BEARING OF STATION X. ON FOUR THOUSAND METERS," and Captain Glass, in command at Fiske Island, was speaking in one of the telephones: "HELLO, PRESIDIO? GET A COMPASS BEARING OF STATION X. ON FOUR THOUSAND METERS, PLEASE." The captain looked out a window as he talked. There, silhouetted against a path of moonlight on the bay, was a huge, square frame. It revolved slowly, searchingly, and at last came to rest. And before the captain had finished with Sergeant Young, at the Presidio, a man came in the door, silently placed a paper on the table, and returned to his station under the direction-finder, out-doors. Five minutes later, Captain Glass spoke over the telephone to Professor Geiger, in Oakland.

ART had listened in for about ten minutes when the telephone bell rang behind him. The sudden noise in the dark made him jump, and even as he did so, he noticed a slight pang in his head. He shut off the set, and answered:—"Yes.—Four thousand meters, you say? That's queer. Tell Captain Glass to call me up, will you, Professor?—Goodbye." While waiting for the telephone call, he turned to his pet bulb and put on the receivers again. He had been on four thousand meters himself, but had heard nothing unusual. Could it happen, by some freakishness of the new set, that it would not receive the mysterious station? The strange, smoky beams from the tube glinted on the irises of his eyes, threw his high cheek-bones into relief, and paled his face like a skull. The light crept on over the shelves. Bits of ap-

paratus gleamed like eyes at one moment, and in the next, were occluded in the darkness again. The telephone rang once more. As he rose to answer, Art turned off the set and lit the droplight.

"Hello, Mr. Arthur Cushing?"

"Yes."

"Captain Glass speaking.—The set has just stopped again. According to our compass readings, the station should be close to the head of Lake Merritt. Do you know of any station near there?"

Before he answered, Art thought, "The head of Lake Merritt!" That's just where I am!" His dimmed eyes fell on the radio set, and he almost dropped the telephone receiver as he sank into a chair.—"Yes—eh—yes. Just a minute, Captain," he said weakly. "You say the station stopped transmitting for a short time about five minutes ago, ran again for three minutes, and is now stopped once more?"

"Yes" came the reply.

"Well, captain, I'll tell you what I'll do—" As he spoke, Arthur closed the filament circuit of the new tube, carefully shielding the telephone transmitter with his other hand.—"I'll just make a small set so I can put it in my car and find the—"

"There—there he goes again," broke in Captain Glass' excited voice on the line. Arthur shut the tube off again, and immediately Captain Glass said, "He's stopped again, Mr. Cushing. No use listening-in. I'll send a radio inspector over there right away. In the meantime, you might scout around for the station."

"All right, sir. Goodbye." Art clicked up the receiver and jumped over to the shelf on the left of the window. He took down an ammeter, and snatching up a pair of pliers, connected it in the aerial circuit. Once more he turned on the luminescent light, and leaned over to read the meter. "Wow!" he exclaimed, "Fifty amperes! And on four thousand meters! No wonder the gobs got excited. They've got nothing on me. Just think of it! Transmitting and receiving at the same time! *And on the same tube!*" As he thought of it, his own invention frightened Art. He had interfered with government traffic. He had started the naval radio engineers on a wild search of all the amateur transmitting stations in the district. The bulb he had developed for radio reception only was getting beyond his understanding. Where was the fifty amperes coming from? What kind of a current could it be that would not break down the insulation within the set? What other wonders might not this mysterious glass sphere produce? To trace and understand these new freaks; to gain control of his own invention; here was a problem indeed!

And now, some fool Radio Inspector would blunder into his set and find the greatest invention of an age, probably arrest him for something, and get all of Art's invention. But no! He would hide this new set before the inspector arrived.

The young experimenter got up to disconnect his apparatus. He had been working but a few minutes when he winced; jumped slightly; made an ugly grimace for a moment, and then became composed again. The boy blinked spasmodically behind his glasses; clenched the edge of the bench until his knuckles turned white—released his grip. "My God!" said Art simply, "I'm stone blind!"

He fell back into a chair. Then Arthur Cushing began to think desperately. But even in these moments, he thought clearly and logically, as he had been taught to do. "What would affect my eyes in this manner? Could it be the light from the new bulb? Frequent contact with X-rays causes mysterious disorders of this kind. I've heard of doctors dying from that. This tube is somewhat similar to an X-ray outfit. But then, with the little contact I've had with the bulb, it would take more than X-rays to do this to me. Radium rays might do it, though. And X-rays are made by a luminescent tube. Why not radium rays by a "harder" tube than an X-ray tube? Good Lord! I wonder —I—wonder—if my pet bulb is a substitute for radium?"

Art felt a grinding and stretching of cords within his head. He stood up, slowly stiffened, and crashed sprawling on the table-top, smashing instruments and tangling apparatus as he fell. Two wires, running to a storage battery, sweated melting insulation, and reeked of an odor that should have made Art jump. But he lay motionless on the table. Even when the curtains of the window over his head sent an orange light out into the night, he did not get up. And it seemed as though in mockery that the telephone bell jangled in the flame-lit room.

Old Bill Howard, Art's neighbor, was heard yelling "Fire! Fire!" at the top of his shaky voice. Men rushed in the radio shack and dragged out Art's body. It was untouched by the flames.

The ashes of Arthur's shed were cold when Professor Geiger came. There came with him several serious men who wore glasses. "But," one of them was saying, "where did he get it? There's not enough of the stuff on the Pacific Coast to do that damage. Why, his head was a veritable honey-comb of radium burns." No one could answer the question.

But as Professor Geiger cast about in the crisp, charred ruins, he shrugged his shoulders and said, "Ah—I regret dat dere wass no record of de experi-

ment. I find notting in de books at school. It must have burned wit' de rest." And even as he spoke, he picked up the corroded metal clasp of a loose-leaf folder, and looked at it reminiscently. He recalled the day when Art had pushed a blue-print in his folder and said,

"Oh, that,—Eh—that's just a little scheme I'm working on."

LETTERS TO THE EDITOR

Continued from page 2

where near as much dissatisfaction on the part of the user, *provided* he knows how to operate it. If he does not, he is little better off than the man with the un-steerable single coil set, as he is in the position of the man left out in the country, miles from anywhere, whose driver has died of heart failure, and who is unable to navigate the machine to a place where he can obtain help. If he knows nothing of the adjustments, or manipulation of the various controls, he would make a sorry mess of his attempt to drive. In the same manner does the "green" novice get things balled up on an inductively coupled receiver, and he is unable to eliminate interference which could be cut out with great ease by someone competent to make the necessary adjustments. Not that these latter are hard or difficult—they are much less so than the driving of an automobile, but the impression seems to exist that the loose coupled receiver is too difficult for the average novice to attempt, which is an insult to his intelligence, and mental capacity. The greenest novice could be taught in a very short time to make the various adjustments that are necessary on a loose coupled set, and the result would be infinitely greater satisfaction to himself and everyone else concerned.

The final result of all these unsteerable sets, navigating on the various ether roads, is that they interfere, or "bump into" each other so often that the novice, having nobody else to blame, and aided by unscrupulous people who have no interest in the art of radio communication, to lay everything to the door of the "amateur," who gets all the blame. How much of the alleged amateur interference is due to other causes, besides, such as power line leakage, X-ray machines, arc lights, motors, etc., etc., nobody can tell. But it is safe to assume that 75% of the alleged "amateur" interference comes from some of these sources, while many people in coastal cities, or located near large commercial or government stations, are interfered with by these latter stations, due to the broad tuning of the single coil sets, and of course, lay everything again to the door of the amateur.

Now, the novice, knowing little of radio, thinks that it is made specifically for his benefit, and that the most important thing is the reception of broadcast music. He overlooks the fact that he is only a citizen, as well as that the amateur is a citizen, also. Neither have more rights than the other, and neither should be shown more consideration than the other. If the amateur *does* use a broadly tuned set, he can be checked, by due process of law, provided proper measurements are taken, showing the excess decrement of the transmitting station. His status is written in the law, and defined as such, and as a citizen he has certain well defined rights. The novice, on the other hand, believes that he has all the rights, which cannot be admitted in our system of Government. The final result is that both the novice and amateur have equal rights, and both have the right to use the air.

This proposition seems to be taking care of itself very well in those communities where amateurs and broadcasters have gotten together and agreed on mutually satisfactory hours, where the amateurs, realizing that they do interfere with those using the inefficient single coil receivers, have agreed to "stand-by" for a certain period of the day, or evening, provided the broadcasters agree to likewise stand by their agreement to shut down their stations at the specified time. For example, in this vicinity, where such a scheme is in effect, the amateurs shut down at 7:30 P.M., and stay off until 10:00 P.M., and then the broadcasters stop, which is believed to work out with great satisfaction to all concerned.

The novices, as a class, however, do not seem to realize that by not knowing the code that they are missing at least 50% of the interest of the radio "game." If they would get in, and learn what the "funny noises" mean, they would get infinitely greater satisfaction out of their stations, and would find that something else besides the plain music was on the air, which something often possesses far greater interest than any general form of entertainment. This seems hard, but after you are over the first stumbling block of learning the various characters that form the letters, you will be surprised at how fast you can recognize and distinguish between various signals, static, etc., etc. Come ahead, Mr. Novice, learn the code, and get in the game—get a "ham" license yourself, and learn how much better this is than the plain listening you have been doing. You'll never regret it, and you'll quit "kicking." Yours truly,

AN OLD HAM.

San Francisco, Calif.

RECENT RADIO PATENTS

Continued from page 85

kept low, and in fact merely that of any one of the windings.

E. A. Sperry, Pat. No. 1,428,507: Sept. 5, 1922. Wireless Repeater System.

A transmitting station and a receiving station are described so arranged that the position of a pointer or an indicator (as in compasses for vessels) at the transmitting station is duplicated by an indicator at the receiving station. To effect this result, every movement of the transmitting indicator is made to effect a momentary transmission of energy from the antenna at a definite frequency. This frequency is made to affect an absorbing circuit at the receiving station so as to maintain a circuit energized and to keep it energized. This circuit causes the energization of certain coils of a repeater motor connected to the receiving indicator. Upon a further movement of the transmitting indicator, energy at a different frequency is transmitted, with the result that different coils of the repeater motor at the receiving station become energized.

R. A. Heising, Pat. No. 1,432,022: Oct. 17, 1922. Circuit Connection for Electron Discharge Apparatus.

A scheme for utilizing alternating current to heat the filament of a thermionic discharge device is described. The source *29* is connected across the filament. In order to neutralize the effect of a constantly varying potential from the filament to the grid and plate, the input and output circuits connect either to the central point of the filament or to a neutral point in the source, so that the average potential difference between the whole length of the filament and the grid and plate is constant.

M. J. Keily, Pat. No. 1,432,867: Oct. 24, 1922. Electron Discharge Device and Method of Making the Same.

The grid and plate of a thermionic device is coated with a black oxide, and it is found that under such circumstances greater heat radiation is permitted, and more power can be conducted to the tube. Also secondary emission or thermionic emission from the grid is substantially entirely prevented, and the danger of "blocking" the tube is eliminated.

J. O. Gargan, Pat. No. 1,432,992: Oct. 24, 1922. Vacuum-Tube Socket.

A socket for safety carrying spare tubes in a radio cabinet set is described, and includes a socket *6* resiliently supported on rubber strips *4*. A bayonet slot *16* serves to accommodate a pin *17* on the tube, and a resilient spring arrangement *11, 12, 13* serves to urge the slot and pin together so as to prevent jarring. This spring arrangement acts against the lower ends of the terminal studs *10*.

E. W. Kellogg and C. W. Rice, Pat. No. 1,435,009: Nov. 7, 1922. Radio Receiving System.

A long horizontal antenna formed by lines *1* and *2* and grounded through resistances such as *4* at both ends is used to receive signals simultaneously on different wavelengths by the aid of the coupling coils *8, 9, 10*. These coils are in the input circuits of amplifiers *11, 12* and *13*, which in turn affect the detectors *20, 21* and *22*. In order to eliminate as far as possible interfering radiations, an artificial line *25, 26, 27* is coupled in the antenna circuit of the same characteristics as the antenna itself, and adjustable portions of this line may be included in the input circuits of the amplifiers.

Peerless Radio Laboratories

Manufacturers of Peerless Radio Frequency, Receiving Sets

San Francisco

November 1, 1922.

RADIO DEVICES CO.,
693 Mission Stret,
San Francisco, Cal.

GENTLEMEN:

In compliance with your request, we wish to state that until we used the Aerovox we had no end of disappointments owing to the fact that there are so many Radio Frequency Amplifying devices of indifferent make and none seem to stand or give the satisfaction that we derive from the Aerovox in connection with the Variometer that you have been making. These two combined, we feel, are about the most important item of our set. We hope our pleasant business relationship may continue forever.

Yours truly,
PEERLESS RADIO LABORATORIES.
By ARTHUR ANNIS, President.
Arthur Annis/MR

EDW. M. JONES

Insurance Brokers

SAN FRANCISCO, CALIFORNIA

October 28, 1922.

AEROVOX CORPORATION,
47 Kearny Street,
San Francisco, Calif.

GENTLEMEN:

You will no doubt be interested in knowing the results obtained by me in the use of the Aerovox Inter-Tube Coupler which I installed about a month ago.

I have received the concerts from thirty-six stations in six States and Canada. These were brought in using one stage of radio frequency and one of audio frequency.

I have recommended the Aerovox to many of my friends, who are getting great results from it.

In conclusion I might add that the efficiency of my set has been increased 100% since installing the Aerovox.

Yours very truly,
EDW. M. JONES.

BOYLE & KENNA

General Insurance

234 BUSH STREET, SAN FRANCISCO

RADIO DEVICES CO.,
693 Mission Street,
San Francisco, Cal.

November 1, 1922.

GENTLEMEN:

I have been using your Aerovox for the last several months and have experimented with one and two stages of radio frequency amplification. I have used your published hookup with the exception of adding a variometer in the plate circuit.

I have been able to hear stations from San Diego, Cal., to Seattle, Wash., and in the interior, back to Detroit, Mich., taking in Kansas City, Mo.; Davenport, Iowa; Phoenix, Ariz.; Denver, Colo.; Salt Lake City, Utah; Great Falls, Mont., and Reno, Nevada. All of these stations, with the exception of Kansas City, Detroit and Davenport, have been received on the loud speaker.

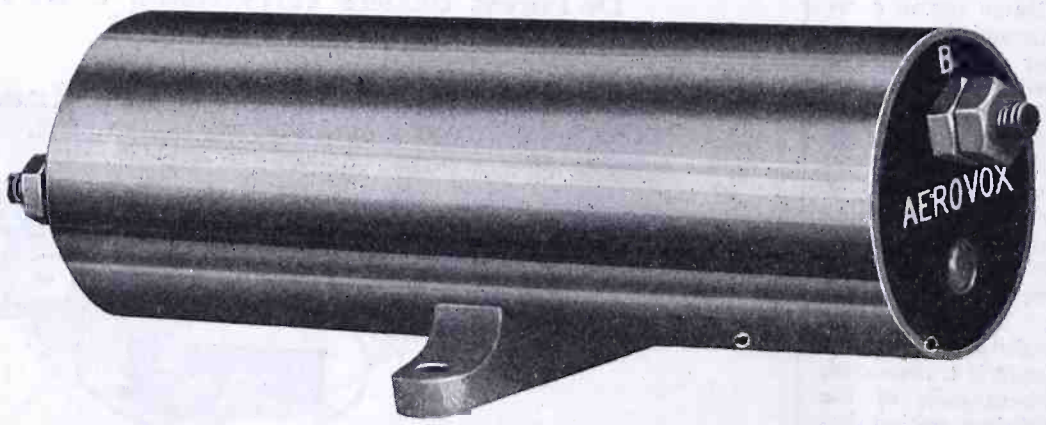
The results have been so amazingly wonderful that I take pleasure in writing you this letter to advise you of the result.

Very truly yours,
JRK:M JAMES R. KENNA.

AEROVOX

Radio Frequency Amplification

is simple enough for the novice, and efficient enough for the adept professional



The cut shows what the AEROVOX Inter-Tube Coupler looks like. The letters show what it has done in the hands of others.

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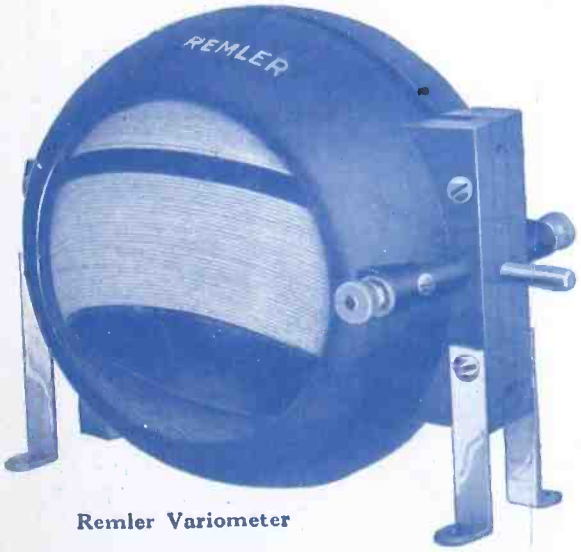

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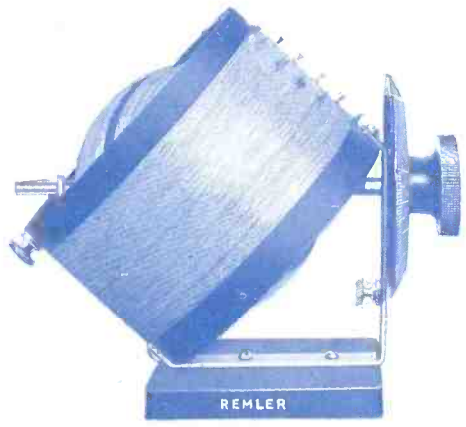

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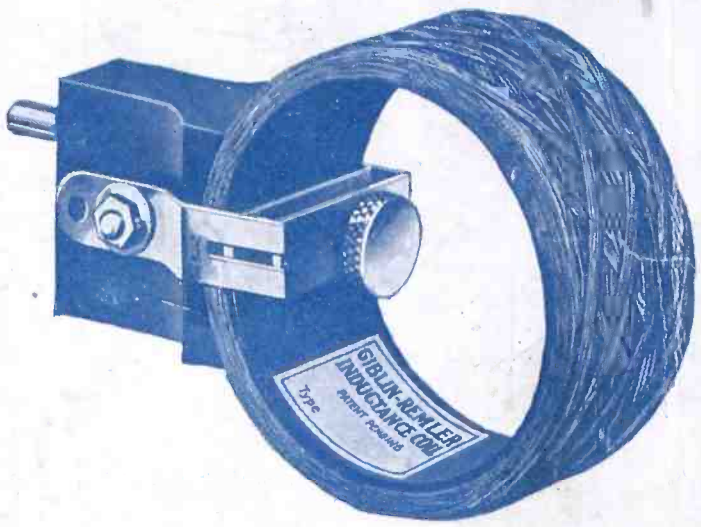

The Most Efficient Compact Inductance Ever Used in Radio

An Engineering History of the Most Efficient Inductance Coil Ever Developed

THEORETICALLY, the ideal inductance coil should have all inductance—no capacity—no resistance—and no natural period. Such a coil would result in maximum signal strength with no interference from signals that were not on exactly the same wave length as the signals being received.

Thomas P. Giblin, the radio engineer who originated the compact inductance coil, has been working on coil design for many years with this knowledge of the theoretically "perfect inductance" constantly in mind. The first of his coils to appear on the market used the single lattice, or so called honey-comb winding. After a great deal of study and research, this winding was slightly improved by staggering the turns between layers resulting in a multi-lattice, or so called duo-lateral winding.

However, Mr. Giblin was not satisfied. He felt confident that he could produce a coil that would come much nearer to having the characteristics of a theoretically "perfect inductance." Complete success was at last achieved when the present Giblin-Remler coil—THE MOST EFFICIENT COMPACT INDUCTANCE EVER USED IN RADIO—was developed.

In this coil the turns are wound close together, resulting in a greatly increased inductance for the same amount of wire. Hence the resistance is lower for a given inductance. The slight increase of capacity between turns has been many times compensated for by a greatly decreased capacity between layers resulting from spacing the layers with a cotton yarn of high dielectric strength. The result was a new coil having MORE INDUCTANCE—LESS DISTRIBUTED CAPACITY—AND A LOWER NATURAL PERIOD THAN ANY PREVIOUS COIL. Furthermore, the new coil has maximum insulation between layers at the point of greatest potential difference.

Under actual tests, this coil showed such wonderful improvement over his earlier forms of winding that Mr. Giblin indorsed it with his name.

Write direct for complete specifications and table of contents for this new inductance coil.

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