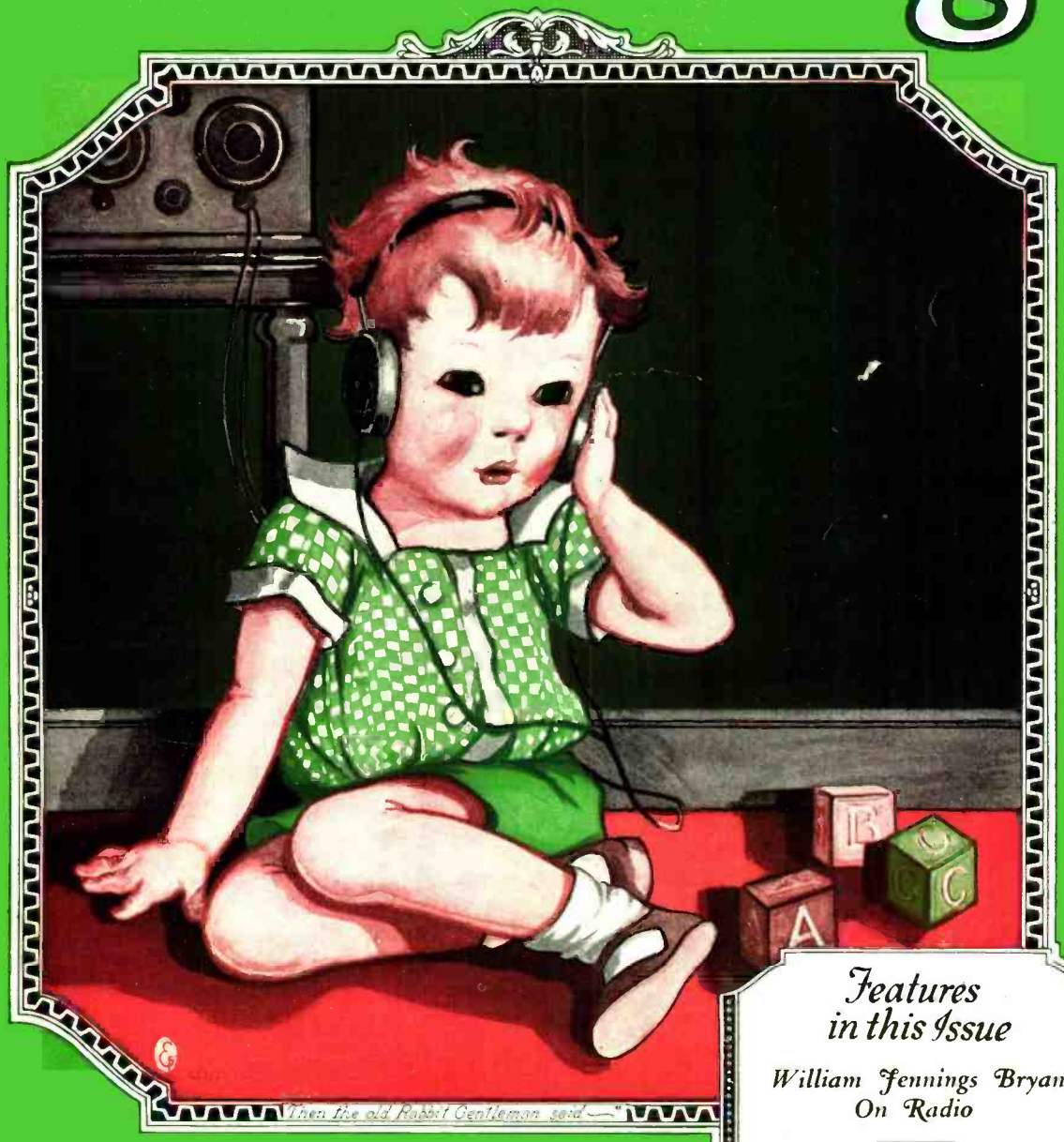
MAY 1924 25 CENTS

The Wireless Age



"When the old Rabbit Gentleman said—"

"America's Foremost Radiophone Review"

Features in this Issue

C-12—Similar to C-11 with standard base
$5.00

C-11—1.1 Volt .25 amp. Dry Battery Det. and Amp. Special Base
$5.00

C-299—3 Volts .06 amp. Dry Battery Det. and Amp.
$5.00

C-300—6 Volts Gas Content Detector
$5.00

The complete line of Cunningham RADIO TUBES

FOR EVERY TYPE OF RECEIVING SET

C-301A—6 Volts ¼ amp. Amplifier
$5.00

WHATEVER type of receiving set or circuit you are using—one or more of these five Cunningham receiving tubes will be ideal for obtaining maximum distance reception with perfect reproduction of both voice and music.

Three of the five tubes are designed to use dry batteries for filament lighting. C-299, the latest development in Radio Tubes, is compact in design and highly efficient in operation as a radio frequency amplifier, a detector and as an audio-frequency amplifier. When used for the latter purpose, the output of two stages is sufficient for the operation of a small loud speaker.

The most remarkable feature of this tube is the new patented filament used which draws only .06 amperes at 3 volts.

C-11 is a dry battery tube with a special base for use in sets having special sockets. It is a good detector and audio-frequency amplifier. The filament is lighted from a single dry battery and draws .25 amperes.

C-12 is identical to C-11 in operating characteristics, but is mounted on a standard base to permit the use of a dry battery tube in sets equipped with standard sockets without the aid of special adaptors.

Whenever storage battery supply is available for filament lighting, the C-300 will be the best tube to use as a detector because it is the most sensitive for the reception of distant and weak signals.

Under the same condition, C-301A will be the best tube for amplification at either radio or audio frequency, because it gives greater gain per stage than any other tube on the amateur market. The new patented filament used, similar to that in C-299 draws only .25 amperes at 6 volts, reducing the necessity of frequent storage battery charging.

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

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

E. T. Cunningham Inc.

Home Office: 182 Second St.
San Francisco, Calif.

154 West Lake Street
Chicago, Illinois

30 Church Street
New York City, N. Y.

clearer Tone!

N & K Phones are designed for just one purpose—the *natural reproduction* of musical tones. They are sold under a guarantee to reproduce both high and low tones more clearly, with greater naturalness and mellowness. They will not increase the loudness of weak signals—because *all* the tones, high and low, have to be kept in *natural proportion*, to secure such mellowness as N & K gives. Volume is the job of your *receiving set.*

Fans and mere beginners alike are enthusiastic over N & K's wonderful clearness. Out of several hundred amateur stations that tested N & K Phones last year, fully 90 per cent pronounced them the best they had ever used.

"Entirely free from mechanical sounds" says station 1PX . . . . "Exclude noise of visitors moving around operating room" says station G.R.R . . . . "Tone soft and clear as a bell" says 1F1; and so on. We will gladly send you our new folder reproducing other comments from fans and telling the real *reasons why* N & K Phones reproduce more clearly than other phones. *Write now.*

TH. GOLDSCHMIDT CORP.
Dept. W5, 15 William St., New York, N. Y.

N&K

"KING OF THE AIR"

TRADE MARK

PHONES

N & K Head Set, Model D, 4000 ohms, is a remarkable example of skillful workmanship. Made of nickeled brass with hard rubber ear cups, accurately machine threaded to insure proper seating of diaphragm. A special device insures uniform spacing between diaphragm and magnet poles. Magnets of finest German steel, wound by entirely new method. Sanitary headband, covered with genuine leather. Six foot cord. Price, $8.50.

DEALERS:

N & K Phones are being backed by a wide advertising campaign that is already bringing a big increase in sales. Get in on these profits! N & K comes packed in cartons of ten with advertising display cards for window and counter and leaflets. If your jobber cannot supply you, write us today.

The Wireless Age

America's Foremost Radiophone Review

Vol. XI — No. 8

May, 1924—Contents

Your Authors

LOUIS FRANK (Amplifiers, of which the first installment is published in this number) is a resident of New York City. When he graduated from High School he secured a scholarship in Cornell University where languages were his special hobby. His education, like that of many young men, was interrupted by the war; but, unlike many, upon returning from France, he returned to Cornell and graduated. Mr. Frank is something of a traveler and has only recently returned to this country from Spain. At the present moment he is pursuing some studies at Columbia University. His knowledge of radio is of high order as readers of his article will discover.

RICHARD H. RANGER (Wire Lines and Radio) is a graduate of Massachusetts Institute of Technology. He held the commission of captain in the Signal Corps of the Army and served in the A. E. F. He is at present a designing engineer in the employ of the Radio Corporation of America and he has given several demonstrations and lectures on subjects connected with the progress of radio under the auspices of that corporation. Among his writings on radio is a book entitled "Radio Pathfinder." Captain Ranger is a member of the Institute of Radio Engineers. Readers will be interested to know that he made the matrimonial "hook-up" last November and now lives in Brooklyn.

W. C. WHITE ("The Heart of Radio") started experimenting with radio at an early age. While still a high-school freshman in 1905, he built and demonstrated a radio transmitter and receiver for the class in physics. He is a graduate of Columbia University and since graduation has been an engineer with the General Electric Company. He carried on the early development of vacuum tubes in the research laboratories of Dr. Irving Langmuir. Many of the actual designs of circuits are due to Mr. White or were made under his direction. He is now in charge of radio vacuum tube development for G. E. Co.

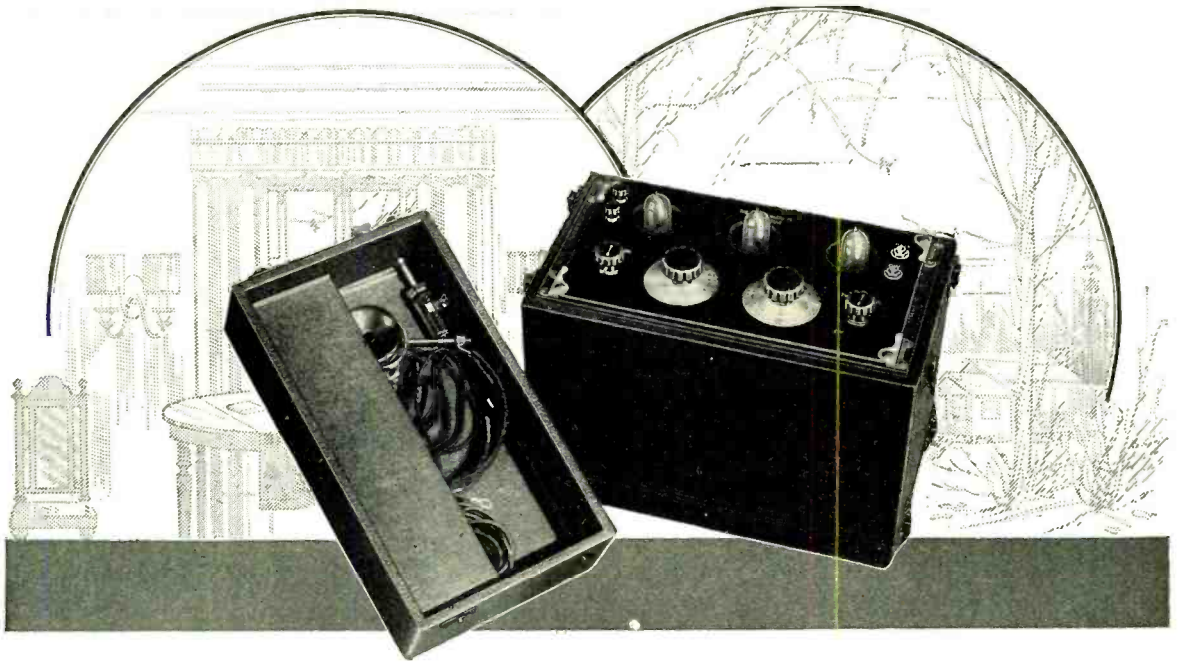
PUBLISHED MONTHLY AT WIRELESS PRESS, INC., 326 BROADWAY, NEW YORK

LOS ANGELES, CALIF., 456 So. Spring St. Coast Publishers Co. — CHICAGO, ILL., Marquette Bldg. Wheeler & Northrup — GREAT BRITAIN 12-13 Henrietta St., London — AUSTRALIA 97 Clarence St., Sydney, N. S. W.

Yearly subscription in U. S. A., $2.50—Outside U. S. A., $3.00; Single Copies, 25 cents. Entered as second class matter Oct. 9, 1913, Post Office, New York, N. Y., under the Act of March 3, 1879.

When subscription expires you will find a renewal blank enclosed. Return with remittance promptly.

James G. Harbord, Pres. — L. MacConnach, Secy. — George S. DeSousa, Treas. — H. L. Welker, Adv. Mgr. — H. H. Reber, Bus. Mgr.
Major Jerome W. Howe, Editor — C. S. Anderson, Associate Editor



For City Homes and Summer Cottages

MODEL III

Carry it Like a Traveling Bag

A MARVEL of compactness—no larger than a traveling bag. The sturdy cabinet is covered with a grain-seal finished Fabrikoid that makes it an attractive piece of home furniture as well as a practical outdoor set.

Each station has its own dial setting—which never changes, regardless of where you are located or what kind of antenna is used. This is particularly desirable to the summer vacationist, cottager, camper or tourist—as the dial setting outdoors, with a temporary antenna, is the same for any given station as it is in your own living room.

New! The famous Kennedy built as a home radio receiver, that is instantly convertible into a portable unit, no larger than a traveling bag.

Model III is essentially the same as the latest Kennedy Receivers but is housed in a three-compartment case specially designed for portability. It has the same purity of tone—the same naturalness and vividness of reproduction—the same ease of tuning. By turning one single dial, the best broadcasting entertainment is literally at your finger-tips.

The circuit used is an exclusive development of Kennedy Engineers—fundamentally sound and correct. It does not radiate or throw out the squeals and whistles that are the cause of present active agitation against radiating receivers.

Price, without accessories, $101.50. ($104.00 west of Rockies.) With Kennedy 3000-ohm phones and plug, $111.50. ($114.00 west of Rockies.)

Ask any Kennedy dealer to demonstrate this new Model III—he will gladly install it in your home so you can judge its remarkable performance.

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

THE COLIN B. KENNEDY COMPANY
SAINT LOUIS

KENNEDY

The Royalty K *of Radio*

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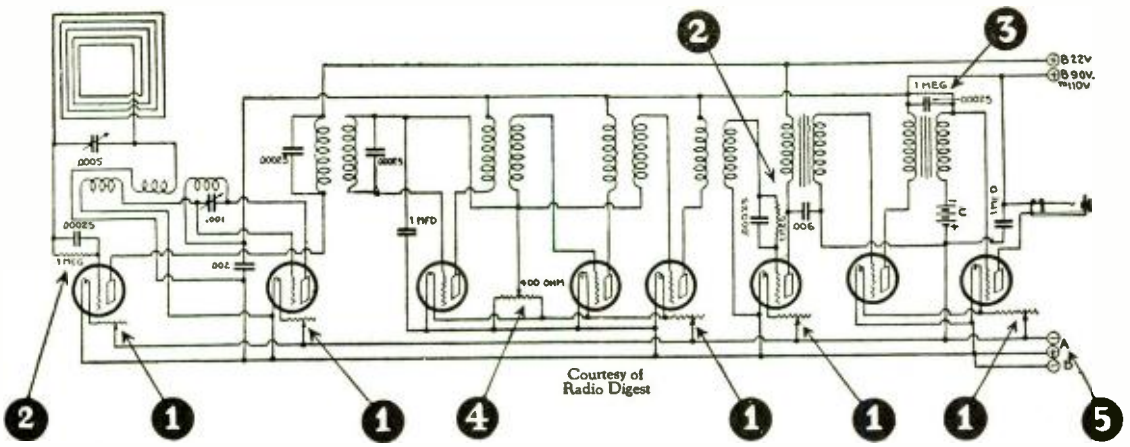


For the Super-heterodyne

Bradleystat

PERFECT FILAMENT CONTROL

For all tubes. Provides a stepless, noiseless range of control that simplifies tuning and oscillator control. Holds the record for long range tuning.

Bradleyleak

THE PERFECT GRID LEAK

Provides a stepless range of grid leak control from ¼ to 10 megohms. Furnished with or without grid condenser rated at 0.00025 m-f.

Bradleyohm

THE PERFECT RESISTOR

Made in three ranges:—10,000 to 100,000 ohms; 25,000 to 250,000 ohms; 50,000 to 500,000 ohms. Ideal for use as fixed or adjustable resistors.

Bradleyometer

THE PERFECT POTENTIOMETER

Made in 200-ohm and 400-ohm ratings for all circuits. Gives a smooth, stepless range of potential control, so essential for super-heterodyne circuits.

Bradleyswitch

PERFECT BATTERY SWITCH

A compact, enclosed battery switch which requires only one hole in panel to mount it. Nickel-plated and well built. Should be installed in every set to protect tubes against accidental burning. Saves time, tubes, and batteries.

THIS remarkable radio receiver, when properly constructed, is a marvelous hook-up for selective tuning and long range. It is gaining in popularity, everywhere, and is destined, no doubt, to become one of the leading types of receivers among discriminating radio enthusiasts.

The surest way to build a successful super-heterodyne receiver is to use only the finest parts. Among the important items are the adjustable grid leaks, potentiometers, special resistors, filament rheostats, and battery switches. In fact, there are no parts more important than the grid leaks and condensers.

For these parts, standardize on Allen-Bradley radio products listed on this page. They represent the experience of rheostat designers with more than twenty years of training in this important field. Attempts have been made, from time to time, to imitate Allen-Bradley radio products, but without avail. They stand supreme in their field, and with a record of successful performance that places them in the front rank of high-grade radio products.

Mail this Coupon for Radio Bulletins

If you will drop this coupon in the mail, with your name and address, we will send you a complete set of folders describing Allen-Bradley radio products in detail. Be sure to get this information before you lay out your super-heterodyne receiver.

Allen-Bradley Co.

Electric Controlling Apparatus

283 Greenfield Ave. A-B Milwaukee, Wis.

Manufacturers of graphite disc rheostats for over 20 years

Allen-Bradley Co.
283 Greenfield Av.
Milwaukee, Wisc.

Please send me, by return mail, a complete set of your radio folders on Allen-Bradley radio products. RUSH.

Name .....

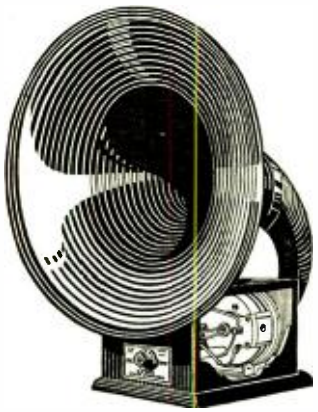
Address .....

Brooklyn Hears Great Britain on the DICTOGRAND!

51 Hale Ave.
Brklyn NY
May 16, 1924

Dictograph Products Corp
Dear Sir: Kindly send me your
large package of "Applause
Cards" as advertised on
the Radio News. I have a Dictograph
loud speaker and received
station W-J-Z and three other
English stations all on the
loud speaker on the last
test! I have tried all makes
and found yours to be the best
Respectfully yours
J. Schulze
51 Hale Ave.
Brklyn

Mgr. Q-Ette Shirt Co
8430 Jamaica Ave
Woodhaven NY



The Master Instrument That Made the Record

1. Operates without extra batteries.
2. Adjustable dial controls volume.
3. Handsomely compact in construction.
4. Finished in a rich ebony; set off by a glistening silvered rim on the bell.

Fully guaranteed.

ONLY
$24.50
Ready to Operate

The "Aristocrat" Dictograph Headset

1. *3,000 ohms*
2. *10 ounces (none lighter)*
3. *Head-fit headband*
4. *Cup-curved ear pieces*
5. *Finished in black and orange*
6. *Guaranteed fully*

ANOTHER record!

First, San Francisco heard Japan and Newark on the Dictograndl.

Now, Brooklyn hears Great Britain on the Dictograndl.

Amazing? Not to owners of this incomparable instrument. For Dictograndl users in every state are familiar with the thrill of listening to far distant stations—night after night—right on the loudspeaker.

And they have found that this marvelous mechanism, so magically sensitive to faint impulses from the other side of the world, is startlingly life-like on local stations!

Ask your radio shop to demonstrate the Dictograndl!

FREE

*"Applause Cards"**

"—Station W-J-Z signing off. If you have enjoyed the artist's program, won't you write in and tell them?"

By all means! Quickly and easily with "Applause Cards."* They're handsomely printed mailing cards. All ready for you to fill in with your comments, sign, and drop in the mail box.

Keep a pack of them near your receiving set. You can use "Applause Cards"* liberally because they are FREE AT YOUR RADIO DEALER'S.

"Applause Cards"* were originated by this Company, makers of the popular Dictograndl Loud Speaker and the Aristocrat Dictograph Headset. The only "Applause Cards"* are Dictograph Copyrighted "Applause Cards."*

A big FREE package of them awaits you at your dealer's. Or if he has not yet stocked, write us, and we'll ship you a generous supply of "Applause Cards"* free, prepaid direct, provided you give us your dealer's name. Dept. F-5.

DICTOGRAPH PRODUCTS CORPORATION
220 West 42nd Street, New York City

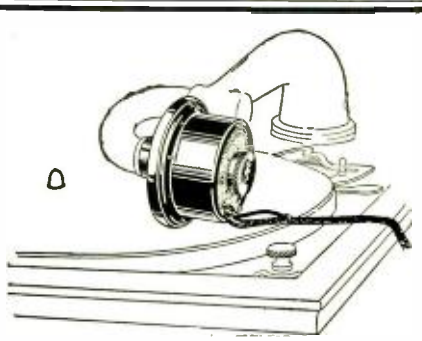
*Copyrighted

The Dictograph "Phono-Unit"

Makes a loud speaker of your phonograph!

1. *Uses no extra batteries*
2. *Has adapters to fit any make of phonograph*
3. *Attached and detached in a moment*
4. *Calibrated dial on back controls volume*
5. *Finished in nickel*
6. *Fully guaranteed*

$10.00



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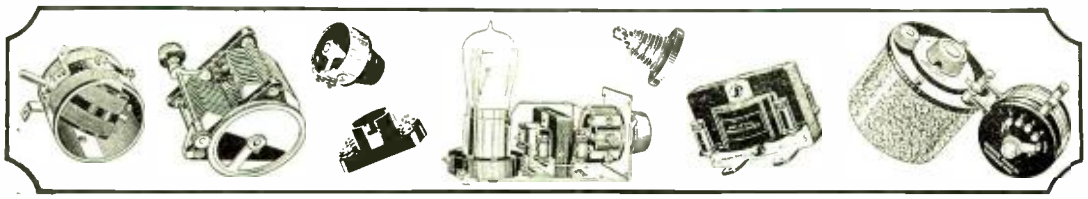


Standards of Excellence

"Products of Proven Merit"

Type 231-A Audio Transformer

The first closed core transformers on the market available for use in broadcast receivers were built by the GENERAL RADIO COMPANY, nearly a decade ago.

Today the type 231-A is the standard of excellence in transformer construction.

Thousands of these transformers are in use by fans throughout the entire radio world. They have proven a source of delight to "listeners-in" everywhere because of their volume and quality of amplification.

Many of the leading manufactured broadcast receivers are using GENERAL RADIO CO. transformers as standard equipment—because of their unfailing satisfaction.

Whether you are building a set or buying one, the question of "Quality Amplification" will be settled once and for all if you insist upon the GENERAL RADIO CO. transformers.

Winding Ratio 3.7 to 1. Impedance Ratio 10 to 1.

PRICE $5.00

Type 247-H Variable Condenser

The 247-H geared variable condenser is the product of extensive laboratory research by skilled radio engineers.

In its design are incorporated features which promote the utmost electrical and mechanical efficiency.

Its method of vernier adjustment is particularly commendable.

By using the counter-balanced gear, operated by a pinion, capacity may be accurately controlled to a minute degree—thus making possible extreme selectivity.

Its bearings are smooth running and its dielectric losses are low.

Due to its critical capacity control and general over-all efficiency, the 247-H condenser is readily adaptable to use in a wavemeter and filter as well as in the receiver circuit.

Capacity of the 247-H condenser—.0005 microfarad.

PRICE $5.00

Write TODAY for our Instructive Folders "Quality Amplification" and "Quality Condensers"—also our latest Radio Bulletin 917-W.

GENERAL RADIO Co

MANUFACTURERS OF

RADIO AND ELECTRICAL LABORATORY APPARATUS

MASSACHUSETTS AVENUE and WINDSOR STREET

CAMBRIDGE MASSACHUSETTS

When writing to advertisers please mention THE WIRELESS AGE

Better Radio—
right through the summer!

Some three million more listeners than there were last year—and they'll all have a season of real enjoyment!

ALL through the country fans are headed straight for the most amusing and enlightening season that radio ever offered. Daily treats! Daily helps! Daily marvels!

Three Main Developments

contribute to the tremendous step-ahead of this summer's radio regime. Better programs—stronger broadcasting—clearer reception.

Better Programs

Selected more keenly—and chosen according to the tastes of the vast audience whose opinions are molding the quality and tone of the programs. An outstanding feature will be the coming presidential campaign. All important messages of all the parties will be broadcasted. More churches are planning to send their services to vacationists. Sports will be vividly and adequately reported. All round programs—packed with vital interest—art—news—home hints—business—fun—good music!

Better Sending and Receiving

Sending over diversified wave lengths to permit greater selectivity. More powerful sending stations—interconnections of important stations for simultaneous broadcasting of messages of national import—rebroadcasting from high power stations through substations located at distant points. All these make for more satisfactory reception. And the vast improvements in sets and circuits, in tubes and loudspeakers assure clearer and truer reception. Surely this will be a season of jollity and interest. Tune in—and get the good things that crowd the air!

All Brandes Products are sold under a money-back guarantee by reliable dealers everywhere.

Table-Talker $10.00
50c additional west of the Rockies.
In Canada $14.00
Navy Type Headset 8.00
In Canada 11.00
Superior Headset. 6.00
In Canada..... 7.00

Brandes
The name to know in Radio

Clear from the skies

YOU can get greater clarity with a good storage battery than by any other means. If you are in any doubt about this important matter, try some friend's set that is hooked up to an Exide.

It is a fascination to see how far distant a station you can tune in, but still more fascinating to get it so clearly that you actually enjoy the concert.

Two things to remember

There are two things to remember about Exide Batteries: They give uniform current over a long period of discharge. This means not only clear reception but economy.

The second thing to remember is that there is an Exide Radio Battery made for every type of tube. In addition to the "B" Battery there are Exide "A's" for 2-volt, 4-volt and 6-volt tubes.

From the "midget" five-pound battery for low-voltage tubes to the larger battery for six volts, each Exide is powerful, rugged, silent, and so long-lasting that it makes for true economy.

For low-voltage tubes

Specially designed for WD-11 and UV-199 vacuum tubes, but can be used with any low-voltage tube. The two-volt Exide A Battery consists of a single cell. It will heat the filament of a WD-11 or other quarter-ampere tube for approximately 96 hours. The 4-volt A battery, having two cells, will light the filament of a UV-199 tube for 200 hours.

Exide "B" Battery

Exide
RADIO BATTERIES

For six-volt tubes

Made in four sizes—of 25, 50, 100, and 150 ampere hour capacities. Like all Exides, this battery is conservatively rated. It has extra-heavy plates, assuring constant potential over a long period of discharge.

And the reason is obvious

The Exide Radio Battery results from experience in the radio field dating far back of amateur radio. In fact, a majority of all government and commercial radio plants are equipped with Exide Batteries. The giant dirigible Shenandoah and the great ship Leviathan are Exide-equipped.

Go to any radio dealer or Exide Service Station and ask for Exide A and B Batteries. If your dealer cannot supply you with free booklets describing the complete Exide line of radio batteries, write to us.

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

In Canada, Exide Batteries of Canada, Limited, 133-157 Dufferin Street, Toronto

Editorial Chat

AS May sunshine emerges from April showers we ask, "What is the prospect for summer radio?" "Excellent," answer the leaders in the radio world. And we, who have watched radio develop during the past few years are well assured that they are right. We have followed the installation of more powerful and perfect transmitting and broadcasting stations, and the design of improved receivers. We have noted how the reception reports from radio fans indicate continually more satisfactory results. So we have no fear of any slackening of radio interest or satisfaction during the long days and the hot months. It would indicate a lop-sided development of radio science if millions of people were spending billions of dollars for an advantage that can be enjoyed only half the year. The fact is that advance in radio science is affecting all its aspects, this old summer bogey among them. More people are within easy range of one or more stations. Then, too, improvement in receivers has provided many folks with better and more powerful sets. Moreover, owners of sets are acquiring better understanding of their operation, and are able to get better reception due to a more skillful manipulation of the dials. It is obvious that much of the clamor about static in the past has arisen from faulty operation of sets. Broadcasters are enthusiastic about summer-time radio. They are planning their programs ahead and are specially planning for the political conventions and campaigns. It would manifestly be folly for broadcasters to make such plans if there were any grounds for doubting the value of radio in the summer.

* * *

RADIO fans must recognize a difference between winter and summer conditions and be guided accordingly. The greatest distinction is concerned not so much with radio as with our habits of existence. In winter we stay within doors and cultivate indoor diversions, among them radio. In the summer we get out in the open and engage in a multitude of sports and outdoor activities—and forget our radio set. Now this is unnecessary and unwise. The radio set represents a considerable investment; why not benefit from it the year round? You can have it on your porch, or on your lawn. You can put it in your boat, or in your automobile. Small, portable sets can be taken along on vacations and outings. No need to say goodby to radio for the summer. The dance music and the interesting talks and religious services and all the rest of the fine programs will continue to be in the ether for your pleasure and profit. Enjoy them.

* * *

MICHAEL FARADAY was one of the world's most valuable experimenters. He lived about a century ago, and electrical science, in pursuance of its pleasant custom, commemorated his genius by naming an electrical unit the *farad*. Gladstone, the British statesman, watching Faraday at work, probably while he was thrusting a bar magnet into a coil of wire and discovering that a current of electricity was thereby induced in the coil, asked, "What's the use of it?" Faraday retorted, "There is every probability that you will be able to tax it." Today the experiments of Faraday and a long train of scientists have brought us radio, and now our own Gladstones pounce upon *it* as a new thing to tax. A 10% tax on radio receivers: this is the enormity which our Senate is considering. Why enormity more than any other tax? Because radio is not a luxury, like tobacco and perfume, except in a very narrow sense. Viewed more broadly, it is a newly developing science with vast and unmeasured possibilities of contributing to the blessings of our civilization. Governments do not tax developing science; they encourage it.

* * *

THIS from one of our readers. We are glad to be assured that our broadcast station directory is appreciated. We endeavor to keep it posted up to date accurately and believe that it supplies a real need. The Canadian list was not permanently omitted, and in this number not only does it reappear, but we have also added the British, French and Cuban stations.

* * *

THE Chicago Board of Trade protests that the plaintiff does not come into court with clean hands, in an answer in the Federal Court to charges brought against it for broadcasting copyrighted music without license. This answer is framed into a remarkably clear exposition—from the broadcasters' point of view—of the controversy which is arousing more interest as the activities of the American Society of Composers, Authors and Publishers become more effective in limiting the broadcasting of musical numbers. Its salient points are: (1) That this broadcasting station (like many stations) is not receiving any profits from its activities and is only incurring expense therefor; but is broadcasting in the hope to create a feeling of good will among its listeners; (2) that the transmission of music by means of radio is a development not known or contemplated when the present copyright law was passed, which fact should make that law inapplicable to broadcasting; (3) that broadcasting and the sale of music are both forms of inter-state commerce and that the Society of Composers, Authors and Publishers have in effect entered into a conspiracy in restraint of trade in violation of the Sherman Anti-Trust Act and (4) that the method practiced by this society are threatening and coercive. Altogether a rather strong and ingenious defense. It will be interesting to note the outcome.

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

Eleven Degrees from the North Pole

Ice—endless miles of ice, as far as the eye can see. And frozen fast in the ice, amid the deadly stillness and the unearthly lights of the Arctic, a staunch little eighty-nine foot schooner! But Donald B. MacMillan and his band of brave explorers are not alone tonight.

ZENITH TRADE MARK
Long-Distance Radio

Under their ice-bound hatches they listen eagerly to the news of the outside world, broadcast to them from the Zenith-Edgewater Beach Hotel Broadcasting Station, Chicago—to violins in Newark, Schenectady, Los Angeles—to singers in Atlanta—to a lively orchestra in Honolulu.

Stations in all these cities—and in several hundred others—they have readily tuned in; yet the Bowdoin tonight is only eleven degrees from the North Pole!

Out of all the radio sets on the market, Dr. MacMillan selected the Zenith exclusively—because of its flawless construction, its unusual selectivity, its dependability and its tremendous REACH.

And you can do all that Dr. MacMillan does, and more, with either of the two new models described at the right. Their moderate price brings them easily within your reach. Write today for full particulars.

Zenith Radio Corporation

McCORMICK BUILDING, CHICAGO

Model 3R The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the new and different Zenith three-circuit regenerative tuner.

Fine vernier adjustments—in connection with the unique Zenith aperiodic or non-resonant "selector" primary circuit—make possible extreme selectivity.

2,000 to 3,000 Miles With Any Loud-Speaker

The new Zenith 3R has broken all records, even those set by its famous predecessors of the Zenith line. Satisfactory reception over distances of 2,000 to 3,000 miles, and over, is readily accomplished in full volume, using ***any ordinary loud-speaker***. No special skill is required.

The Zenith is the only set built which is capable of being used with all present-day tubes as well as with any tubes that may be brought out in the future. The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet $160

Model 4R The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the new Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be satisfactorily accomplished over distances of more than 2,000 miles..... $85

ZENITH RADIO CORPORATION,
Dept.X, 328 South Michigan Avenue, Chicago, Illinois

Gentlemen:
Please send me illustrated literature on Zenith Radio.

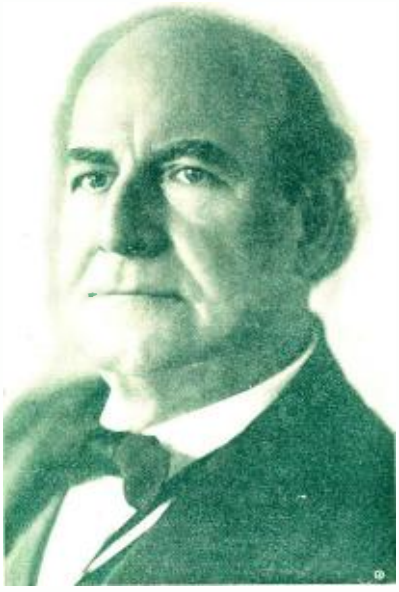
Name.....

Address.....

William Jennings Bryan

Tells us

Radio will help bring World Peace



THE Radio is the greatest invention placed to the credit of human intelligence. It is the most wonderful thing that man has thus far drawn from God's storehouse of mysteries. It is so new and has opened a field so large that no one can estimate its future usefulness. Already it has brought music and instruction of many kinds to a constantly increasing number of people.

Being interested in the politics of the nation, I welcome the broadcasting station as a great instrumentality for the spread of information. It will not be long before candidates for local offices will be able to address their constituents over the radio just before election, thus being able to take advantage of all the information gained during the campaign. Even presidential candidates can address a large percentage of the nation the day before election, concentrating their arguments upon the contested issues and answering any misrepresentations that may have been made.

The abuse of so tremendous an influence would be so harmful, that the Government, acting for all the people, may be relied upon to insure fairness in the use of broadcasting apparatus, and, used with fairness, its value to the public will be inestimable.

It is not too early to calculate the use of the radio as a means of bringing nations into closer communication. When, in November, 1921, President Harding opened the largest wireless telegraph station in the United States, he received answers from twenty-six nations that read his message, the farthest being Australia. Peace ought to be brought nearer and war be more quickly banished from the earth when the executives of all the nations can confer as if around a council table.

This appreciation and analysis of Radio was written expressly for THE WIRELESS AGE by Mr. William J. Bryan.

William Jennings Bryan is one of the first of our big political leaders to realize the possibilities of Radio and to develop them. In this picture he is shown examining the apparatus that transmits his "winged" words to hundreds of thousands of listeners. This was in the Hotel Commodore in New York City, and with him are shown Mr. James W. Gerard, former Ambassador to Germany (turning the dial), Mr. J. W. Hughes, a lifelong friend, and Senator Edward I. Edwards. Station WJZ broadcast Mr. Bryan's speech on this occasion.

It is clearly of value to get an appraisal of radio from our great national leaders, and who in the forum of national life has impressed his character more indelibly upon us than William Jennings Bryan, silver-tongued orator and long the idol of a great national party?

All people will not accept his precise political and other pronouncements, but none will deny his mental calibre, his fighting quality, his high purposes or his great service to his country.

He is still a "young," active man of 64 and yet has been thrice nominated by the Democratic Party for President; has been Secretary of State and still is a foremost leader in many important movements looking toward reform and progress.

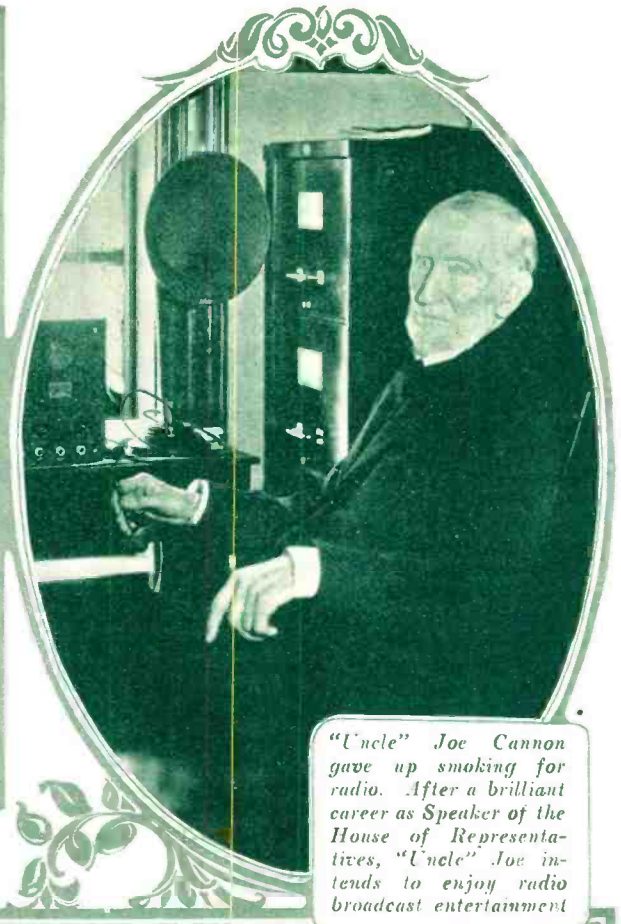
In his early political career he was renowned for a championship of tariff for revenue only, of bimetalism and of regional banks such as are now represented by our Reserve Bank System. He advocated constitutional amendments providing for an income tax, for woman suffrage and for prohibition. He has led the movement for prohibition like a knight in shining armor and is still in the lists.

As secretary of state in President Wilson's first administration he will be remembered chiefly for his negotiation of Peace Treaties with 32 nations.

Mr. Bryan is easily the most influential leader of the Democratic Party today and is devoting his great talents to combating the Darwinian theory of Origin of the Species and in support of the Volstead Act. And he is using radio.

A Radio Slant on Interesting Folk

Presentation of a Radiola Grand to the Governor of Honolulu, Hawaii. R. R. Carlisle, of the R C A is tuning in for the benefit of Governor and Mrs. Farrington



"Uncle" Joe Cannon gave up smoking for radio. After a brilliant career as Speaker of the House of Representatives, "Uncle" Joe intends to enjoy radio broadcast entertainment

The famous "Astor Coffee Dance Orchestra," which is officially known as B. Fischer & Company. This orchestra has for some time been a star feature on the programs of station WEAF. In "Peeps Into Broadcast Stations" another popular orchestra is shown. Both illustrate pertinently the widespread public interest in orchestral music since the advent of broadcasting

The Super-Heterodyne Receiver

By R. H. Langley

Radio Engineer, General Electric Company

The new super-heterodyne receiver which the Radio Corporation of America has added to its line of Radiolas

PERHAPS the easiest way to understand the Super-Heterodyne system of radio broadcast reception is to consider a mechanical analogy. Picture a simple pendulum. This will consist, let us say, of a billiard ball hanging at the end of a piece of slender string or thread.

If the upper end of this is fastened to some stationary support, such as a hook in the top sill of a doorway, the pendulum will swing when it is first put up, but will finally slow down and come to rest.

If the ball is now drawn slightly to one side and released the pendulum will swing and we shall find that it makes a certain number of swings per second depending primarily upon the length of the string. If the string is shortened the ball will swing more rapidly and will make a greater number of complete swings per minute. Let us take the pendulum off of the stationary hook and hang it from the center of a string, stretched quite tight between the two sides of the door. If we now start the pendulum, it will move the supporting string very slightly due to the fact that the string is not absolutely rigid.

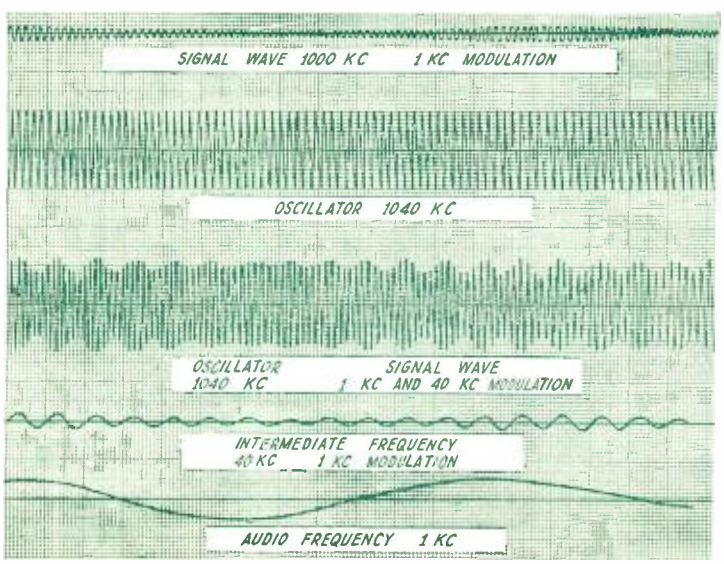
If we hang a second pendulum of exactly the same length as the first on this string, and start one of them going it will communicate its motion to the second pendulum through the string and the second pendulum will very soon swing almost as far as the first one did when it was started. When this time comes it will be found that the first pendulum has practically stopped swinging. The second pendulum will now drive the first one and in a few more swings the first pendulum will have all the motion and the second pendulum will be practically at rest. This interchange will go on back and forth, between the two pendulums until all the energy in the system has been dissipated and both pendulums will then come to rest.

Suppose now, that the second pendulum had been made slightly longer or shorter than the first one. The two pendulums would then have different frequencies of swing, and would not be in resonance with each other. If the first one was started the second one would pick up some motion from it, but not nearly so much as it would if they were of exactly the same length, and the first one would never stop entirely until the system came to rest.

When the two pendulums are of different lengths consider what will happen to the string from which they are hanging. Remember that the string will move as a whole, that is, one part of it cannot move forward with one pendulum while the other part is moving backward with the other pendulum. What will this string do? It is being urged to move at two different frequencies at the same time. This it cannot do. The only thing it can do, and the thing which it does do is to move at a new frequency which will be found to be the difference between the frequencies of the two pendulums.

Suppose now that we hang a third pendulum on the string and adjust its length so that it will have a frequency exactly equal to the difference between the frequencies of the first two pendulums. When the two pendulums are put into motion they will move the

(Continued on page 27)



Oscillogram showing relation between the different frequencies in the super-heterodyne receiver

Illustrating by pendulum the principle of the super-heterodyne

The Theater in Radio

Mary Pickford in "Dorothy Vernon of Haddon Hall." The inset shows a typical family situation—Douglas Fairbanks staging an exclusive performance for Mistress Mary. His exuberance is largely due to his having finished his "Thief of Bagdad"

The Theater in Radio

Being the Chronicles of One S. Pepys, Radio Fan

By William A. Hurd

THE theater in radio is more significant to me than ever it was before. It means that I can choose a play to my best liking without submitting to the tyranny of critics or the abominable council of my alleged friends.

In truth, the twirling of the dials on my radio set in quest of a good show will be a pastime comparable only to my present habit of browsing through a bookshop. The ecstasy of fireside abandonment can never be realized in public.

Selecting the particular play to my best liking will be a comparatively simple process of elimination. I do know that a play to be broadcast must of itself be good. There I have a standard.

Theatrical reviews imply something of the *noblesse oblige;* that note of finality I am not willing to accept. It seems to matter not whether they be authoritative. And if I am in company with a friend I find that I may not question the virtues of a dramatic criticism unless I question the viewpoint of my companion.

The theater has always engaged my interest, but I do find a greater fascination in radio. It is therefore pleasant to observe the theater — that institution ordinarily reluctant to emerge from its old crystallized forms —come to radio for its broadcast blessing and entertainment.

On the whole, I have found broadcast shows to be enjoyable; for good lines and lively music bring to me entertainment of a most delectable order.

Scenery and costumes cannot be broadcast. Broadcast announcers can attempt to do little more than describe the effect, which I find is often misleading much in the same manner that I discover my impression of a character in a book does not coincide with that of the artist. And so likewise do many unspoken situations lose much of their value in radio.

Constance Binney in Sweet Little Devil

Opera would lend itself in especial to broadcasting, for its situations are of small consequence. The entire plot is contained in two, or perhaps three, short paragraphs which the editor of the libretto chooses to label as the "argument," and by way of proving his contention, gives it front page space. The magnitude of some few opera settings can scarce be crammed into the limits of a stage—as those of Wagner. But I would lief as not employ my imagination, comfortably ensconced in a morris-chair at my radio, than struggle to peer under the chandelier from the family circle, four balconies above the privileged class who work their way down to grand tier boxes from positions of office boys.

I will enjoy drama on my radio when it has been properly developed for broadcasting. At such time, broadcast station personnels will include players who have radio personalities that supplement the so-called stage personalities. And before the microphone, characters need have no thought other than of their lines, which may well portray the author's emotions through voice inflection in an understandable manner.

* * *

The theater made its début in radio some time since when it was thought

The Theater in Radio

Mary Hay as "Mary Jane" in the musical comedy "Mary Jane McKane"

Ada-May and Harry Puck in "Lollipop" broadcast from W J Z

Fowler and Tamara in a specialty dance in "Lollipop"

Ada-May Weeks in the musical comedy "Lollipop"

musical reviews were in truth written for broadcasting. But I withheld my concurrence. I bethought me the producers of such extravaganzas were somewhat confused since none of us could be sure for what purpose they were intended. And it seemed to me that the broadcast announcers were themselves confused, what with disjointed scenes to explain, and situations so impossible the audience must see them to comprehend the joke which, forsooth, begins at the box office.

Wherefor, since musical reviews—which are on the order of extravaganzas—are ill-adapted to broadcasting, I must content myself with musical comedy. And I find it is not difficult.

In the musical comedy, scarce four minutes elapse between any spoken line and the next musical number. I am not beset with puzzlement when characters talk, for dialogue is of a light order to suit the plot. And whosoever would converse must cleave together lest I be at great pains to identify their voices in my loud speaker. It seems to me that any chance word will occasion the untoward entrance of the chorus, which needs no encouragement at all, and if the principals spoke at any distance apart there would be an unseemly confusion of tongues.

* * *

The public prints announced the broadcasting of Mary Jane McKane direct from the theater. And I did hail the announcement with great joy for I had never before heard a musical comedy on my radio.

Marjorie Gateson, one of the principals in "Sweet Little Devil," listening in on her radio in her dressing room between acts

Mary Hay and Hal Skelly seemed less concerned with the importance of their lines, which I deemed were very good, than how much fun they could have with their parts. And in truth they were merrier than ever I thought two stars could be in the same show.

Mistress Bertha Brainard, the winsome announcer for WJZ, was at great pains to learn the cue for each fade-out, of which there were five in the first act, because she might otherwise find herself trying to announce with no light at all, and her notes would then be of small consequence. And in that matter, I thought she was prudent for I have too often, myself, tried to locate a torch light in the dark. She did manage adroitly in her announcing since the operators had removed the control apparatus to the roof having been overcrowded back stage. And they changed their location so near the beginning of the show that Mistress Brainard was not able to arrange signals with the stage manager, which fact, alone, I thought would confound the most placid operator. Watching for a change of scenes at such great distance from the stage and yet explaining each episode in a fashion that was intelligible seemed to me a mark of courage.

The second act I deemed of less merit than the rest as there was scant music, so uncertain were the characters who would marry which other. But when the last act had done I was consoled in the matter of music for the producers were inclined to be doubly profligate, and I was minded to go straightway to a ticket vender and purchase a reservation in the front row, for I am unduly liberal in connection with expenditures on such affairs that please me.

* * *

I deemed myself in good fortune to hear Mary Jane McKane, so at my radio betimes, tuning on various meters, at great pains to learn how I should set my dials for Sweet Little Devil. After some reflection, I did decide that my receiver is a mystery which my understanding may never encompass, and I should not like such a scandal to get as far abroad as my own household. I tuned in, not the least knowing how it was accomplished, and I am content to leave such problems to those more learned in the art, which is, methinks, to leave them unsolved.

Constance Binney did so sparkle as a Sweet Little Devil, I deemed myself ill cast with such mortal stuff as clay. And all the players seemed live-

Virginia Smith and Nick Long, Jr. in "Lollipop"

lier than ever I thought any could be, and the next day I strove to learn by inquiry of the publicity agent if they were inspired before the microphone, which he stoutly denied, telling me that such capers would scarce compare with their frolics behind the scenes. So I bargained some time with him that I might see for myself such unseemly conduct back-stage, he being loathe to have publicity get into the public print, but to which I paid no heed, nor was he unwontedly depressed that I should have back at him with my pen.

Part of the cast of "Sweet Little Devil" listening in on the radio between appearances on the stage. The set is operated by the electrician who stands at the switchboard above

I must look to the improvement of my mind for there are many matters of which I am grossly ignorant, and it was only after I had gone behind the scenes that I learned actors are like other people. The characters of Sweet Little Devil have a radio back-stage which they enjoy between times of acting, and a receiving set provides them with as much pleasure as anything. I displayed my amazement, so arousing their mirth that an unseemly gale swept through the gathering, and a great lightness came in my head, and I bethought me of the cynical Mark Twain, who quoth, "All things are made lovely."

I did observe that microphones were distributed about the stage in such a manner that any one could be used for broadcasting without the others being connected. This, I learned, was necessary since the one placed in the footlights had to be cut off during dancing numbers because the foot steps would interfere with the transmission of the music.

The day passed in serious converse with the producer who methought was unfair in the matter of broadcasting only the one act, I striving to convince him that no play at all is preferable to too little. My discourse was so eloquent that I doubt if he will ever again want to see a radio fan. But the wisdom of my cajolery was borne out by the great number of telegrams and epistles received in response to the prize of a handsomely framed photograph of Constance Binney, autographed by herself, offered to the listener who first acknowledged the reception of the name of a relative spoken by Mistress Binney and next repeated by the leading man, and a like prize to the listener at the greatest distance from New York, the name being Uncle Sylvestor. Sweet Little Devil went off the air at 10:45 and the first reply came in at 10:50, but I am confounded to know of what greatest distance the show was heard as epistles seem never to stop coming, nor the most remote region yet heard from.

* * *

Early supper and at my radio, tuning in for Lollipop. I had been so pleased with the other musical comedies, I knew this one would afford me an evening of real luxury. And in that I was not disappointed. Ada-May Weeks does harbor a trait which I do like in all women, fortunate enough to be so gifted — the possessor's appeal to my protective inclination. And the producer was prodigal with music numbers much to my liking. A costume specialty in the last act, which of course could not be broadcast, annoyed me since it did lack any point, soever, on my radio, but I had great admiration for the adroit fashion of Mistress Brainard's announcing, she making it very lively.

In such good measure did the comedy lines of Lollipop make the issue between trade unions and exclusive society a seemly jest that I was mindful of what great moment a viewpoint can be to either one and yet be of no consequence at all. So I decided that I would fain purchase a ticket at such time that my purse was not put to it for the droll necessities of life, which I swear exceed my tenacity.

* * *

So up to see Mr. D. Fairbanks and Mistress M. Pickford, who had been persuadad against their will to broadcast from WJZ, and I did hail the opportunity with great joy, for both have won my esteem, which methinks is not peculiar to myself inasmuch as I did gain entry to the studio only with dexterity of a subtle order, there being so many about the place.

Mistress Mary was, forsooth, very pale, she being frightened before the microphone, which I thought would not happen if it had been concealed in a camera, but the studio manager would have none of my ideas, he striving to convince her that she need but

(*Continued on page 70*)

Wire Lines and Radio

How Each Help to Make World's Communications of Greater Use to Mankind

By Richard H. Ranger

Member of the Institute of Radio Engineers

LIMITATIONS to radio? Certainly! But they are only relative limitations which are being overcome progressively. Selectivity in simultaneous transmission is a serious feature becoming more pronounced as radio uses become more extensive. But wave selectivity is marvelously efficient and will become more so as necessity demands it. In addition, the possibilities in directive transmission and reception will enhance the traffic capabilities of the ether enormously. May we not imagine the radio central of the future as the center of a hub of wires extending from the city out a little distance into the country, where directive transmitters and receivers extend the wire spokes into wireless rays to reach all parts of the globe instantly. The same wave length may then be used simultaneously on separate spokes of the radio wheel without mutual interference.

Think of the possibilities such an arrangement would lend to broadcasting. With a ring of high-powered stations connected to a central studio its superior programs could go out in all directions and cover the country.

Photo-radiography

Fortunately, radio waves seem to keep their form pretty true throughout their entire journey. They may be absorbed or they may get chopped up by other ether waves, but such as do get through are true to form. No ether friction seems to exist which would change a sharp wave front into a long, drawn-out one with decreasingly small waves fore and aft, as happens with water waves, for example.

This characteristic opens up a new hope for achievement of the long-sought photo-telegraphy, such as has been attempted since light-sensitive selenium cells were first discovered half a century ago. For practical photo-telegraphy, the minute variations in light intensity of a picture must be communicated faithfully to the distant receiver. Radio offers this capability.

New devotees of the radio are not leaving it to radio engineers to venture such predictions as the foregoing. They are making confident prophecies themselves. And they are a fruitful source of speculation as to the future

Suggested plan for central studios and directional transmission from the city suburbs

Making Radio Waves Stand Still

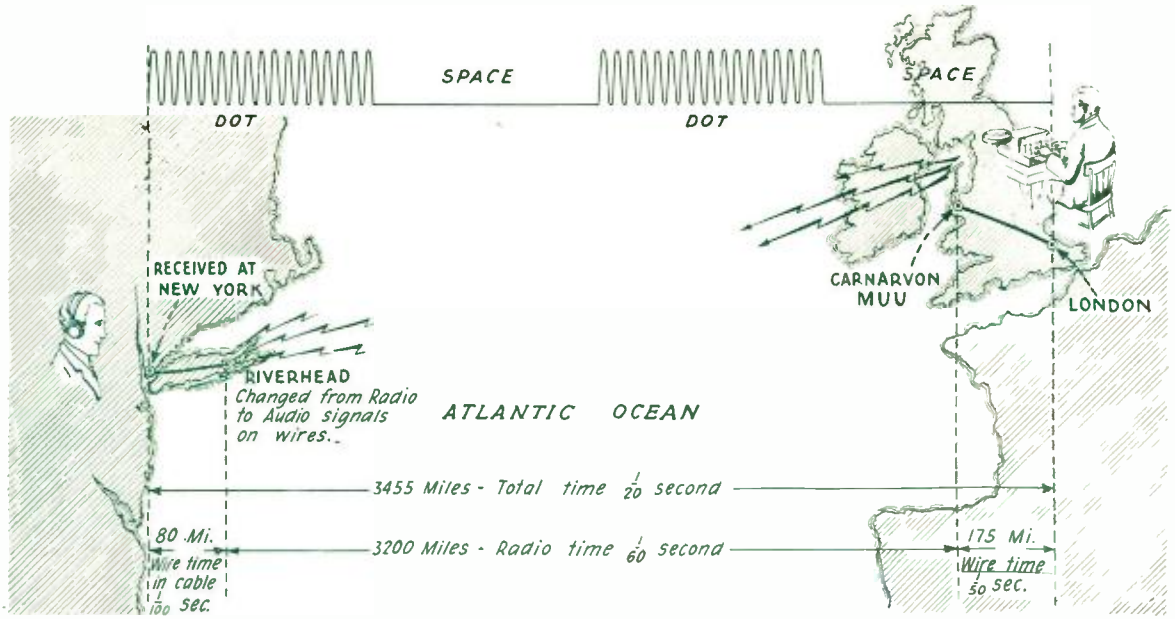
MR. RANGER, the author of this article, gave a demonstration and lecture a few weeks ago before a meeting of the Washington branch of the American Society of Electrical Engineers, which was well attended by radio fans.

He pointed out how by means of a system of powerful sending stations located at widely separated points along the coast and connected by land wires, as illustrated in this article, it is possible to avoid interruption due to static disturbances and thunder storms by dodging them since we have a selection of several paths by which to send the radio waves.

By actually sending signals from the lecture hall in the Cosmos Club to Warsaw, Poland, and getting the signals relayed back, he demonstrated the speed of radio waves to his audience. Then, in order to impress the character of these waves upon his listeners, he made them slow down and finally stand still. For this purpose he used the long coils shown in the accompanying photograph. Connecting an oscillator to one end of the coil, he sent electric impulses down the coil. The speed of these impulses or waves was delayed due to the inductance properties of the coil. Moreover the distributed capacity was high, so that it was possible to reduce the speed of the electric waves to one-thousandth of the initial rate. Then since these waves started back from the far end of the coil they met the oncoming waves and thus an effect was produced of standing waves.

Mr. Ranger then pointed out a useful application of this principle. By means of a tape record made by a syphon recorder a ship is able to observe the standing waves as it passes them successively and from a knowledge of the wavelength is able to calculate its distance from the sending station, so that we have here a Radio Log for the further aid of navigation.

Captain Ranger demonstrating the speed of radio waves at the Cosmos Club in Washington. Note the long coils, by means of which he produced standing waves



A picture of the relative speeds of wireless and wire transmission

of radio. Naturally one of the most common grounds for such speculation is the question: Will radio ever replace telephone lines? How long a lease on life have the telephone and telegraph companies when radio hits its real stride? We will look into that question.

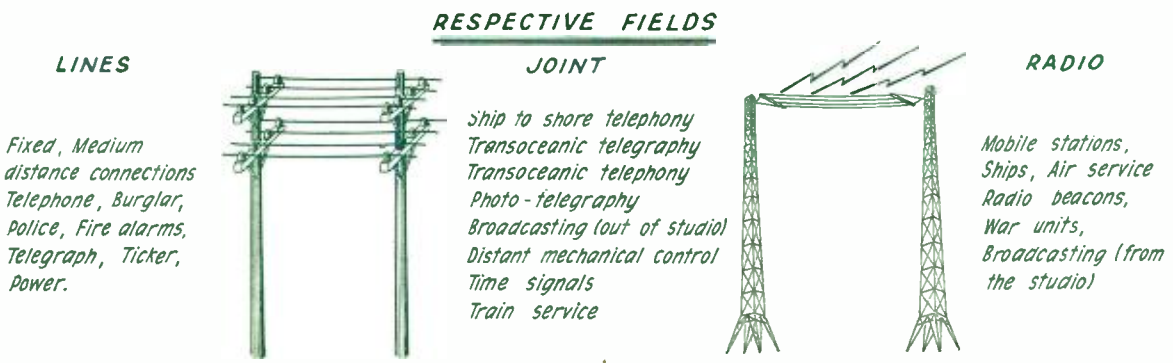
Radio will never reign supreme. Why? Because the ultimate question of whether one device or another will be used to do a given job is an economic function of how much each costs. Therefore in certain specific fields, wire lines will continue to be more practical, while radio will unquestionably supplant the wire lines in others, as well as setting up new fields that wire lines could never hope to touch.

That which will determine the real fields of wire lines and radio depends chiefly on the characteristics of the substances involved as the transmitting media. Wire lines go from one specific spot to another and as such afford the best means of selective intercommunication where large numbers of individual, simultaneous connections are desired, particularly for relatively short distances. In this field comes the telephone, burglar and fire alarms; telautograph or other indicating devices; local telegraph and ticker service.

Radio has pre-eminently the fields of mobile communication, such as to ships at sea and general dissemination of news now so wonderfully expanded into radio broadcasting. When airships and aeroplanes become more extensively developed, radio will be ready, particularly in the important "beacon" work, to be the radio lighthouses. The uncertainties of war give radio the distinct advantage in connecting the combat units. But it is to be expected that radio may have the more useful rôle of bringing all nations near together to rub off the sharp corners of overstrained elbows.

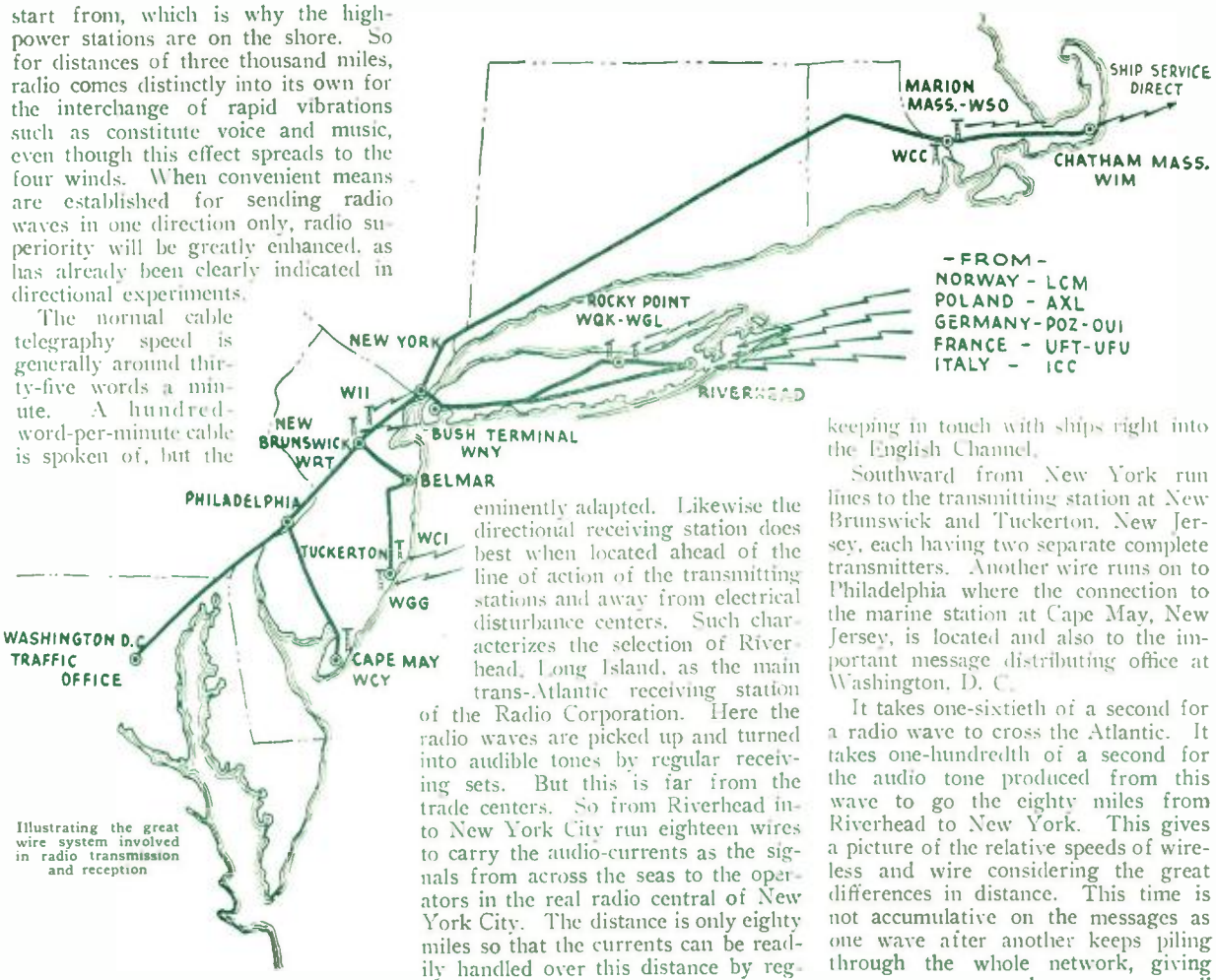
On the borderline between wire and wireless come the fields of long distance telegraph and telephone. It is extremely doubtful if wire telephony could ever bridge the Atlantic, even if it were economically sound. But radio has done that in a hit or miss way in the amateur tests, and in a regular way by the big trans-Atlantic stations when the high-power engineers set out to do the job. The question of when this will become a commercial reality only awaits the usual formalities of international as well as intercompany agreements.

The trouble with telephony over such great distances by wire or cable is of the extreme attenuation or decrease in the original signal input in traversing such long lengths of energy-consuming wire. Radio, too, is attenuated, chiefly at the sending and receiving stations themselves, due to the fact that our spreading wire antennas have a relatively poor hold on the "ether," which is the radio-conducting medium in space. But on long distances, these end losses become the lesser part of the whole loss. This wonderful enveloping layer of radio ether over the earth's surface is really a pretty good carrier of our words when once the waves have started. It makes a big difference where they



start from, which is why the high-power stations are on the shore. So for distances of three thousand miles, radio comes distinctly into its own for the interchange of rapid vibrations such as constitute voice and music, even though this effect spreads to the four winds. When convenient means are established for sending radio waves in one direction only, radio superiority will be greatly enhanced, as has already been clearly indicated in directional experiments.

The normal cable telegraphy speed is generally around thirty-five words a minute. A hundred-word-per-minute cable is spoken of, but the radio has already hit one hundred and twenty-seven words per minute across the Atlantic.



Illustrating the great wire system involved in radio transmission and reception

Here is where the joining of wire lines to wireless becomes of tremendous importance in over-all effectiveness. For transmission efficiency, the flat and even marshy coast lands are eminently adapted. Likewise the directional receiving station does best when located ahead of the line of action of the transmitting stations and away from electrical disturbance centers. Such characterizes the selection of Riverhead, Long Island, as the main trans-Atlantic receiving station of the Radio Corporation. Here the radio waves are picked up and turned into audible tones by regular receiving sets. But this is far from the trade centers. So from Riverhead into New York City run eighteen wires to carry the audio-currents as the signals from across the seas to the operators in the real radio central of New York City. The distance is only eighty miles so that the currents can be readily handled over this distance by regular wire telephone practice.

Other wire lines run all the way up to Marion, Mass., from New York to control the effective transmitting station at this point. Thence other wires run on to Chatham, Mass., where a most effective marine station has been built up which has many records of keeping in touch with ships right into the English Channel.

Southward from New York run lines to the transmitting station at New Brunswick and Tuckerton, New Jersey, each having two separate complete transmitters. Another wire runs on to Philadelphia where the connection to the marine station at Cape May, New Jersey, is located and also to the important message distributing office at Washington, D. C.

It takes one-sixtieth of a second for a radio wave to cross the Atlantic. It takes one-hundredth of a second for the audio tone produced from this wave to go the eighty miles from Riverhead to New York. This gives a picture of the relative speeds of wireless and wire considering the great differences in distance. This time is not accumulative on the messages as one wave after another keeps piling through the whole network, giving one, two or even three operators all they can do to change the dots and dashes into typewritten messages.

So wire and wireless unite in the radio art to give to the country the most economical and effective service that these sister arts of electricity have yet to offer.

The Super-Heterodyne Receiver

(*Continued from page 19*)

supporting string at the new frequency and the string will swing the new pendulum at exactly its own period and it will consequently be set into motion.

Now the first pendulum represents the incoming radio waves. The second pendulum represents the wave produced by the oscillator tube in the receiving set. The third pendulum represents the so called intermediate frequency amplifier. This is an amplifier built to work at one particular frequency, and because it is so built, it can be made very efficient, much more efficient than any amplifier which is required to work over a considerable range.

The incoming radio wave may be anywhere from 220 to 550 meters wave length which corresponds to frequency ranging from 1,360,000 to 545,000 cycles per second. An amplifier cannot be built which will amplify all of these various frequencies equally and effectively. If, however, we have a tube in the receiving set oscillating at any frequency to which we desire to adjust it, we can arrange matters so that the difference between the frequency of the incoming wave and the frequency of the local oscillating tube is exactly the frequency which the intermediate frequency amplifier has been built for.

As we change from one broadcasting station to another and consequently from one frequency to another, we change the frequency being produced by the oscillator an equal amount so that the difference is always the frequency of our amplifier. That this result has been accomplished by the adjustment is indicated by the signal received in the loud speaker. In other words there is no response in the loud speaker until the frequency of the local oscillator has been adjusted to the proper relation with the incoming signal, namely, that which gives a difference equal to the frequency of the amplifier.

Another advantage of this method is that the intermediate frequency amplifier can be made very highly selective to tune out interference.

Just think what radio will do for the little red schoolhouse!

Radio in the Schools

Superintendent Paul C. Stetson, head of the public schools of Dayton, Ohio, says that radio in the school provides recreation, encourages scientific studies, inspires to artistic development and destroys provincialism

By Truman B. Mills

READIN', Ritin' and 'Rithmetic made up the three R's in the curriculum of the Little Red Schoolhouse days. Not many of us can remember that far back, but all of us are aware of the fact that great strides have been made in school work in the past decade. Among the latest additions to the three R's has been Radio.

Schools have been notoriously slow in adopting new methods during the past and this habit has interfered with the extension of the radio to school work. There are always those who hold to the old ways and fight the introduction of the new and the novel.

"We got along all right in the old days," the conservative school board member declared. "Just look at the big men that were turned out by the little red schoolhouse. All these new fangled methods only add to the taxes," the cheese-paring educator complained.

As a result the radio has had to take a back seat in the school affairs of most cities. But not so in Dayton, Ohio. Realizing that this modern scientific marvel is destined to play a big part in our lives and that the fullest use should be made of it in our everyday activities, Dayton educators were among the first to adopt the radio as an adjunct to present day educational methods.

Superintendent Paul C. Stetson, head of the Dayton schools, is very enthusiastic over the use of radio in education

Although the introduction of the radio was tried out first as an experiment in school work, it has now become an established part of the educational system, and is being expanded to meet the growing demands of teachers and pupils.

Results far beyond expectations have been obtained through the use of the radio in the schools, and plans are now under way to make Dayton one of the foremost cities in the United States using the radio. Pupils have taken an extraordinary interest in the innovation both from the standpoint of broadcasting and receiving.

When first suggested, it was thought that receiving stations only would be established in the various schools so that the pupils of the grade and high school departments could take advantage of the programs that are being broadcast daily throughout the country. Later, through the interest and enterprise of pupils and wide-awake faculty members a broadcasting station was established in Parker high school. This is one of the four high schools of the city and is given over to training of the freshman students.

At the outset the board of education made an appropriation of several hundred dollars for the purchase of equipment and installation. This was of course only the preliminary move. Additional money has been expended and a complete broadcasting outfit has been purchased.

Stivers and Steele high schools now have receiving stations and the grade schools of the city are one by one putting in instruments for receiving. The new Roosevelt high school, which is just being completed and which will be one of the largest and finest equipped high schools in the United States, will have a receiving station.

The Parker station is WABD, and has an assigned wave length of 283 meters, or 1060 kilocycles. The operating schedule has been on Friday night of each week from seven to eight o'clock. Plans for the future call for operation two or three nights of each week, as material is being gathered together which will require a

Radio has been added to the three R's. Students are taught how to broadcast programs as well as how to manage apparatus

lengthening of the present schedule. Paul Jackson, who was graduated from Steele high school last June, is the commercial operator in charge of the station. The outfit used is a Western Electric CW-931. The users report that it is giving very good service.

The programs for the most part have been made up of talent taken from the student body, but as there has been a demand on the part of outsiders to come in and furnish programs it has been necessary to put some restrictions on the use of outside talent in order to give the fullest play to pupils. Any pupil who is capable of playing a musical instrument, of singing, reciting or reading, is invited to apply for a place on the programs in as many numbers as he, or she, wishes to appear.

Here, then, is one use of the radio in the schools that tends to develop the latent talents in the pupils and causes them to aspire to greater things in self-expression. It is not hard to imagine how elated a young person is when he is permitted to take part in a radio program and send his voice out through the air! But this is only one of the ways the radio excites interest among pupils.

There is a feeling among the school folks and parents that the future holds much in the way of radio development in educational work. One of the proposed plans calls for the broadcasting of talks of distinguished persons that come to Dayton. Take for instance a recent case: Roy J. Snell, the arctic explorer and writer, was in the city and gave interesting talks in the schools. As it was, he had to go around to the different school buildings to reach the thousands of children. In the future it is planned to have such speakers give their talk in one school and broadcast the speech to the pupils of other schools all at one time, thus saving much time and effort.

Superintendent Paul C. Stetson, head of the Dayton Schools, who is very enthusiastic over the use of the radio, said:

"In a recent article by H. G. Wells, this noted English author made the interesting observation that in a short time our educational methods would be completely revolutionized due to the two great inventions of moving pictures and the radio. Mr. Wells predicts that, in a short time, textbooks will be discarded by the public schools and that lectures will be delivered on science, literature, history, etc., by means of motion pictures. He states that the possibilities of the use of motion pictures have not been realized in the slightest degree. The radio is classed by Mr. Wells as one of the greatest boons to modern civilization. It is his feeling that in a few years, students will assemble in a lecture room and hear lectures on chemistry or physics by the most famous scientists in the United States.

"Although Mr. Wells may have allowed his enthusiasm for moving pictures and radio to carry him too far in his prediction of what will happen to the work in the public schools, that these two great inventions are having, and will have, a profound effect on our educational system, will not be doubted.

Parker High School in Dayton, Ohio, where radio is part of the school curriculum. This is station WABD

"Dayton is fortunate in having made a very good beginning in the use of both motion pictures and the radio. Our plan for visual education has become widely known as the Dayton Plan and is being used extensively in many cities. Dayton is one of three school systems in the United States which now hold broadcasting licenses.

"There are four main purposes in the use of the radio in the public schools in Dayton at present. In the first place, we are trying to develop interest in the radio as a means of education for the pupils who belong to the radio clubs. There are no organized classes in the radio work, but many of the lectures which are received over the radio are of an educational nature. We are attempting to correlate some of the work of our music department with the concerts which come over the radio. In the second place, we feel that having both the receiving and broadcasting stations serves to stimulate research work in electricity. The radio club has a real educational and technical value. Many of the young men who are members of this club are acquiring a real interest in scientific problems through their contact and work with radio. In this way it provides a valuable function in vocational guidance. We do not know how many young men may be stimulated to follow scientific lines by having their interest aroused through membership in this club.

"In the third place, the radio in the schools is quite important since it has a definite recreational value. The schools of today are more than places where children are grouped together to learn certain definite lessons. A very important part of the modern school is to provide the right sort of recreation. Through the installation of a radio station it is possible for us to entertain large groups of students with the very best lectures and music. It has a fourth value—namely that of promoting sociability among the entire student body.

"We trust that the radio stations in our various schools will be valuable in enlarging the pupils' horizons. A great country like America tends to break up into small groups which allow their social provincialism and prejudice to work against the country as a whole. The automobile has been a great factor in breaking up this provincialism and prejudice. It is no uncommon sight to see cars from Texas, California, Maine, Florida and Michigan, parked side by side on the streets of any large city. This means that these people are going back home with a broader vision and new ideas of what constitutes their country. We hope that the radio will have the same effect. When a class has heard a concert from Pittsburgh, they will unconsciously become more interested in Pittsburgh. It will cease to be merely a name and will become more of a reality. When one can be in communication with people thousands of miles away, he will no longer harbor narrow prejudices which are a drawback to the broad development of any country. The development of radio is certainly in its infancy. No one would be so foolish as to predict its future, but it is a source of satisfaction to know that the various high schools and elementary schools in Dayton have been wide awake enough to take advantage of this great invention. It will be a factor in building up a complete school system."

"The Heart of Radio"

Vacuum Tubes Worth $3,500 Operated to Gain Information as to Their Characteristics and Length of Life for the Benefit of the Radio Fan

By W. C. White
Engineer, General Electric Company

Figure 1—Life testing rack for UV-199, UV-200 and UV-201A tubes

THE General Electric Research Laboratories are usually thought of as the birthplace of many new electrical developments, such as the drawn tungsten wire incandescent lamp, the gas filled Mazda lamp, the Coolidge X-Ray tube, the Pliotron and the X-L filament vacuum tube, to mention only a few of its many contributions. This laboratory, however, has another very important function to perform in the service that it renders the various affiliated manufacturing groups.

The most widely known example of this is Mazda Service which is carried on in relation to the manufacture of incandescent lamps. Mazda Service is not directly rendered to the individual purchaser of lamps, but to the manufacturing groups where these lamps are made. This Mazda Service includes not only gathering and distributing of lamp manufacturing information, but also systematic and periodical examination of the quality and characteristics of the lamps under manufacture at the different factories. This service results in better lamps to the public.

A considerable number of the problems involved in the manufacture of vacuum tubes are identical to those of incandescent lamp making, and in the case of Radiotrons, uniformity and quality are, if anything, of even greater importance than in lamps. At the same time, the manufacture of these tubes requires a somewhat new technique in comparison with lamps, and therefore, this problem of good quality and uniformity is much more difficult.

About a year ago a rather extensive system of Radiotron service to be furnished the factories by the Research Laboratories was outlined and shortly afterward put into effect.

For each type of Radiotron manufactured certain allowable limits of variation in the different constants have been assigned. These cover, among other things, the electron emission, the amplification, the plate current and the electrical measurement of vacuum. On account of the large production of tubes, and the fact that every tube manufactured is given several different tests, this necessarily requires a considerable number of rather complex testing equipments. An important part of these testing equipments is the various voltmeters and milliammeters used for obtaining the constants of the tubes.

Once a month a representative of the Research Laboratory makes a three- or four-day visit to each factory. His first duty is to check the various instruments on the test sets, as upon the reading of these instruments the whole test procedure and result are based. Next, the general operation of the test sets is gone over in considerable detail to see if their general behavior is satisfactory.

About twenty-five tubes of each type under manufacture are then picked at random from the shipping room and these are re-tested by the laboratory representative in the factory test sets as a check on the accuracy of these sets. In this way the possibility of unsatisfactory tubes passing the factory tests is largely eliminated.

In addition to the regular testing sets, each factory is equipped with special apparatus for measuring such constants of the tube as impedance, filament amperes at rated filament volts, amplification constant, mutual conductance and input impedance. This equipment is frequently used by the factories in checking their daily production.

The sample tubes selected for examination are then tested in these special equipments to obtain information as to the average values of these various constants, and also as we shall see later as a check on the testing equipment itself.

The factory engineers are continually testing the constants of their manufactured product and taking the proper steps to see that these constants are kept within the proper limits. The duty, therefore, of the laboratory representative is primarily to be certain that the factories have testing equipment that is in perfect working condition and that they obtain correct results in using it.

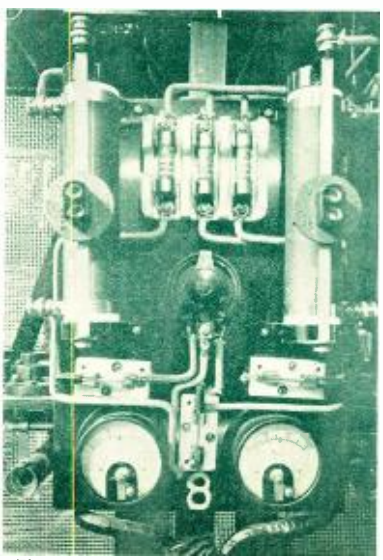


Figure 2—An enlarged view of a panel in the testing rack

To this end the sample tubes which were originally selected from the factory shipping room are brought back to the Research Laboratory and all the tests repeated on a standardized equipment maintained for this purpose. All of these measurements are carefully examined for discrepancies so that any such discrepancies can be investigated, the cause found and the remedy applied. This process that has been described, therefore, indicates and checks the average product of each factory, but of still greater importance, gives assurance to the factory engineers that their various pieces of testing equipment are in satisfactory condition and can be depended upon. The first few months that this system was in operation a great deal of difficulty was experienced in making the various equipments give results that checked within the desirable limits of error, but since that time variations in the results from the testing equipments have been rare.

Reports are then made out covering the complete series of tests on these tubes, showing the quality and uniformity, and copies are forwarded to each of the factories.

The sample tubes that form the basis of this testing procedure have not, however, ended their usefulness at the close of these tests. About one-half of them are put on a life testing equipment located in the Research Laboratory. For each type of Radiotron there have been assigned standardized electrical conditions for life test, such as filament voltage, plate voltage and grid voltage.

In addition to these samples obtained from the factory every month, each factory ships weekly to the laboratory a few tubes which are also put on life test.

This rather extensive life testing equipment is interesting and its construction and operation will next be described. The equipment utilizes two rooms, one in which the tubes are continuously operated during their life and the other room containing the testing equipments in which the tubes are tested for their performance and various constants at frequent intervals during their operating life.

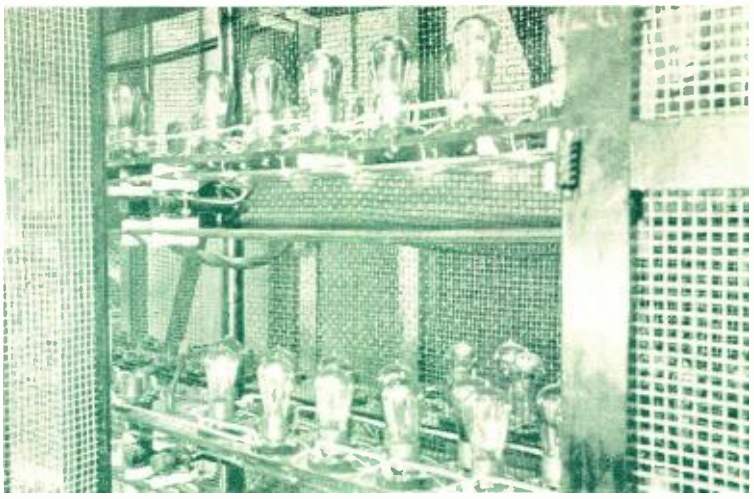


Figure 4—Two of the sections accommodating the five-watt tube

The life testing "rack," as it is called, for the UV-199, UV-200 and UV-201A tubes is shown in figure 1. This rack contains slightly over five hundred sockets for the UV-199 tubes and over three hundred standard sockets suitable for the UV-201A or UV-200 tubes. On a second rack are also included about 250 sockets for small power tubes, using the standard base. In addition, ninety sockets for the fifty-watt type of tube, and thirty-five for the 250-watt type are included.

The equipment for receiving tube life testing which will first be described is divided into thirty-two sections; that is, it is possible to carry on simultaneously life tests under thirty-two different conditions as regards filament voltage, plate voltage and grid voltage. Adjustment is provided for any filament voltage throughout the entire working range of the tube. Any plate voltage between 0 and 125 can be utilized and any negative grid voltage up to minus fifteen volts is available on each section. Sixteen of these small control panels can be seen in figure 1 and there are sixteen similar panels on the opposite side of the rack.

An enlarged view of one of these panels is shown in figure 2. In the lower right hand corner of this panel is a small voltmeter which indicates the plate voltage. This voltage is controlled and set at any desired value by one of the slide wire resistance units located above. The other slide wire resistance unit is used to adjust filament voltage. This voltage must be set and maintained with great accuracy, a far greater accuracy than can be indicated by a small type of instrument suitable for location on these panels. For this reason a special highly accurate voltmeter which is calibrated against a standard at frequent intervals is used for testing the various filament voltages. Figure 1 shows the young lady in charge of the life testing equipment making this filament voltage check on one of the sections. This voltage is checked three times a day.

Referring again to figure 2, the small circular potentiometer rheostat shown in the center of the panel is used to control the negative grid bias applied to the tubes. The value of this grid bias voltage is indicated by the voltmeter at the lower left hand corner of the panel. Three fuses and three single pole switches are provided, as shown on the panel, to protect and control the plate, grid and filament circuits.

Located near the side of each of the voltmeters shown on the panel of fig-

Figure 3—Testing for electron emission, state of vacuum and general operation of tube

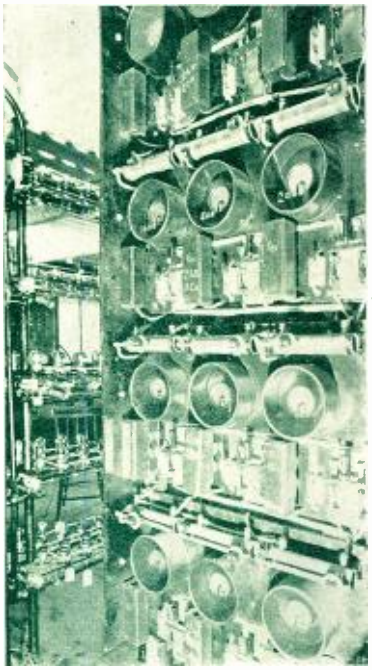


Figure 5—Panel for controlling the filament and grid voltages

ure 2 a resistance stick will be noted. This resistance is bridged across the filament leads and draws a filament current equivalent to that of several tubes. The function of this resistance is to minimize to an unimportant value the fluctuation of filament voltage on any particular section when the filament of one or more tubes burns out.

Four of the sections used in receiving tube testing are much larger than the other sections and are maintained under the standard test conditions. On these sections are tested the sample tubes obtained weekly and monthly from the factories. The remaining sections are smaller, containing only from twelve to thirty sockets each and are used for running special tests.

Methods of improving the manufacture of detail design of the tubes are continually under investigation and also many special tests are made to determine the effect of various changes in mode of operation upon tube life. No change in the design or method of manufacture of the tubes is made until life tests have indicated that this change does not exert some unforeseen or detrimental effect upon the life or quality of the tube. For these reasons a majority of the special testing sections are continually in use.

In the standardized life test the tubes are removed in general from the racks at 25, 50, 100, 250, 500, 750, 1000 hours and at further intervals of 250 hours, and tests of electron emission and vacuum and a general operating test are made. The making of these tests is shown in figure 3.

Initial tests on tubes before they leave the factory and pass into the hands of the consumer through the dealer are, of course, very important, but of equal importance is assurance that these same tubes will not deteriorate after a short life in the hands of the user. It is for this reason that these tests are made on the constants and performance of the tubes at intervals during life.

A second rack similar in general construction to the first is used for the life testing of the group of power tubes comprising those of 5, 50 and 250-watt types or any others of the same general characteristics and voltage. This entire rack is enclosed in screen meshing. This meshing is clearly seen in figure 1 back of the receiving tube rack.

Figure 4 shows two of the sections accommodating the five-watt type of tube, one of the screen doors being open. The power tube testing rack has plate voltages varying between 350 and 2000 and safety switches are provided on each of the screen doors so that this high voltage is automatically disconnected if any of these doors are opened.

Four sections are provided for the testing of the five-watt type of tube. All of these sections are supplied from a common high voltage source, but each section may be operated at a different filament or grid voltage. In a similar way the fifty-watt type of tube can be tested on four sections, all of these sections being supplied with a plate voltage of 1000 D. C. Four sections are also provided for the testing of the 250-watt type of tube, a common plate voltage of 2000 being provided.

On account of the high voltages, the control for these power tube sections is largely centralized at two points. Figure 5 shows the panel for controlling the filament and grid voltages. For

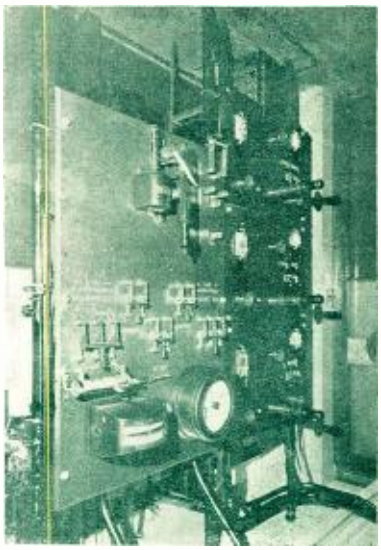


Figure 6—Panel for controlling the plate voltage for the 5, 50, and 250-watt sections

convenience, the plate current meters are also included on this panel. Owing to the fact that these individual plate current meters for each section must be at high voltage, they are protected by grounded metal cases with glass fronts. Therefore, from this centralized panel the grid voltage and load on each tube can be adjusted.

The left hand panel of figure 6, which is divided into three horizontal sections, controls the plate voltage for the 5 50 and 250-watt sections. Each of these three-panel sections contains a plate voltmeter, a main disconnecting switch of the plug type, an ammeter showing the total load and a rheostat and switch in the field of the generator.

A great many of the power tubes are of such a low impedance that with rated voltage on the plate and without a negative grid voltage the plate current would be very high so that the heating of the anode would be ex-

(Continued on page 35)

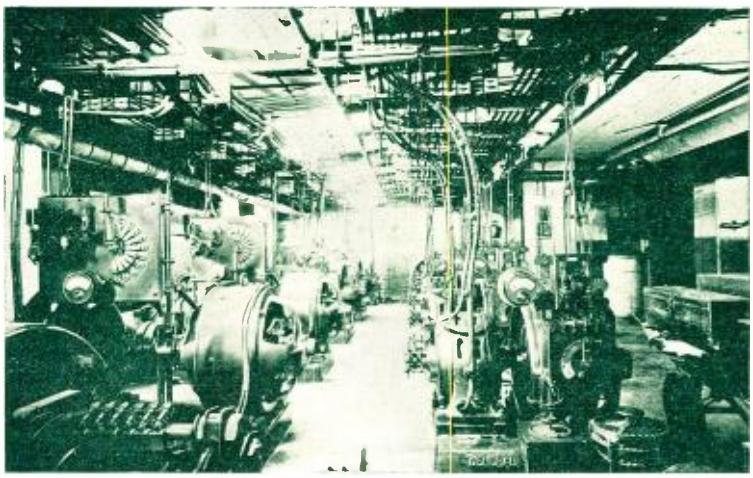


Figure 7—A group of machines which illustrates a portion of the laboratory equipment

Radiosyncrasy—First Prize

A WIRELESS AGE Receiver Awarded for This Title Selected From Over One Thousand Submitted

A WIRELESS AGE Receiver to be Awarded to the Winner of "Radio in the Home" Contest

THE WIRELESS AGE received well over one thousand titles in the February-March contest.

First prize, THE WIRELESS AGE Reflex Receiver (described in the February issue) was awarded to A. G. Kuehn, Bristol, Oklahoma. His suggestion for a title was "Radiosyncrasy."

The ingenuity of Radiosyncrasy may be seen in the analysis of its root derivation: Radio (its own sweet self), syn (with), and krasis (mingling or mixing) from the Greek; which gives us an interpretation for the picture: mixed up radio. The inventor of this new word, which may easily become famous, probably had also in his mind such suggestive ideas as "idiosyncrasy," "syncopate" and even "crazy."

Second prize, five dollars, was awarded to E. B. Correll, Milwaukee, Wisconsin. He offered the title: "Youth and Age on Different Meters.'

Unquestionably, youth and age have been, and probably always will be, on "different meters." In fact, the old issue between youth and age was never more aptly expressed.

Third, fourth and fifth prizes, a year's subscription to THE WIRELESS AGE, were awarded to Stephen J. Leo, Jersey City, New Jersey; G. A. Wendling, Troy, New York, and J. P. Bucher, Newport News, Virginia. The titles suggested by each were respectively, "Broadcasting the Haunts and Habits of Delayed Husbands." "A Subject for Reflex-ion," and "A Child Shall Lead Them."

Winning Titles

1.—Radiosyncrasy.
2.—Youth and Age on Different Meters.
3.—Broadcasting the Haunts and Habits of Delayed Husbands.
4.—A Subject for Reflex-ion.
5.—A Child Shall Lead Them.

Each of the three titles very nearly won second place in the contest. "Broadcasting the Haunts and Habits of Delayed Husbands" could have been a little more unique in its phrasing. "A Subject for Reflex-ion" was one of several titles on the same general thought which directed the attention of the reader to the subject itself and the study of it. "A Child Shall Lead Them" was the only title that pertinently expressed the idea of the younger generation leading the elders in radio.

The majority of titles received had letters attached commending THE WIRELESS AGE for presenting an illustration that portrays a situation with which all were familiar. A few were so enthusiastic in their praise they actually forgot to offer any suggestions for the title itself. We observed, however, that such titles found their way into the office soon afterwards.

Quite unsolicited, contest letters have come in great numbers commending the general excellence of THE WIRELESS AGE, offering suggestions of future articles desired, unbiased criticisms of recent issues, and in general, indicating a very real interest in the progress of the magazine. All such letters were pleasing, and the more appreciated because they were sent of the writers' own volition. The response manifestly arose from the contest which was unanimously voted worth while. Current opinion is evidently that such contests bring home to the reader the "human side" of radio.

Many suggestions were based on "Jazz" and various modifications of that title. Others were "Interference," "Papa Loves Mamma," etc., "Static," "No Place Like Home," and other titles of songs, comic strips and popular phrases.

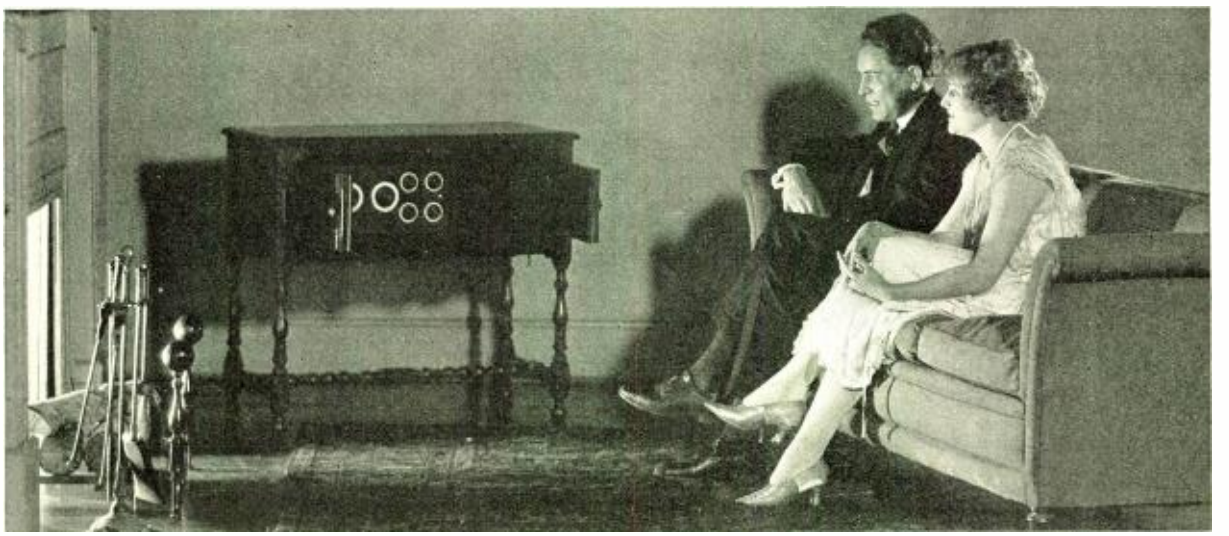
The "Radio In the Home" contest, announced in the April number, will assuredly be a like success. Those who were less fortunate in the last contest may enter the new one with better assurance of success.

THE WIRELESS AGE Contests are strictly a family game in which all readers may participate. The prime motive is, and will be, a spirit of play of an evening, between times of tuning in on the radio.

So let's see how much fun we can have in the new one.

—THE EDITORS.

Radio in the Home Contest



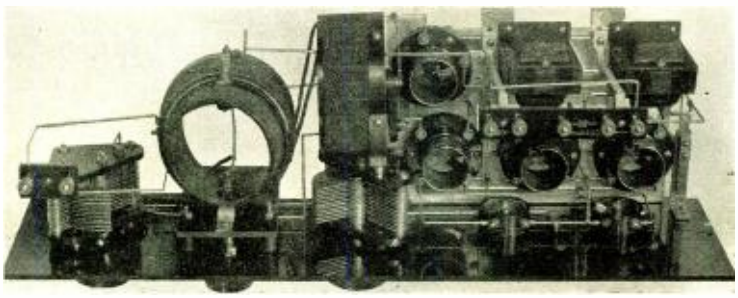
THE NEW CONTEST—RADIO IN THE HOME

Just send us a snap-shot or photo of your radio set showing how it is arranged to fit in harmoniously with the surrounding furnishings. The above photo illustrating a Cutting and Washington Receiver is a good example. If your set is "home-made" it will do just as well. The best photo will receive a Wireless Age Receiver (described in April number) as first prize. Second prize, $10.00. Third prize, $5.00. Next ten best photos, a year's subscription to The Wireless Age or "The Wireless Experimenters' Manual," by Elmer E. Bucher, to each. Contest closes May 31st

An Improved Superdyne Six-Tubes

For Volume on Distant Stations It Is the Equivalent of a High-Priced Receiver

IN this improved six-tube Superdyne, the various tuning coils which comprise the antenna, inductance, the tickler coil and the plate reactance coil, are Curkoids (25 turns). The secondary and tickler coils are used in connection with the Curkoid dual coupler mounting—affording a very fine degree of adjustment of relationship. The coupling is adjusted by means of a worm gear arrangement controlled by a dial on the front of the panel.



One of the several types of superdyne receivers. This is a four-tube set made by C. D. Tuska Co.

The plate reactance coil which serves to increase the impedance in the plate circuit to the point of maximum regeneration is mounted on a fixed mounting, placed at right angles to the other two inductances.

The grid and plate tuning variable condensers may be of any good reliable manufacture. Their capacity is .0005 mfd. corresponding to the average 23-plate condenser. It is very important that these condensers have very low losses.

This receiver may be used with a loop, instead of an aerial and ground, by connecting the two terminals of the loop to the aerial and ground binding posts by placing a small fixed condenser in series with one side of the loop. A .00025 should be satisfactory.

Better results, however, may be obtained by grounding the negative side of the filament and connecting a small aerial, consisting of 15 to 20 feet of insulated bell wire strung across the room to the stationary plate of the first variable condenser.

In arranging the lay-out for this set it will be found that the arrangement in the circuit diagram will provide the shortest possible leads. It is well to remember that the leads which carry radio frequency currents must be very short and direct.

In wiring up the set the filament leads and other parts at more or less ground potential, should run nearer the front of the panel in order to prevent hand capacity effects. Also the variable condensers should have their rotor plates connected to the filament or ground side of the circuit and their stationary plates to the grid or plate or high potential sides of the circuit. This will almost eliminate any tendency toward body capacity effects.

Operating the Set

In the operation of this receiver everything depends upon the radio frequency stage. Great care must be used in constructing it, both in the placing of instruments and connecting them up. The main thing to remember is to hold the radio frequency tube from oscillating when both tuned circuits are brought to absolute resonance. It does not really matter which direction the rotor or stator is wound, as they can be shifted in the mountings.

Sometimes it will be found that reversing the lead to the coil and plate circuit will considerably change or affect the audibility of signals. The operation in general is apt to be a bit puzzling at first, so a few hints on the general manipulation of the dials will not be out of order.

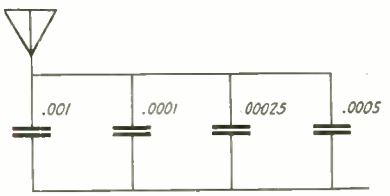
Set the resonating condenser, or rather the one which tunes the plate reactance, at about 20 and the wavelength dial at about the same, and advance the tickler coil from zero until a click is heard in the phones or loud speaker. This denotes oscillation. Work slowly on the edge of this point, coming forward with the resonating condenser and wavelength dials until the old familiar squeal of a station is heard. Tune this in at the loudest point and then reduce the stabilizer little by little and follow up with the resonating condenser keeping the squeal at a low tone until finally the squeal is entirely lost and the speech comes in perfectly clear. Then again adjust the wavelength dial for micrometer adjustment to further clear up the music or speech. Experience in tuning is necessary. Do not be discouraged if your first attempts are not successful, or if it does not come up to your full expectations the first time you try to tune it.

The parts used in this receiver are as follows:

Superdyne List of Materials

One special Curkoid Dual Coupler.
One special fixed mounting for Curkoid Inductance.
Three 50-turn Curkoids.
Two 23-plate .0005 mfd. Hammarlund Variable Condensers.
Seven Eby binding posts.
One 7″x26″ Bakelite Dilecto Panel.
One 7″x26″ Cabinet.
Two Paragon Audio Frequency Amplifying Transformers.
Five Bradleystats.
One Bradleyleak.
Five Freshman Fixed Condensers.
Six Na-ald Deluxe Standard Sockets.
One pair Modern Push-pull Transformers.
Three 7 Quinby Aluminum Frames.
One Warren Loop (this may be used instead of an outdoor antenna as mentioned in the text).
Two Weston Plugs.

Remember, of course, that you are at perfect liberty to select other parts of reliable manufacture and be as much assured of success.



Fixed condensers of the right capacity for the particular type of antenna used are to be preferred to using a variable condenser

The range of this receiver seems to be unlimited. With location in Chicago, it has been found easy to tune in western stations as distant as Los Angeles and Portland, Oregon, on the loud speaker without resorting to the head phones first, and the volume from KFI can be favorably compared with that of a phonograph. For volume on distant stations it is equivalent to any of the high priced sets on the market today. It is probably the most sensitive set known for the number of tubes used.

Trouble may be experienced with a suitable grid leak. This, you will note, with some tubes will have a tendency to block or choke when resonance is passed. This condition may be remedied by touching the finger tip to the grid terminal on the socket of the detector tube. However, if this becomes annoying it may be remedied by using a better grade grid condenser or using a grid leak, the latter being preferable.

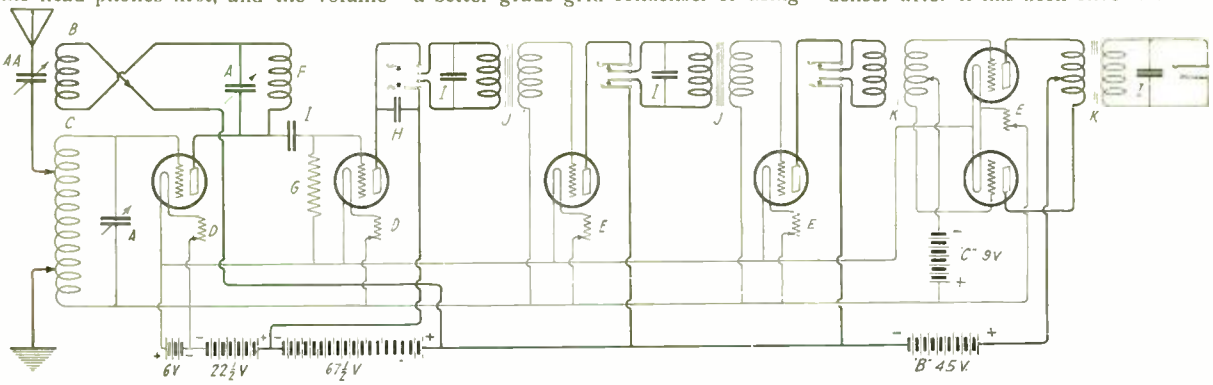
One very important thing to remember is never to connect a grid leak across the grid condenser. If a grid leak is needed it should be connected from the grid terminal of the detector socket to the negative terminal of the filament with as short leads as possible.

From 2 to 3 megohms will be found most favorable for use with tubes similar to the UV-201A. The grid condenser is .00025.

The best type of antenna to use with this receiver is a single wire about 70 feet in length, and 30 or 40 feet high.

Do not touch the wavelength condenser after it has been once tuned or balanced with the aerial, for this will throw the entire set out of tune. The position for this condenser must be found by experiment.

Very much care indeed must be taken in the wiring and selection of instruments. It is always best to select the very best instruments, and this is true economy, for eventually, the better grades must be installed.



Circuit diagram of the six-tube superdyne receiver described

"The Heart of Radio"

(*Continued from page 32*)

cessive and soon destroy the tube. In order to prevent the destruction of these power tubes in case the negative grid voltage supply should fail, the other voltages remaining at normal, a relay is provided which automatically opens the field circuit of the generators in case the negative grid bias voltage fails or drops below a certain value.

The right hand panel of figure 6 is the main controlling panel for the whole life testing equipment. In addition to the usual control switches, this panel includes an indicating voltmeter so that any marked variation in the filament voltage supply is easily noted and also a recording voltmeter in which there is kept a daily chart of the voltage fluctuation. This daily chart also gives a ready means of determining the hours per week during which the equipment is operated. The equipment is normally operated from 8 o'clock on Monday morning, continuously day and night, until 12 o'clock Saturday noon, being shut down over the week end. This gives a normal operation of 124 hours per week. This equipment requires the operation of five motor generator sets which are located in the basement of the building. These motor generator sets are among the group of machines shown in figure 7, which illustrates a portion of the laboratory power equipment.

The motor generator set furnishing the filament voltage supply has a complete automatic regulating equipment both on the motor and the generator so as to provide continuously perfect constant filament voltage.

At the present time there are approximately five hundred tubes on life test in this room. This represents a value of over $3,500 in tubes operated to full life solely in order to gain information as to their characteristics and length of life, and to help enable the factories to make better and better quality tubes.

The question is often asked: "What is the life of a certain model of Radiotron?" It is the purpose of this equipment just described, and which is installed and maintained at considerable expense, to answer this question and to answer it in the most thorough manner possible. The answer, however, is not a definite figure for any particular type of Radiotron, but information indicating how the life is changed by the many different conditions under which the tube is used. It is, therefore, incorrect to consider that every type of tube has a definite life figure. A slight variation in filament voltage greatly changes the life of the tube. It also varies depending upon the particular combination of filament, grid and plate voltage that is used. Because of the fact that nearly everyone operates a tube in a little different way and does not have accurate instruments for continuously maintaining the filament voltage at a certain value it is absolutely impossible to predict what the life of a tube will be in the hands of the user. The life of a Radiotron can no more be accurately determined than the life of an automobile. A certain automobile is delivered shiny and new from the factory. A few hours later it may be a wreck on the roadside or yet again it may have a long useful life and be finally relegated to a museum where it will serve a useful purpose for a century or more.

So it is with vacuum tubes. The actual life in the hands of the user can never be predicted, but it is the aim of the manufacturer to supply tubes of the highest possible quality so that if care is taken in their operation the life under the conditions of normal operation will be satisfactory.

A Summary of the Entire Subject of Amplifiers

Amplifiers

Amplification Without Distortion

Every kind of amplifier described with rules to guide the designer

By Louis Frank

PART I

Single-stage amplifiers. Resistance amplifiers. Inductance amplifiers. Tuned circuit amplifiers. Tuned Radio Frequency

To be continued in successive issues

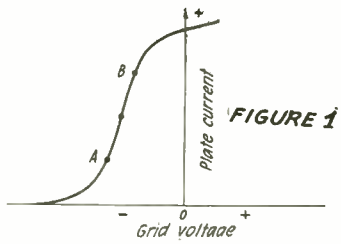
THE radio frequency energy collected by a receiving antenna depends upon a number of factors, but even in the best of cases is small. As a result it has been necessary in the past to increase the transmitter power to exceedingly large values in order to maintain communication with the receiving stations. The intensity of the received signal may be enlarged by amplifying the small received energy at the receiver and this is the common practice today since all broadcasting stations are operating on relatively low powers and it becomes absolutely essential to amplify.

Before the advent of the electron tube the only type of amplifiers available were the old Brown relay and the Telefunken sound intensifier. These produced at the best very small amplifications. In the case of the electron tube there was developed a device which has inherent in it large amplifying properties, and by the use of a number of tubes almost unlimited amplifications may be secured. At the same time the electron tube is capable of fulfilling one of the most important conditions of a good amplifier: namely amplification without distortion. So important is the entire subject of amplification that it may be considered the backbone of reception today. It is therefore the object of this article to summarize the entire subject of amplifiers, emphasizing the high lights of the subject.

Single Stage Amplifier

When a small voltage is applied to the grid of a three-element vacuum tube a large current will flow in the plate circuit as a result of the well known relay action of the tube. This large plate current may be made to flow through a high resistance or inductance placed in series with the plate, and across this resistance or inductance therefore, a voltage may be developed which may be many times greater than the originally impressed grid voltage. Or from the point of view of energy, a considerably greater amount of energy will be available in the plate circuit for operating, for example, a loud speaker, than is applied to the grid input of the tube. To secure this amplifying action the circuits must be properly designed.

Not only will a good amplifier amplify, if properly designed, but to be a



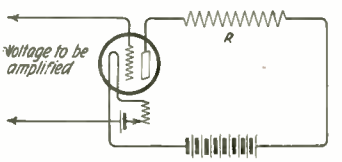


FIGURE 2

good amplifier it must fulfill one other important condition: It must produce in the output circuit of the tube an enlarged and exact copy of the signal impressed on the grid input circuit. This will only be the case if the plate current is always proportional to the grid voltage. From the general shape of the grid voltage-plate current characteristic of the tube, figure 1, it will be seen that this condition of direct proportionality is obtained over the small range of grid voltages where the curve is a straight line, namely between points A and B. Operation within this range can be accomplished by adjusting the value of the grid bias potential to a value midway between that of A and B. Thus our first design consideration is to operate the amplifier tube always with a negative grid bias, so that we work on the straight line portion of the characteristic curve thus securing amplification without distortion.

When the tube is operated under such conditions the amplification of the tube is constant, and is called the "amplification factor" of the tube, represented by μ_o. The amplification factor of a tube is one of the most important constants of the tube, for the actual amplification secured in practice depends upon it. The amplification factor of a tube is defined as the maximum theoretical amplification which may be obtained in the tube. Thus if (e) volts are applied to the grid, then the maximum possible volts which may be obtained in the plate is $\mu_o e$ volts. This maximum is never really attained, but it may be approached very closely in actual practice as will be shown. The maximum amplification which a tube is capable of giving, namely μ_o, depends solely on the construction of the elements and how they are placed relative to one another. Thus if the grid wires are placed close together, and are made very fine, the amplification constant increases, and if the grid is moved closer to the filament it will also increase.

As opposed to the theoretical maximum amplification factor of the tube μ_o, we have the actual or true amplification which is really secured in practice when the amplifier tube has a resistance or inductance in the plate circuit. This is called μ, and is in all cases less than the maximum factor μ_o. That it must be less will be evident from the following. For each volt which is applied to the grid there is developed inside of the tube in the plate circuit μ_o volts due to the amplification factor μ_o. Now obviously some of this amplified voltage must be consumed in the internal plate circuit resistance of the tube, leaving the balance of the amplified μ_o volts for the output. Thus the actual output must be less than the theoretical maximum amplification of the tube. It is the object of correct amplifier design, however, to make the voltage consumed inside the tube as small as possible, thus leaving most of the amplified voltage available for the output. We will now consider the actual design of the various types of amplifiers.

The circuit for such an amplifier is indicated in figure 2. In this case the amplified voltage is obtained across a resistance placed in the plate circuit. The question is what is the real amplification which can be obtained with this amplifier. This depends upon a number of factors, but assuming that we are working with a given filament current and plate voltage it depends upon the amplification constant, μ_o, of the tube, and upon the value of the

external resistance R. If we call the internal resistance of the tube R_ρ, then the total plate circuit resistance is $R+R_\rho$. It can be shown mathematically that the true amplification increases as the external resistance R increases. When the resistance R equals the internal resistance of the tube R_ρ the actual amplification obtained is ½ of the maximum possible amplification μ_o, for obviously half of the voltage will be consumed in the plate resistance of the tube. If we make the external resistance R less than that of the tube then the real amplification will decrease below $\frac{1}{2}\mu_o$. If we increase the value of R then the real amplification will increase, and it increases according to the curve of figure 3, which shows real amplification against the external resistance R. From this curve it is seen that the practical maximum true amplification, where the curve begins to flatten out, is obtained only if the load resistance is several times higher than the plate resistance of the tube, say about three times as great. Thus for the type of tubes on the market today like the UV-199, UV-201A, etc., which have plate resistances of about 20,000 ohms, it is desirable to have over 50,000 ohms in the plate.

It would appear that the more we increased the value of the external plate resistance R the more true amplification we would get. However from figure 3 we see that while this is so the actual increase in amplification after point A is reached is very small for the greatly increased value of resistances. In other words we have here reached the practical engineering limit. However there is another drawback to actually increasing the value of the resistance R.

One-Step Resistance Amplifier

The amplification of a tube depends upon the plate voltage actually applied to the plate. Now if we have a constant plate battery voltage it is evident that there must be a drop of voltage across the external resistance R. Thus only part of the plate battery voltage is applied to the plate. The greater the resistance R the greater will the drop across it be, and the smaller will be the actual voltage applied to the plate, thus decreasing the amplification obtained. If we wanted to keep the effective voltage on the plate constant irrespective of the external resistance R we would have to increase the plate battery voltage as we increased R, in order to counteract the voltage drop across R. This is very costly, hence there must be some limitation to the increase of the external resistance R. For these reasons in actual amplifier design it is not desirable to go beyond about three times the tube resistance for the value of the external resistance R. Thus for the 20,000 ohm tubes at present on the market a suitable value for R is about 50,000 to 60,000 ohms.

The circuit for this amplifier is indicated in figure 4, in which it is seen the amplified voltage is developed across an inductance in series with the plate circuit. In general the resistance of this inductance is much lower than its reactance at the frequencies employed and it may therefore be neglected. In such an amplifier the true amplification is directly proportional to

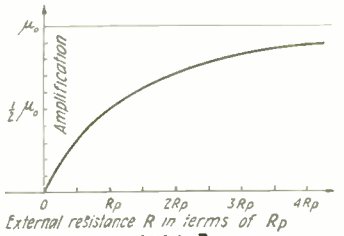


FIGURE 3

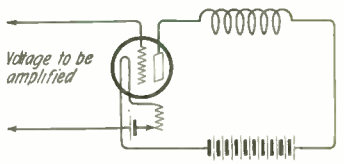


FIGURE 4

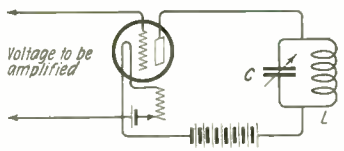


FIGURE 5

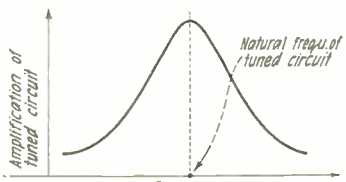


FIGURE 6

the reactance. The larger we make the reactance the greater is the true amplification obtained. Hence by making the inductance L very large we can approach the theoretical maximum amplification very closely. This type of amplifier will give higher amplifications in general than the resistance amplifier above described. For the inductance L is an iron core inductance, and its resistance is therefore very low compared to its reactance. Thus there is a very small direct voltage drop in it, hence the entire plate battery voltage is effective on the plate of the tube. In using inductance coupled amplifiers care must be taken to prevent saturation of the iron core, for direct current flows through it and magnetizes it. If it becomes saturated distortion will occur. There are just two practical ways to avoid this. The first is to use an inductance having an iron core with very large cross-section, so that the small plate current will create only a very low flux density. This precaution need be observed only if the inductance is a closed core affair.

One-Step Inductance Amplifier

The second way to avoid distortion due to saturation of the iron core is to use an open core inductance, or a closed core inductance with a small air gap. The small air gap or open core effectively prevents saturation. The exact value of inductance to use for maximum amplification is not very critical but should be about two times the value of the internal plate resistance of the valve at the lowest frequency used. To illustrate by means of a practical example, suppose you desire this amplifier for receiving broadcasting. Then we may consider the lowest frequency received as about 50 cycles, since music ranges in frequency between 50 cycles and 10,000 cycles. At 50 cycles the reactance of our inductance should be at least twice the internal resistance of the tube, which for the usual type of tubes as the UV-199 and UV-201A is 20,000 ohms. Thus our reactance should be about 40,000 ohms at 50 cycles. Since reactance is given by the simple equation:

Reactance $= 6 \times$ frequency $\times$ inductance $= 6fL$, we have

$40{,}000 = 6 \times 50 \times L$

therefore inductance $= L = 133$ henries.

For the frequencies higher than 50 cycles the reactance will be greater, hence the amplification may be somewhat greater at the higher frequencies, so that it is seen that no loss of amplification is thus secured.

ONE STAGE TUNED CIRCUIT AMPLIFIER

In this type of amplifier a tuned radio frequency circuit is used as in figure 5, and the amplified voltage is developed across the tuned circuit. In general this circuit is a radio frequency circuit and can therefore only be used for radio frequency amplification. If an analysis is made of the impedance of this circuit it will be found that to currents of the same frequency as its natural frequency it offers the maximum impedance. Hence for any given current value the maximum voltage will be generated across the circuit at its natural frequency. At this natural frequency, or resonant frequency of the circuit, the circuit behaves like a pure resistance whose value is given by the simple equation

$$R \text{ effective} = \frac{L}{CR}$$

(Continued on page 68)

Sun Spots and Radio

Prominent Radio Engineers Refute Astronomer's Theory

PROFESSOR MORECROFT, Dr. Goldsmith and John V. L. Hogan, knowing that The Wireless Age is at all times primarily concerned with publishing authoritative material, submit their statements which are designed to impress our readers with the importance of understanding the profound difference between a theory and a basis of fact. With due respect to Professor David Todd, the three prominent engineers point out that his theory of Sun Spots and Radio is only a theory, unsupported by sufficient evidence of proof and that, furthermore, static will not interfere whatever with our mid-summer's radio.

Letters to THE WIRELESS AGE from

Dr. Alfred N. Goldsmith

Chief Broadcast Engineer, Radio Corporation of America

tells "The Wireless Age" readers that the coming summer will give us plenty of radio enjoyment.

To the Editor:

An investigation of electrical disturbances of radio reception discloses the remarkable irregularity of the effects observed and demonstrates the difficulty of predicting the strength of electrical disturbances (static) at any future time.

As a general rule, static is least in the early morning and in the cold winter months. On the other hand, there are sometimes very severe periods of static at night and even in the coldest weather.

Static varies from year to year, sometimes being unusually weak for several years in succession and sometimes being strong one year and weak the next, and so on.

Then too, there are some years when static is sharply "bunched" during a given limited portion of the year, the remainder of the year being relatively free from static.

Many theories have been advanced to account for static. Lightning storms, electrical currents in the upper layers of the atmosphere, electrical bombardment of the upper atmosphere, earth currents, and changes in the magnetic condition of the earth have all been suggested as possibilities. Presumably, any imaginative geologist, meteorologist, or astronomer could evolve a goodly volume of fairly plausible theories based on his specialty.

But to correlate such theories with the systematically observed facts over a long period of time is quite another matter. In the first place, an enormous volume of information has to be experimentally gathered and this information must then be statistically analyzed. In the second place, effects must be predicted on the basis of this theory and the effects actually found to occur as predicted.

So far as radio engineers are concerned, neither of these requirements has yet been successfully met; and consequently, interesting as any particular theory may be, it cannot be regarded as more than a pleasantly suggestive and stimulating thought.

Professor J. H. Morecroft

Columbia University, President of the Institute of Radio Engineers, Consulting Engineer, New York City

says we cannot predict static conditions from present established data.

To the Editor:

There is no doubt that radio will continue to furnish us instruction and entertainment during the summer months as it has during the winter.

The connection between certain variations in the earth's magnetic field and the presence of spots, or storm centers, on the sun seems to have been reasonably well established but, in so far as I know, there is no proof at all which shows a dependence of our enemy static upon the changing magnetic condition in the earth so brought about. It seems quite likely that such a connection does exist, but it may be so slight as to be negligible. Quite likely the atmospheric disturbances which cause us most of the trouble classed under the head of static are of terrestrial origin. Although much less violent in character than are the sun's, our earthly storms are so much closer that their effect on radio receiving sets may be incomparably greater than is that of the sun's storms.

What then about the coming summer with the predicted prevalence of large, well-defined sun spots? Shall we be so disturbed by these solar turbulences that listening will constantly remind us of frying eggs, in the sputtering spider? We have no reason at all to believe so. The coming summer will give us as much, or more, enjoyment from radio than have its predecessors. The change in activities which the reasonable listener will develop as the summer advances, will be due to calling in his first lines of attack. Instead of listening to stations thousands of miles away, which naturally send to him very weak signals, so weak in fact that they are well buried in static, he will deign to listen to stations nearer home, which because of their nearness, will put at his disposal signals much stronger than the atmospheric disturbances, signals which will therefore be free from objectionable noises to a degree sufficient to make radio listening still a worth-while manner of spending the evening.

John V. L. Hogan

Fellow and Past President, Institute of Radio Engineers
Member, A. I. E. E.

protests that broadcasting was successful in the summers of 1922 and 1923 in spite of atmospheric conditions.

To the Editor:

May I suggest that Professor Todd's prediction carries with it a number of unsound implications? To say, as he does in the April number of your magazine, that "during the coming year radio reception will be most difficult because of heavy static discharges" is necessarily to be misunderstood. Perhaps a careful reading of his entire article, coupled with a knowledge of radio transmission phenomena, would allow one to assign a proper weight to the bare statement that I have quoted. I fear, however, that many of your readers will be led astray by the brevity and positiveness of the prediction, and that they will consider it certain that static will prevent effective broadcast reception this summer. Hence this letter.

The fact is that any prediction as to static is unsafe. We know too little about its origin and causes to warrant any prognostications. Professor Todd may be certain that we shall have unusual solar disturbances, but even if we do there is no certainty that static caused by them will prevent radio transmission. We have the proof of this in Professor Todd's own statement that sun spot activity which broke up transatlantic cable service did not produce static strong enough to interfere with transatlantic broadcasting!

In the spring of 1922 most radio engineers feared "summertime static." When the summer of 1922 was over, they commenced to wonder why so little static disturbance of broadcasting had been observed. Some pessimists insisted that it had been an especially good summer for radio, and said "Wait until *next* July!" But the summer of 1923 disappointed them again, for good broadcast reception was possible right through the hottest months. There is no real reason to expect the summer of 1924 to be any different.

The main technical reason that broadcasting keeps on performing satisfactorily in the summer months is that the transmitters generate powerful continuous waves of high frequency.

Whittemore builds

A RADIO HOME

Government's Radio Engineer plans a home with a complete radio installation

By S. R. Winters

ARCHITECTURAL plans for the building of many homes in the future will make specific provision for the convenient wiring and installation of radio-receiving instruments. Not unlike facilities for a shower bath, the folding bed, electric-light fixtures and the coal bin, the blueprints of the architect of tomorrow will include a systematic plan for installing a radio-telephone receiving set. This foresight in the building of residences will not only recognize radio as an integral unit among the conveniences of modern homes, but will contribute to the pleasing arrangement of the installation of such apparatus.

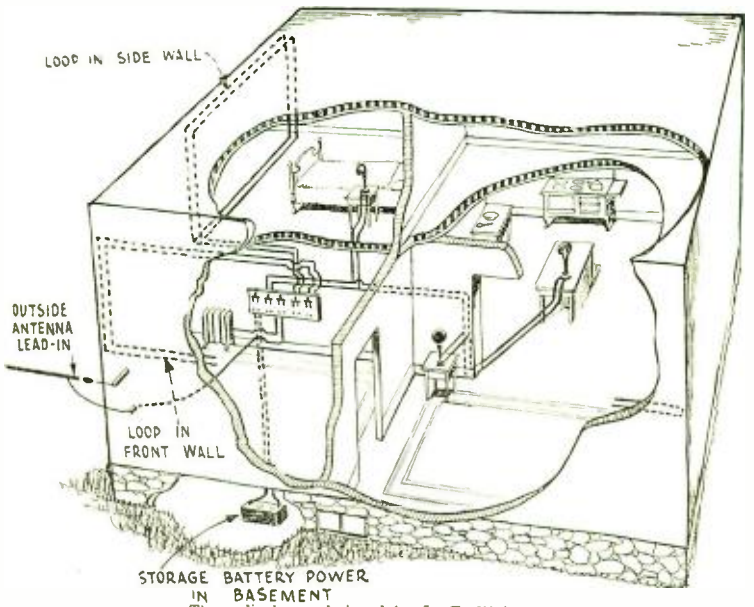
Fortunately for the popularity of the inclusion of radio facilities in the specifications of the architect, L. E. Whittemore, formerly alternate chief of the Radio Laboratory of the Bureau of Standards, but recently appointed secretary to the Governmental Interdepartment Radio Advisory Committee, is among the first if not the first, to make specific provisions for the installation and arrangement of radio instruments in his home. The 7-room house now being constructed for Mr. Whittemore at Edgemoor, Maryland, about eight miles from the heart of Washington, is being erected according to original plans contemplating the convenient and pleasing arrangement of loop antennas, batteries, loud speaker and other units for the reception of radio communications.

Of course, the facilities for installing the radio equipment will be largely devised by Mr. Whittemore. However, the contractor who is building his suburban residence has been instructed to lay a conduit from the basement, where batteries will be placed, to the second floor of this home, thus obviating the unsightliness caused by ordinarily depositing the batteries under the cabinet or table on which the receiving instruments proper are mounted. Wires from the second floor to the first floor will connect with a loud-speaking device, which can be operated when a group of persons desire entertainment, information or other intelligence borne on the invisible electro-magnetic waves.

The study of Mr. Whittemore, which he modestly describes as his "den," will be on the second floor of his residence where the radio-receiving instruments will be installed. The latter will be placed on book shelves which may be closed, thus hiding from view any unseemly mechanism. The terminals for the antennas and those of the receiving set will be brought together in one plug board. The lead-in wires from an overhead antenna will come from a nearby tree and pierce the walls of the home to the antenna plug. In addition to an outside antenna, Mr. Whittemore has installed two large loop antennas, comprised of single turns of wire at different sections of the walls. The use of two loops, situated at different angles, will enable the operator to readily avail himself of the directional characteristics for reception, a peculiar virtue of a loop or coil of wire.

L. E. Whittemore

This "radio home"—if this term is permissible—owned by the secretary to a government committee in which is reposed the administration and regulation of radio among the various government departments as well as the exercise of a profound influence on radio broadcasting and commercial traffic, should serve as an example for popular duplication. Mr. Whittemore, in his former capacity as alternate chief of the Radio Laboratory of the Bureau of Standards, was among the vanguard in the development of this science. Therefore, his judgment in modifying the blueprints of the home-building architect to make specific provisions for radio installations carries with it a prestige and scientific knowledge that deserve widespread emulation and as a result it is not unreasonable to assume that "radio homes" will become increasingly popular in the near future.



The radio home designed by L. E. Whittemore

The article on the construction of a super-heterodyne which it was announced would appear in this number was not completed by the time of going to press and had therefore to be omitted.

Peeps Into Broadcast Stations

Olive Ann Alcorn, dancer, late Winter Garden star, giving her talks on dancing from WFI

Hot Hoot Owl Stuff

BROADCASTING Station KGW, out in Portland, Ore., tries to shape its programs so that in the course of a week every kind of listener, regardless of his tastes will have some entertainment that particularly suits, but the one weekly program that seems to suit all is the meeting of the "Keep Growing Wiser Order of Hoot Owls." One clerk is kept busy on "Hoot Owl" mail all the time and during a meeting two telephones and a telegraph loop are kept constantly busy.

The "Hoot Owls" do not sound like regular radio stuff. They sound as though there was a dandy party going on in the next room and somebody had left the door open. Of course, it is all carefully staged, more so than a regular concert, with every minute of the two hours carefully scheduled, but the general effect is as though it were all haphazard and pure fun. The degree team is made up of the best wits in town, one merchant, one lawyer, a wholesaler, a piano dealer, the owner and manager of a booking service and an insurance man; also the manager of KGW and a goat that is always heard, but never seen.

The "Hoot Owls" always come on the air with an orchestra overture, the "Hoot Owl" song, the first and only regular announcement, and then the meeting is turned over to the grand screech who calls the roll and starts the fun. The first order of business is the initiation and the ride on the goat. From then on it is frolic, music and *ad lib* wit. All solos are put on with orchestra accompaniments and sometimes two orchestras and six singers besides the degree team are introduced.

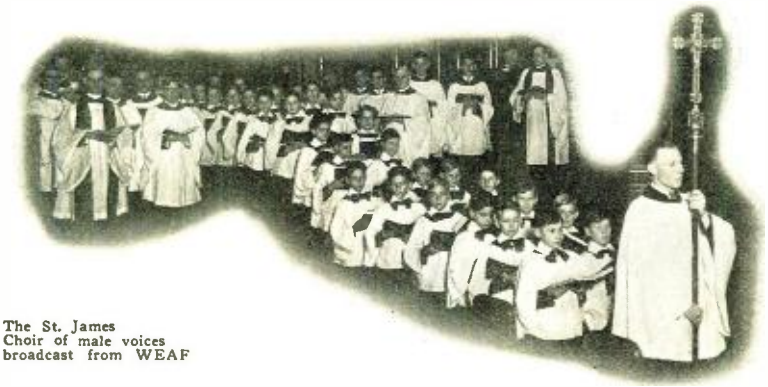
One member of the degree team started to tell a story one night. He was promptly stopped by three other members. Ten minutes later he tried again and got a bit further—there was a blonde opposite the traveling man in the Pullman car—before he was stopped. A third attempt brought him to where just as the porter turned his back. He tried for four meetings to tell that story, but the degree team or the orchestra always drowned him out. The mail doubled and every other letter was an urgent request or a demand that he be allowed to finish. Threats, bribes and mandates came in galore. One old woman came to the studio to see what the place looked like, ostensibly, but before leaving she asked the secretary in a whisper if she couldn't hear the rest, but the story has never been finished.

Lots of requests come in to broadcasting stations to have certain people sing or play, but so far as Dick Haller, manager and director of KGW knows,

Richard V. Haller, announcer and director of KGW

he has only one group so popular that the listeners kick when they are not on the program at a "Hoot Owl" meeting. This group consists of Helen Lewis, Kathleen Duffy and Ruth Meade, all of whom sing and play at least one instrument each. They've never been known to pull a flop, nor have they ever given the audience all it wanted.

Women aren't allowed in the "Hoot Owls." Men and boys who listen are entitled to membership cards and they are issued by the thousands. The degree team, those who put on the programs, is a closed organization, requiring a unanimous vote from the others on the team for admittance and each man must be talented in some way to be eligible. There is at present a long waiting list with a full-fledged bishop at the top.



The St. James Choir of male voices broadcast from WEAF

Lady Martin Harvey Startles CKY Listeners

QUITE a sensation among radio listeners was created by Lady Martin Harvey's address at Central Congregational Church, Winnipeg, broadcast by CKY. The eminent actress denounced alleged activities of the communists among children and made statements which were warmly contradicted by several listeners who telephoned the broadcasting station. The responsibilities of broadcasters for remarks made by speakers during

church services or on public platforms has not yet been defined. To make broadcasting authorities responsible for opinions expressed by speakers would surely be to impose hardship tending to restrict freedom of speech and to curtail the use of radio. Many excellent sermons and addresses would never have been heard had the broadcasting director been expected to insist on their being written out in advance and censored.

Moving a Broadcast Station

IT took only one concert, broadcast from the new studio of WJAX, to prove to the Union Trust Company, which owns and operates this station, that WJAX was getting out over the entire country from its new station just as successfully, and perhaps more so, than from its old location in the Citizens Building.

The new studio is located upon the twentieth floor of the new twenty-story Union Trust Building, the largest bank and office building in Cleveland, which is shortly to be occupied by the Union Trust Company itself.

The moving of the broadcasting station to the new building was simply the forerunner of the moving of the entire bank.

During the process of moving, prize contests were arranged so that immediately after the new station was ready for business, announcements were broadcast. The prizes amounted to well over $1,000, which was offered by Cleveland radio dealers and manufacturers to determine what distance was reached by the new station, as well as clearness of reception. Replies were received from Miami, Florida, and points in the extreme west.

Virginia and Maxime Loomis, two tiny Movie Stars appearing at KFI

Speaking of Bears

FROM the land where wild game is still plentiful has come a request to WGY, the Schenectady, N. Y., radio broadcasting station, that child-eating bears be deleted from bed-time stories for the children. In a country where bears are a frequent sight such stories, it is explained, put fear in the hearts of children.

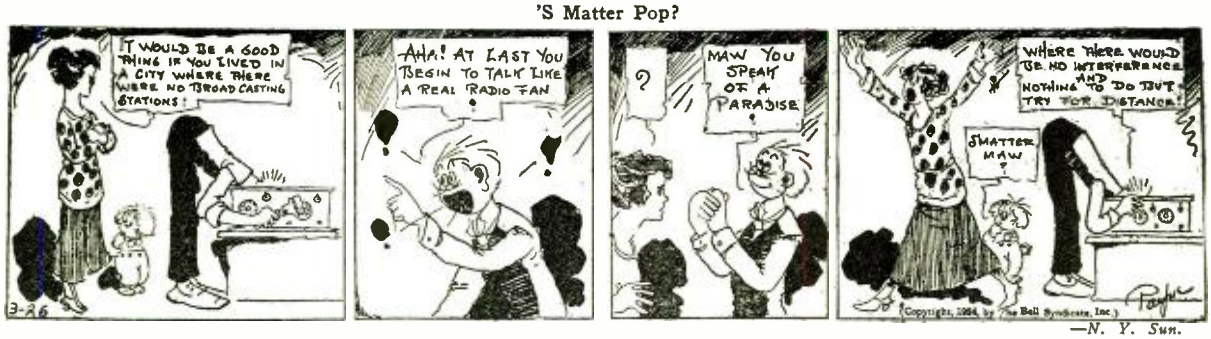
The letter came from F. J. Lee, a resident of Lee Valley, seven miles from Massey Station or New Ontario, Canada. Mr. Lee is the first settler of the place which is named after him. He is well over seventy years old and has lived at Lee Valley for thirty years.

"I want to file a protest," writes Mr. Lee, "against the bedtime stories for the children about bears eating up little boys or wanting to. Remember that stuff goes to this new country where there are bears. There are few children going to school who haven't seen a bear."

Paul Whiteman and his world famous Palais Royal Orchestra broadcasts from WEAF

Best Bets in Humor

'S Matter Pop?



—*N. Y. Sun.*

IN DEEP

SMITH—"It must take a lot of money to follow the radio craze. I hear you have a new outfit—what kind of receivers are you going to have?"

SMYTHE—"I don't know. The court hasn't appointed them yet."

—*American Legion Weekly.*

Befuddled Radio Enthusiast—"Been waiting for over an hour—when does that concert commence?"

—*Life.*

Eclipsing the Ancients

By WILLIAM HARVEY BRADFIELD

Methuselah, Methuselah,
He lived three thousand years ago,
And 'cause he died in early youth,
Knew naught of Radio.

He never had a crystal set,
Much less a Neutrodyne;
He never heard "The Cat" announce
Nor knew the ether's whine.

Cleopatra, Egypt's queen,
Though hemmed around with wealth,
Could never listen in at night
For hints upon her health.

King Solomon, so wondrous wise,
And wed a thousand times,
Could never dance around his house
To South Sea Island chimes.

So, though the ancients had their fun,
Their wealth, their slaves, their glory,
We fellows with a home-made set
Have got 'em skinned, begorrie!

A MISNOMER

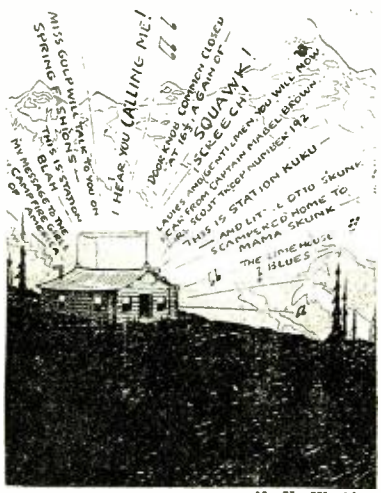
It is indeed a cynic who refers to radio as *wireless* after winding coils, connecting parts and putting up the aerial.

S O S!

A sailor has no EZ time,
When on the DP sails.
It's RD finds, aloft to climb,
Exposed to IC gales;
And then in KC makes a slip,
Or if he DZ grows,
A tumble off the RD ship,
And into the CE goes.

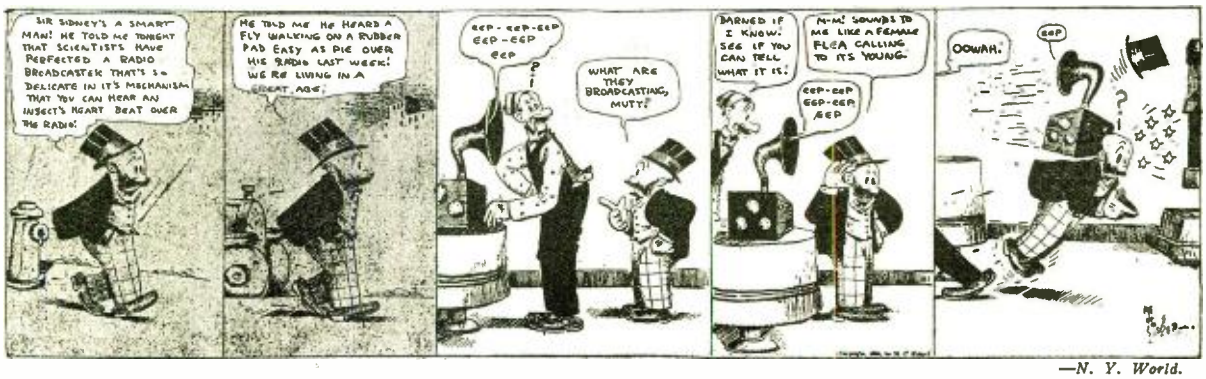
—*Life.*

Solitude **By H. T. Webster**



—*N. Y. World.*

Mutt and Jeff—Yes, Ain't Science Wonderful **By Bud Fisher**



—*N. Y. World.*

Königswusterhausen

By Dr. Albert Neuburger

German Correspondent
For The Wireless Age

IN its development the great wireless station of Königswusterhausen near Berlin forms an interesting experiment. It shows in a work of many years how the great arc-generators have been created. The sending energy for this giant station is now used for wireless telegraphy as well as for telephony.

Let us pursue the growth of this station.

The first and for ten years also the only applicable system for generating continuous electric oscillations, was invented by V. Poulsen in 1903. Wireless telephonic communications over short distances were already demonstrated by Poulsen in 1904. When the German Poulsen patents were offered to the C. Lorenz Aktiengesellschaft in 1906, this firm recognized that during the next years it would be possible only by means of this system to telephone by wireless. Consequently this firm devoted itself for a long time in the construction of wireless sets, fitted out for radio telephony.

Since 1910 radio telephony was practically used for military and naval purposes; i. e., only by the Lorenz-Poulsen system. That nothing was known about this matter for so long a time, is only because the monopoly of using radio telephony had been conceded to the German Navy. The reasons for keeping this system a secret having disappeared, it is now possible to publish an account of the development of the Poulsen arc system.

As can be seen, the development of the arc-generators used in Königswusterhausen was influenced by the endeavor to create and to perfect a system of wireless telephony. While in other giant stations wireless telegraphy was used for communication, this was done at Königswusterhausen by telephony. Now this station serves, as has already been mentioned, for telegraphic transmission as well as for the telephone service.

Aside from the arc-generators it may be mentioned that there are other methods of producing high frequency electrical oscillations of a continuous character; i. e., oscillations of constant amplitude. These methods are the high-frequency generator, the tube, and the arc-system.

While the high-frequency generator system is based upon the tendency to generate high-frequency oscillations for radiotelegraphy directly from generators, and while in the tube transmitter system triodes serve to generate oscillations, there is used in the arc-system a direct current arc which is able to charge and discharge a condenser circuit in rhythmical succession.

The Danish inventor, Valdemar Poulsen, in order to transform direct current energy to high-frequency energy caused a magnetic field to act upon the arc and made the arc glow in an atmosphere of hydrogen and thus devised the practical use of the arc transmitter in wireless traffic.

The arc itself was generated between two electrodes, the positive one of which is made of copper while the negative one consists of coal.

The coal electrode is turned round its axis by means of a special motor so that fresh points of this electrode are always burnt. In this way not only the coal is burning uniformly, but also the arc is always of the same length.

The building that houses the transmitting apparatus

The connection of Poulsen transmitters is either direct or intermediate circuit connection. For the radiation of the oscillations produced by means of the arc both ends of the lamp are connected to the aerial and to the earth (direct connection) instead of the inductance and capacity of the closed circuit. In the other case the aerial, by means of a coil, is coupled to the inductance of the closed circuit (intermediate circuit connection).

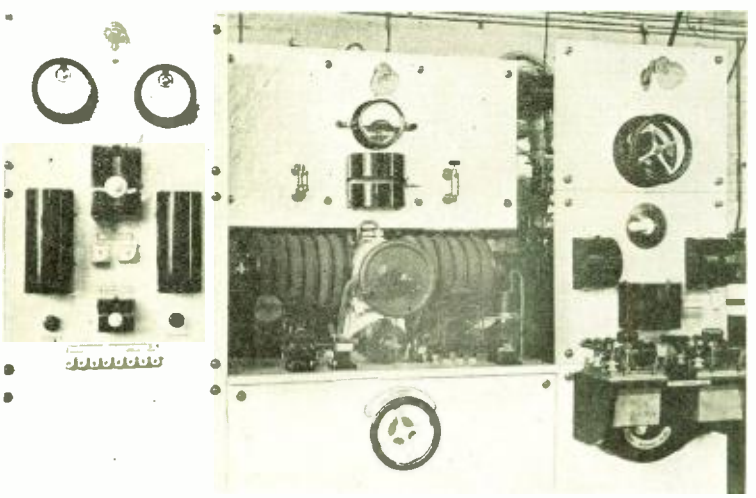
As distinguished from spark transmitters it is not possible to operate with the working current absorbed by the arc for the purpose of radiating the energy in the sense of Morse inkwriter signals, because the arc would be much disturbed or totally quenched. If the ignition were renewed again and again, apart from other difficulties in transmitting, speed would be slackened.

In the service until now two methods of operating have been used, one of which is based upon detuning the aerial in so far as a second wave, a so-called detuning (or "back wave") is sent out during the intervals between the signals.

These are the principles of the arc system in which a good many improvements have been made during the last years by the Lorenz Company and especially by its engineers, Dr. Gerth and Dr. Pungs.

The Lorenz-Poulsen sender of today has two rotary electrodes. By making both electrodes rotate and by replacing the copper electrode by a second coal electrode, the constancy of oscillations is guaranteed so that a good heterodyne reception is possible. The arc noises which formerly had been noticed are totally removed.

(*Continued on page* 60)



Control panel of the Königswusterhausen radio station

RADIO NEWS FROM ALL OVER THE WORLD

Broadcast Reception on Moving Trains in England and America

THE possibility of listening-in and connecting up with the chief broadcasting stations in the country while traveling by train at a high speed, by means of an indoor aerial, has been established.

A six-tube set was recently installed in a train of the English Great Western Railway. Connection was at once secured with the London broadcasting station, and was maintained throughout the whole of the journey.

Forty miles from London, and at a speed of eighty miles an hour, the results were surprisingly good, being clearly heard from a loud speaker above the noise of the train. Sixty miles from London, there was no diminution in the strength of the reception. At this point a change over was made to pick up Birmingham, and this was accomplished. Later tests in the use of head phones and in getting other stations were equally successful.

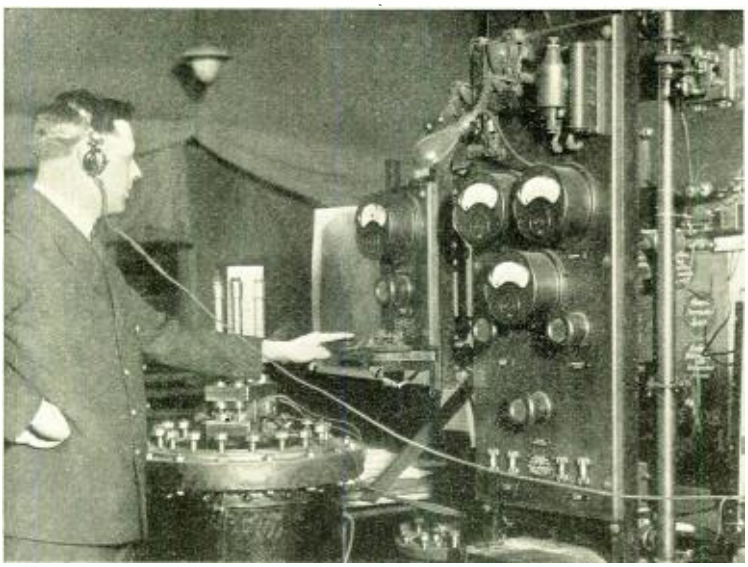
Delegates to the Convention of the Telephone and Telegraph Section of the American Railway Association recently held at Colorado Springs were able to try out the great possibilities of radio on moving trains. The special train bringing delegates from Chicago was equipped for radio reception with a seven-tube heterodyne. The aerial consisted of two wires stretched the full length of the car on either side of the roof. The ground was made to the car water system.

The train left Chicago about ten in the morning and reception continued good throughout the day and evening. The next morning, Sunday, the delegates attended church and took part in a service three hundred and fifty miles away.

Many interesting phenomena were recorded during the trip. Whenever the train passed through a cut approximately as high or higher than the car, the signals were somewhat decreased in intensity, but immediately returned to normal strength when the car emerged from the cut. Sand or stone seemed to have approximately the same effect so far as the observers could tell.

Iron bridges and steel frame buildings, or heavy power, telephone and telegraph pole lines produced the same effect in a greater or lesser degree. On the other hand, passing trains did not appear to produce a noticeable decrease in signal strength.

The most pronounced effect of shielding was observed as the train crossed the Mississippi at Davenport while the Palmer School was sending. Between the steel spans, the signals increased in strength momentarily, but as the train passed between the steel girders, there was a weakening and the signals were almost inaudible with the amplification used.



The submarine oscillator and depth finder recently perfected by the navy department

Neutrodyne Royalties in Dispute

THE Hazeltine Research Corporation has brought suit against the Freed-Eisemann Radio Corporation in the Eastern District Court of Brooklyn.

The Hazeltine Corporation collects royalties on all neutrodyne receiving sets, which are designed in accordance with the neutrodyne principle invented and patented by Professor L. A. Hazeltine of Stevens Institute of Technology. This corporation sought a temporary injunction against the Freed-Eisemann Corporation which manufactures neutrodyne receivers.

The motion was denied by Judge Ince, who ordered the Hazeltine Corporation to return to the Court all royalties paid them by the defendants, pending a further hearing, which is set for June 7, 1924.

At the same time the Court accepted the offer of the Freed-Eisemann Corporation to place in the hands of the Court the full amount withheld by them awaiting adjudication.

The Freed-Eisemann Radio Corporation contend they should pay royalties on certain patented parts only while the Hazeltine people demand royalties on the complete receiver.

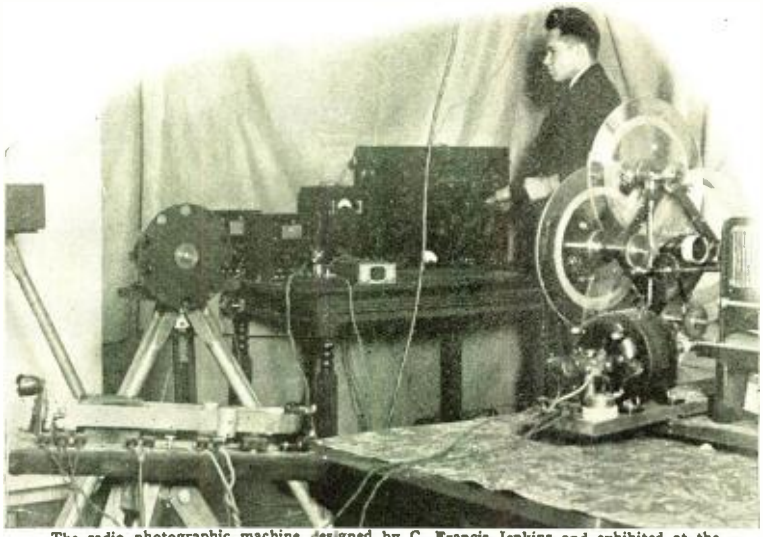
The defendants also charge fraud on the part of the law firm of Pennie, Davis, Marvin and Edmonds, alleging that, when the Freed-Eisemann Radio Corporation contract was signed, the lawyers who represented both parties held stock in the Hazeltine Research Corporation without disclosing this fact to their clients, the Freed-Eisemann Radio Corporation.

Austrian Chancellor Inaugurates Radio Service Between London and Vienna

DR. SIEPEL, Austrian Chancellor, in his address on the occasion of the inauguration of the wireless service between London and Vienna, presented a vision of the great future world-service of radio which is full of promise. His hopes for radio are embodied in the following extract from his address.

"One would not fully appreciate the most modern means of communication —wireless telegraphy—if one only attributed to it an importance in the economic life of the nations. Its extreme importance is confirmed by the fact that the means of entente between nations have in wireless a particularly efficacious acquisition. The interests which divide nations are rarely material. If the nations knew one another better they would understand and appreciate one another better. Let us hope that wireless telegraphy and telephony will perform wonders in this direction and will contribute to abolish not only distances in space, but also moral distances. One of the greatest inventions of modern science would thus serve the end aimed at by the League of Nations. We Austrians have learned for our salvation that the League of Nations is an effective instrument for the entente between the nations, and we are very anxious again to express our thanks, and at the same time the wish that the irresistible waves of good will and international unity will find in the near future the way to the heart of all nations both near and far."

The radio receiving loop of the giant S.S. Leviathan



The radio photographic machine designed by C. Francis Jenkins and exhibited at the Washington, D. C., radio show

Prominent Engineers on Radio Standardization Committee

PRESIDENT J. H. MORECROFT, of the Institute of Radio Engineers, has appointed the following as members of the Standardization Committee of the Institute for the year 1924-25: E. H. Armstrong, L. A. Hazeltine, A. N. Goldsmith, J. V. L. Hogan, J. H. Dellinger, C. A. Hoxie, A. E. Reoch, L. W. Chubb, H. W. Nichols, F. H. Kroger, R. F. Gowen, L. E. Whittemore, Bowden Washington and Capt. Guy Hill. Donald McNicol is chairman of the committee.

A book of definitions of radio engineering terms was published by the Institute in 1922 and the work of the new committee is to bring this important work up to date in view of the many forward steps which have been made in the art of radio since then.

Transcontinental Radio Chain Established

ARRANGEMENTS have been completed for the establishment of stations in five cities in Western Canada. There remains only Vancouver to complete the transcontinental chain of radio stations that will make the Canadian National Railways. Arrangements for the establishment of stations in Winnipeg, Saskatoon, Regina, Edmonton and Calgary have been completed.

These stations are not new, like CKCH in Ottawa, but are stations already existing with which the Canadian National Railways have come to agreement for the broadcasting of programs. In Winnipeg, the Manitoba Government telephone station CKY, using the 450-meter wave length, will broadcast every Thursday evening; from Saskatoon the radio supply station CFQC will broadcast every afternoon between 3 and 4 o'clock; from Regina, station CKCK, 420 meters, will broadcast each Tuesday evening; from Calgary, station CFCN, 440 meters, will broadcast every Wednesday evening, and station CFAC, 430 meters, every Thursday evening; from Edmonton, station CJCK, 450 meters, will broadcast every Friday evening.

Radio Shows

ARRANGEMENTS have been completed to have the first annual International Radio Show, Sept. 22 to 28, at Madison Square Garden. It will be held under the auspices of the Radio Manufacturers' Show Association.

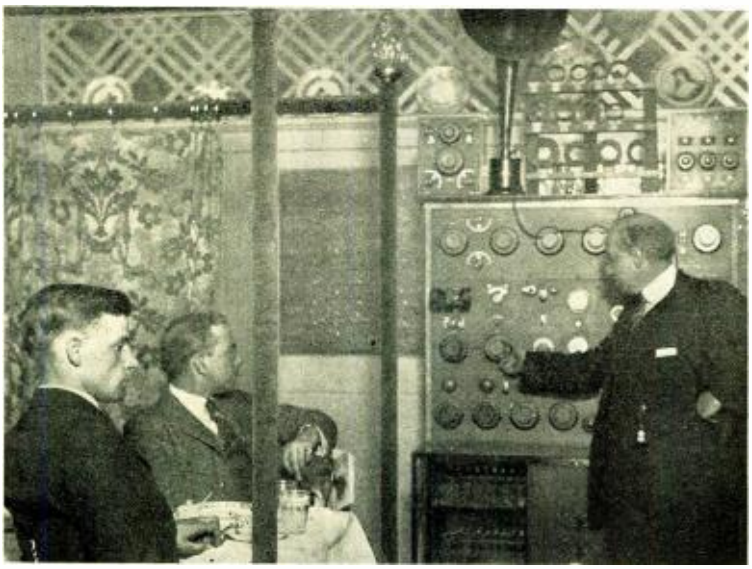
A similar show will be held Nov. 18 to 23 in Chicago at the Coliseum. A ten-year lease has been taken for Madison Square Garden and the Chicago Coliseum, as it is planned to stage the show each year.

One of the features of the exposition will be an Amateur Builders' Contest, divided into three classes as follows: High school boys, grade school boys and the third for girls.

Radio in South Africa

IN Cape Town at the present time there are three amateur stations who indulge in experimental transmissions, on 200 meters namely: AIA (J. S. Streeter, Esq.), Thursdays, 8 P. M.; AIV (B. Jeffs, Esq.), Tuesdays, 8 P. M.; AIQ (H. Rieder, Esq.), Sundays, 8 P. M.

During a couple of weeks in December, 1923, a 6 kw. Western Electric transmitter was installed at Johannesburg. This station was heard by considerable numbers of amateurs all over the Union of South Africa.



Diners being entertained in a Philadelphia tea-room by radio

Washington and Rome in Communication by Radio

SINCE February 20th, the Navy Communication Service at Washington has been in daily touch with the San Paolo radio station at Rome. This circuit, closed as unreliable some time ago, was recently reopened with IDO, San Paolo, a new radio transmitting station in Italy, which operates on a wave length of 10,750 meters. The messages come to Washington on a loop receiver in the Navy Building over a distance of about 4,500 miles, but go out from station NSS at Annapolis on 17,145 meters. Communication is not effected except between 11 and 12 midnight each night, and so far only eight or ten messages have been exchanged a night.

Canadian Broadcast Fading

RADIO enthusiasts in the zone between Montreal and Toronto, have for a long time been puzzled by the difficulties attending the reception of broadcasting from these cities.

To settle the question definitely and conclusively the E. B. Myers Company sent out an expert from Montreal to make tests and obtain data at numerous points between Montreal and Toronto. The results of these tests are illuminating and highly interesting.

Looking east it would appear that Station CFCA reaches to Belleville fairly well, but at that point the gap appears to commence. For instance—Peterborough, at a northern angle, is almost isolated from the Toronto station, though Montreal stations reached in on occasions.

Kingston hears but little of either Montreal or Toronto, but the chief factor there is that, Kingston being located at the head of Lake Ontario and water routes being most conductive, the powerful American stations sail in with great strength, and practically drown out the weaker Canadian stations.

East of Kingston is the apparent "resistance belt." Brockville, Prescott and Cornwall are seemingly indifferent to Canadian broadcasting, though the latter city breaks in on Montreal occasionally. To catch Toronto is an interesting bit of news among the fans.

As far as Montreal is concerned, Toronto is not isolated because of any atmospheric conditions, despite the failure of a very large percentage of amateur operators to receive the Queen City's broadcasting. The trouble seems to be caused by simultaneous broadcasting by Montreal and Toronto stations and if the program times were altered so as not to conflict, Toronto could be heard readily enough. The majority of complaints come from the central districts of Montreal. Residents in the suburbs and in the upper lever seem to be able to receive Toronto fairly frequently.

Japan's Broadcasting Development

APPLICATIONS for erection of broadcasting stations in Japan have already been filed by nearly a dozen corporations and individuals. They are all well-financed powerful enterprises. In Tokio, beside the Radio Corporation of Japan which is stated to have its connections with the Radio Corporation of America, the Annaka Telephone Apparatus Manufactory, the Japan Electric Power Company, the International Wireless Company, the Matsutaka Kinema Company, the Tokio Municipal Electricity Bureau Laboratory and others are mentioned as applicants. They are all planning to broadcast musical, theatrical and other entertainment.

The Tokio Stock Exchange and some newspapers in Tokio and the Yokohama Exchange at Yokohama have also applied for permits. They will specialize in giving price quotations and general news.

The applicant at Nagoya is a new corporation supported by leading business people of the city. It will make the central provinces of Japan its area of activity. Not only will it broadcast entertainment, but news matter, and price quotations as well.

At Osaka the "Osaka Asahi," one of the biggest and most enterprising newspapers in Japan, has applied for a permit to broadcast entertainment and news.

The newspaper has a small broadcasting station already, but use is not yet permitted although on the ground of conducting experiments it is operated.

The Government wants the corporations to be merged into one corporation, apparently because it will simplify Government supervision. Prior to the grant of permits the Government will induce the corporations to hold conferences and see if they can bring about a merger.

The owners of receiving sets must have their receiving apparatus adjusted by Government officials to the wave lengths of their broadcasting stations. They can listen in only to broadcasting from the station to which their receiver is tuned.

Many radio fans are disappointed because of this law and radio dealers too, find it a handicap in business development.

I. R. E. Radio Officers for 1924

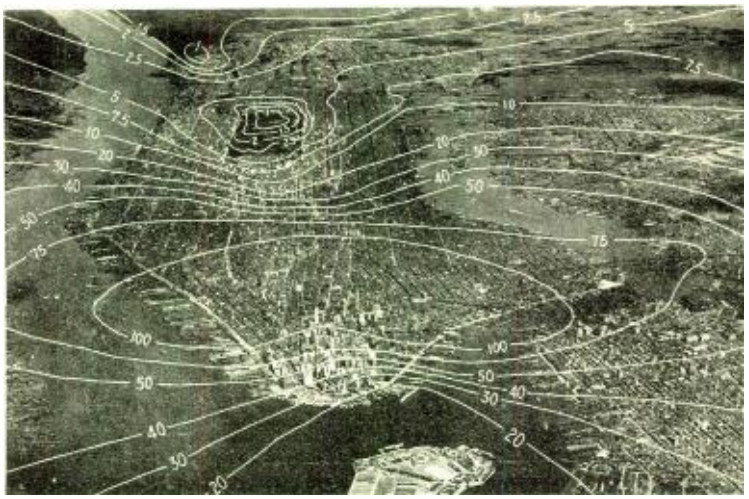
THE recent election held by the Institute of Radio Engineers resulted in the following being elected to serve throughout the year 1924: J. H. Morecroft, president; J. H. Dellinger, vice-president, and W. F. Hubley, treasurer. New members elected to the Board of Managers are: H. W. Nichols and A. H. Grebe. Other members of the Board are: Melville Eastham, Edward Bennett, L. A. Hazeltine, Donald McNicol and Lloyd Espenschied.

Dr. A. N. Goldsmith was reappointed secretary for the present year.

The First Survey of the Ether

Physical Barriers Obstruct Many Electromagnetic Waves

By Edgar H. Felix



The field of radio waves as affected by conditions in New York City

ARE ether waves all-pervading? Is our generally accepted theory of the composition of matter correct? Is it true that we have only electrons circulating freely in a nothingness of ether, collecting in groups of various kinds to form atoms and molecules? Do all such collections of electrons respond in the same way to electromagnetic waves set up by our radio transmitters?

There is much supporting evidence to indicate the general correctness of this theory. We have taken sensitive receiving sets far below the surface of the earth and successfully picked up broadcasting in the Giant Cave of Kentucky and in a tunnel far under the Hudson River. Receiving sets have functioned successfully on aircraft, moving trains and submarines. Is it not correct to conclude that ether waves travel through any kind of matter and are not interrupted by physical objects?

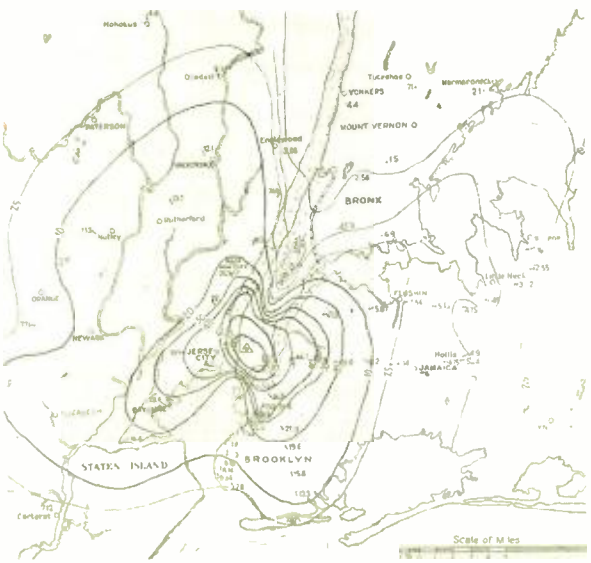
On the other hand, many peculiar transmitting conditions have been noted which supporters of the theory have difficulty in explaining. One famous eastern broadcasting station is heard throughout the West and in Europe, but is difficult to pick up in New England. Another carried extremely well hundreds of miles to the South and West, yet is quite difficult to pick up a few miles to the northward. Evidently there are physical barriers which obstruct the travel of electromagnetic waves which cannot be attributed to the directional effect of the transmitting antenna.

Subterranean metallic deposits are sometimes cited as the cause of transmission difficulties. The experience of amateur short wave transmitters does not serve to confirm this theory. Amateur stations in New York have greater difficulty in establishing communication with stations in Boston and Portland than they have in communicating with stations in Ohio and Illinois. The Central Western stations are twice as far away, with mountain ranges and mineral deposits lying in their path. Neither mountain ranges nor metallic deposits obstruct the travel of ether waves from New York to New England: on the contrary, they have the advantage of a fair proportion of over water transmission when communicating with New York.

Judging from all this conflicting evidence, no satisfactory answer to the question of how electromagnetic waves travel and what conditions affect them will be had until a complete survey of the ether is made. The chief difficulty which has stood in the way of a thorough survey of the ether has been lack of simple and practical measuring equipment by means of which the intensity of received signals may be accurately measured. Fundamentally, such an equipment is simply a means of measuring the received current in an antenna of known constants. But accurately measuring weak signals and maintaining accurately constant conditions in a receiving system is most difficult.

Messrs. Ralph Bown, Carl Englund and H. T. Friis presented a paper before the Institute of Radio Engineers which described a field strength measuring system which has been used successfully in making a survey of the ether of the city of New York. The device consists of a sensitive receiving set, a carefully shielded local oscillator, both coupled by means of an adjustable resistance with a loop antenna. Readings and comparisons of the received signal and signals produced by the local oscillator of such a value that they exactly equal in intensity the received signals served as the basis of measurement. The entire apparatus was mounted in an automobile and measurements were made at many points. In a later paper by Ralph Bown and G. D. Gillett, the results of the first extended series of measurements was made public. The results obtained are indicated on the accompanying airplane map. Station WEAF is shown in the center and curved lines are used to indicate definite levels of reception in the same manner that isometric lines indicate temperatures on a weather map. The first circle shown is a level of 100 millivolts per meter

(Continued on page 60)



Contour map showing radio field strength of transmission in New York City with station WEAF working

A Reflex With a Valve Instead of Crystal

A Portable Set

By Laurence M. Cockaday

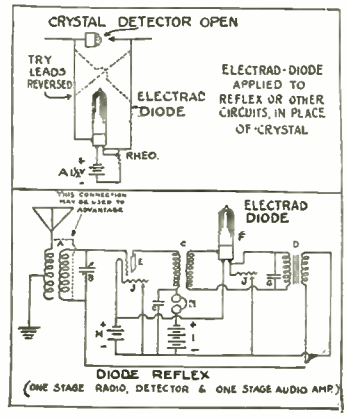
THERE is one serious drawback to the use of a crystal as a detector in single tube reflex sets. This is in the matter of adjustment. The operator has to be forever fooling with the "catwhisker" and eventually he becomes tired of it and gives up in disgust. This is not so when more than one stage of radio frequency amplification is used, because the radio frequency signal then becomes so strong that the crystal adjustment makes relatively little difference.

Another drawback with the crystal detector in a simple single-tube-crystal reflex receiver is the fact that such a simple set seldom makes use of a potentiometer for controlling regeneration. It is all done with the crystal adjustment.

Our readers will recognize that this is true—if they are using such a set—because they will remember that they have to readjust their crystal for any considerable change in wave length.

A Fleming valve or diode tube as it is called by one manufacturer, is one of the original vacuum tubes, having two elements, a filament and a plate. The tube when used as a detector alone, without any radio-frequency amplification, is a steady reliable detector, but it is not very sensitive. It is not quite as good as a fine piece of crystal. However, when the radio-frequency signal has been amplified as in a reflex set, surprising results have been obtained. This is because the radio-frequency voltages applied to the plate and filament path of the tube have been sufficiently increased to produce the proper response through the tube.

The tube used in this way has two distinct advantages, in the reflex set, it produces just as good a signal as the crystal, but it needs no adjustment for sensitivity, and it needs no further adjustment for wave length changes, just set the filament rheostat to the most sensitive point and the set is ready at all times.



A small portable set has been giving satisfactory signals from a loud speaker on local signals and has been picking up DX quite consistently on the phones.

PARTS FOR SIMPLE REFLEX RECEIVER

One Fada variocoupler and 3-inch dial.
One nine point multiple inductance switch.
One Amsco variable condenser .0005.
One 3-inch dial.
One Cardwell radio-frequency transformer.
One Cardwell audio-frequency transformer (For First Stage).
One W.D. vacuum tube.
One Electrad diode tube.
Two Micadon fixed condensers .001 mfd.
One 1½-volt dry cell.
One small B battery, 45 volts.
Two rheostats, 6 ohms, and 2 knobs or dials for same.
One regular vacuum tube socket.
One diode tube socket.
One pair N & K phones.
One panel 7 x 12 inches.
Cabinet 7 x 12 inches.
Four ft. connecting wire and 4 ft. of bus wire.
Six binding posts Eby Junior or others.
Wire solder.
Your dealer can supply alternative parts at his discretion.

In building the set, the best procedure would be to mount the variocoupler on the left end of the panel—looking from the front—with the variable condenser beside it.

The two rheostats should be mounted next beside the condenser with the WD-12 and the diode tube directly in back of them respectively.

Then mount the two transformers on the base in such a manner that the connections will be as short as possible.

In wiring the set, follow the diadram exactly, connecting the two fixed condensers, one across the primary of the audio-frequency transformer and the other across the phones and the "B" battery. Keep all the wires as short as you are able to and keep the grid connections isolated from the other parts of the wiring as much as possible.

If you already have a one, two, or three tube reflex set with a crystal detector you may use one of these tubes obtaining an extra rheostat, a dry-cell of 1½ volts and connect it directly to your present crystal detector stand as indicated in the figure. This will enable you to compare the two methods of detection for yourself.

You will be pleasantly surprised by the quality of the signals received on this little set and will find that you have been amply repaid by trying out the circuit.

RAILS: A Radio Language Society

A NEW radio organization is here. It is led by well known radio men who are developing the use of the Auxiliary International language Ilo for amateur and broadcast work.

The organizer is O. C. Roos, a Fellow of the I. R. E., who has taught the language for many years. He corresponded in 1911 from the wilds of the Orient with engineers in Europe, Kashmir and Japan, and taught Filipinos and Chinese to use the language in exchanging the products of their country with teachers in England. "Ilo" (now called "Ido" by many), now being taught in Boston's two radio schools, gratis, is meeting an actual demand among radio fans.

The new organization is called "RAILS"—or Radio Auxiliary International Language Society. Its exchanges of information with foreign fans will be by radio telegraph or post. It will eventually publish an official monthly—probably next Fall — and will give lectures on radio subjects as a means of teaching "Ilo."

The officers of the RAILS so far chosen are E. F. W. Alexanderson, and John Stone Stone, honorary presidents; John Hays Hammond, Jr., honorary vice-president; O. C. Roos, president; C. E. Kolster, vice-president; George Lewis, executive secretary; Guy Entwistle, treasurer. There are also foreign correspondents, linguistic advisers and other officers to be chosen.

The organization will be a link between the amateur, or broadcast listener, and the radio leaders in foreign fields. Much interest is shown by the fact that Mr. Roos is getting about 35 letters a day at Beacon Chambers, Boston, Mass., at the the Boston *Sunday Advertiser* in regard to the work he is doing. He will answer all questions addressed to either of the above places.

Radio communication is making every fan "world-conscious," and this feeling is dissolving before our eyes the age-old prejudices against a synthetic language which so many literary folk have hitherto invoked to impede the movement. Radio amateurs may do in two years what academicians and literary lights have failed to do in several decades. The slogan of the new society is "RAILS Across the World."

AFLOAT AND ASHORE WITH THE OPERATOR

By W. S. Fitzpatrick

SAN FRANCISCO boasts an old-timers' club called "Radio Pioneers," comprising men who were in the radio profession prior to ten years ago.

The Atlantic Coast is not quite as fortunate in having such an exclusive organization, but if there were one it would produce some mighty keen rivalry. As a matter of fact the Atlantic Coast could have a fairly large organization of pioneers who are *right now* sea-going operators and who entered the field as such over *fifteen* years ago.

Many of these men are well known while others have kept in the background; nevertheless all have records to be proud of.

R. W. Toms E. N. Pickerill O. L. Goertz B. Beckerman

E. N. Pickerill, chief operator of the *Leviathan*, the pride of America's merchant marine, was a professional radio operator nineteen years ago. He has seen varied service both at sea and in shore duty and now has seven assistant operators under him on the big ship. During the war he was a lieutenant aviator in the United States Army. Pickerill is a real American—a member of the Sons of the American Revolution.

Benjamin Beckerman was assigned to a ship of the Old Dominion Line in 1908. He is still running on that line as senior operator of the *Jefferson*, and this long service was broken only by his naval enlistment during the war and by not more than a trip or two on other steamship lines.

Frank E. Black, chief operator on the big trans-Atlantic liner ***America,*** started before the head telephones came into use as receiving equipment. In his day the incoming messages were recorded on tape which, incidentally, also recorded all the static and lightning flashes. Old telegraph operators in Black's class began to read the click of the relay, which enabled them to pick much more of the message out of the static and have it on paper some little time before those who had to translate from the tape. This eventually brought about receiving by sound rather than sight, and had it not done so there would be no present day broadcasting. At the time Black started no signals had been heard at as great a distance as a hundred miles! Is Frank Black an old timer? Rather!

Arthur Cohen, an assistant on the *America*, started his radio career in February, 1905, and has been actively engaged in it practically ever since, even during the war when he was a naval radio instructor at Cambridge.

Milton O. Green dates his radio service back about fifteen years. He was manager of the New Orleans coast station thirteen years ago, has since been chief on large trans-Atlantic passenger liners and is now on the Isthmian Line freighter *Steel Seafarer*.

Herbert M. Rodebaugh is said to be the oldest man both in years and in point of service along the Atlantic Coast. He had the distinction in 1917 of being in charge of the first ship to carry a girl junior operator, which, incidently, is the same ship on which he is now running—the *Howard* of the Merchants and Miners Line.

Robert W. Toms, now on the *Steel Trader*, has been continuously engaged as a ship operator more than sixteen years, this record being broken only by his war service in France, during which time he engaged in the famous battle of the Mons. He holds a medal issued by the British government as one of the number who actually saw the "Angel of Mons," which appeared one night during that bloody battle.

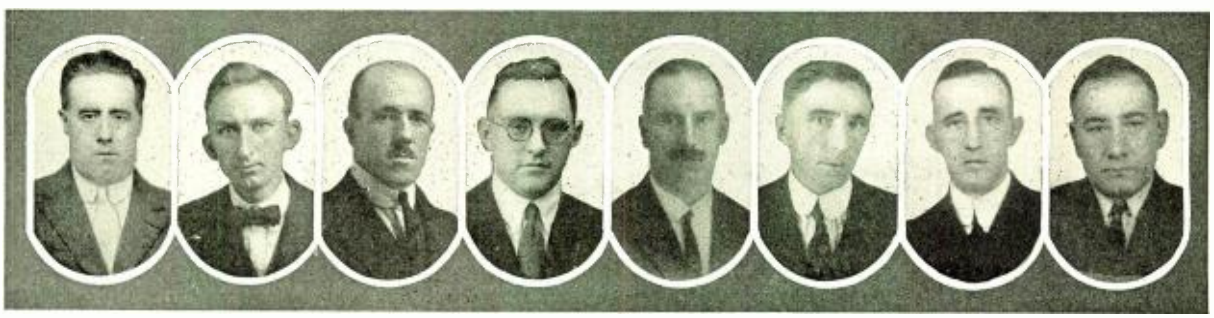
Oscar L. Goertz became a wireless operator on ships during 1906. From 1914 to 1919, he was in the United States Army Signal Corps on foreign service in the Philippine Islands. He holds a Signal Corps experts' certificate showing proficiency in radio and telegraph circuits, as well as operating and maintenance. Following his discharge he again took up ship operating and for the past two years was chief on the *President Van Buren* running between New York and London. He is now temporarily assigned as senior on the *Jamestown*.

James F. Forsyth—they all call him "Doc"—now running between New York and Mediterranean ports on the *Carenco*, is said to have not had a trip off as a vacation in the past thirteen years and five months. Doc is one of radio's old stand-bys and one of the best.

Henry F. Bollendonk, one of the *Leviathan's* crew, is primarily a telegraph operator with experience on railroad, Western Union, stock, press and cable circuits. He became a wireless man on ships in 1910.

Robert Lee Etheridge, is, as his name suggests, of old Virginia stock. He entered radio in February, 1910,

(*Continued on page 74*)



J. F. Forsyth C. E. Stevens H. Hatton E. J. Marschall R. W. Young F. W. Harper M. B. G. Rabbitts E. W. Rogers

Killing Receiver Noises

By R. A. Bradley

TO the broadcast fan who has not the working knowledge and experience of the hardened amateur, a radio set not working properly or entirely out of order in most cases presents a problem quite out of his ken. The conglomeration of knobs, condensers, rheostats, sockets and transformers seems quite akin to the proverbial Chinese puzzle. While he knows, perhaps, the general workings of the "insides," he is at a loss to know where to start, if for instance during the course of an evening's program the set goes dead. Now if this same fan had before him an outline of the things which *can* go wrong and *why* they go wrong and how to set them right, he will then have a good idea of where to start and consequently be able to trace his difficulty immediately, without aimlessly connecting and disconnecting wires and making futile adjustments. To this end we have prepared this outline, "Trouble Analysis." This is the initial instalment and succeeding issues will give the second and third of this series.

1. There are various sounds which come out of the phones or loud speaker of a radio set, which to the uninitiated mean nothing, but to the expert or old-timer each means a definite thing—either natural and uncontrollable or the exact indication of trouble—where it is and what to do to remedy it. We have done our best to describe in cut and dried words these sounds, classifying them under noises and squeals. In this instalment we tackle the noises since they generally mean actual trouble, whereas squeals more often denote improper adjustment or lack of experience in tuning on the part of the operator.

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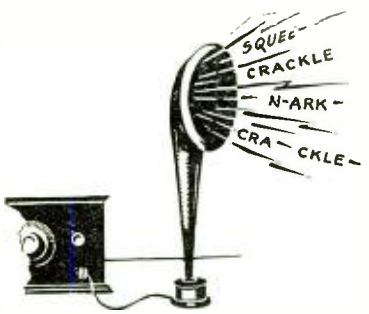
1. Crackling and frying noises varying in intensity and appearing spasmodically.

2. Crackling of fixed intensity, irregular in occurrence—accompanied by the momentary loss of signal—out and in.



3. Crackling present only when set is jarred or moved.

1. This may be due to atmospheric disturbances, and this form of noise is probably something entirely beyond our control and which no radio set can eliminate. Most prevalent in summer time though very bad preceding, during and following a rain storm and during a fairly heavy snow. Static should not greatly disturb reception from local stations.

2. Antenna—The swinging of an antenna so that it makes contact with any non-insulating or conducting object will set up in the receiver a great crackling noise, sometimes totally obliterating any signal. An antenna should be as taut as the wire will stand and the masts properly guyed or supported to prevent swinging in any wind short of a gale. Very often too little attention is paid to insulators. Observation has shown us that a man will spend two hundred dollars on an elaborate receiving set and then go to the "5 and 10" for his insulators. Your antenna together with the ground connection constitutes your entire and only means of intercepting the tiny bits of energy which are converted in your receiver into music and speech, so make it good and permanent.

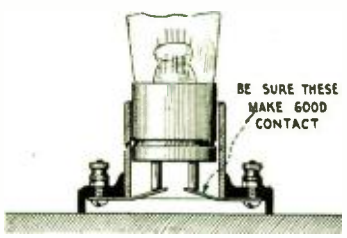
3. Broken or unsoldered connections. Very often in bought sets as well as home made, bad connections develop. Sometimes noises may be traced to a badly soldered joint or one that is not soldered at all. The best way to find such a joint is to move all the wires with the finger tips while the set is running. Upon striking the right one there should be a pronounced crackling in the phones. For the purpose of such a test the wires should be merely touched and very lightly as a more complete contact with the fingers will produce other sounds which are apt to be confusing.

THE RADIO DOCTOR.

In nine out of ten instances the average person can remedy his own difficulty if a definite procedure is followed. There are a few things to do first, just as they tell you to do, before the doctor comes. If you were to call in an expert in your particular case, he would in all probability ask you about the "symptoms" before even touching the set. He would ask you the state of charge of your storage battery, the condition of your B-batteries and probably ask you what results you had obtained from the set previous to its "illness." Then he would turn to the set, turn on the rheostats controlling the filaments of the tubes and if the tubes lighted properly, it would mean to him that the filament circuit was all right. Then he would insert the phone plug in the jack and if he heard a slight click as the plug made contact with the prongs of the jack, he would know that the B-battery circuits were correct and complete. With this start he would undoubtedly endeavor to make the set give forth some sounds by which he could trace the difficulty just as we have outlined their various meanings in this article. If the set refused to respond at all, and was to all intents and purposes a "dead set" he would then follow a different course which we will outline in a following issue.

4. Complete fade-out and in of signal while set is untouched and undisturbed in any way, accompanied perhaps by slight clicking or crackling.

5. Marked fading and reappearance of signal upon jarring set.



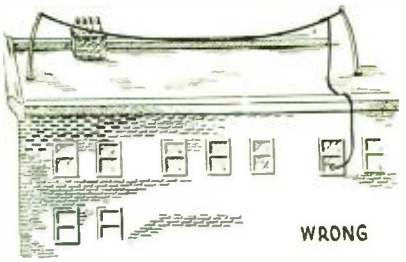
6. Continuous and loud frying and crackling noises despite adjustment of dials or rheostats.

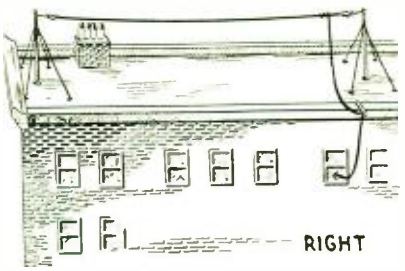
7. Marked hissing despite adjustment of dial, controlling means of regeneration.

4. Phone cords and loud speaker cords often give trouble in the way of producing noises in the set. To test for this trouble, the phone cords should be stretched and jerked while the set is in operation. If in jerking in this way all sounds go out with a click the trouble, you can be sure, is a broken wire in the cords and these should be replaced. However, if the trouble does not lie here, the connections in the receiver cases should be examined and if necessary the phone cap and diaphragm removed to ascertain whether there is a poor or broken connection here.

5. Sockets—There are on the market today only a few really good sockets. So this is a place where trouble often develops. If you have a manufactured set do not attempt to substitute other sockets for the ones therein, but if yours is home made, spend a dollar for a good socket with good contacts and throw out your 15 cent "mounted mud" ones. Remember that a tube is no better than its socket. Dust often collects on the contact springs. These as well as the tube prongs should be kept clean by touching them up with a fine file once in a while. Be sure the prongs have plenty of "pep" in them and are bent up far enough to exert pressure on the prongs of the tubes.

6. B-Batteries.—Any fault in the B-battery leads may be traced at once by inserting the phone plug into the jack and removing it. There should be a slight click if all is well. If there is none, trace the plus B lead from battery to phone jack. One of the most well known and reliable manufacturers of B-batteries advises the discarding of 22½-volt units when the voltage has dropped below 17 volts and the 45-volt batteries after they have dropped below 35 as then the battery becomes noisy and produces much of the hissing and frying noises that we





hear in some sets. This noise is present only in the dry B-batteries, the storage B-battery not having this characteristic. If you have a neutrodyne or superheterodyne or any set having five or more tubes it will pay you to install storage batteries instead of the dry cell type. The recharging is simple and inexpensive and the original cost very little higher than the dry battery and it will prove in the end cheaper.

7. Do not force your tubes. You may find that by "racing" the rheostat you gain a little in volume. This only shortens the lives of the tubes and should be avoided on soft detector tubes. A pronounced hissing will be noticed when the rheostat is advanced too far.

Next month we will describe "Squeals." whence, wherefore, why and why not. Watch for it. Cut out this article and save it to use with the following ones as the series complete will form a convenient means of "knowing" your set.

Wireless Age Set Pleases

Mr. Abraham Ringel's article on "Distortion-Free Amplifiers" in the December number still elicits favorable attention from readers. Here is a sample.

THE WIRELESS AGE:

Gentlemen—I am so enthusiastic over the operation of a set built from a hook-up published in a copy of WIRELESS AGE I am writing you immediately upon the completion and trial of the set.

The set is the one described by Abraham Ringel in the December, 1923, issue. It is the four-tube resistance coupled amplifier.

It does everything the writer claims and far more. In addition to the most perfect and clear reception I'll ever ask to hear, you can plug in several sets of headphones on the second and third tubes without affecting the operation of the loud speaker in the least.

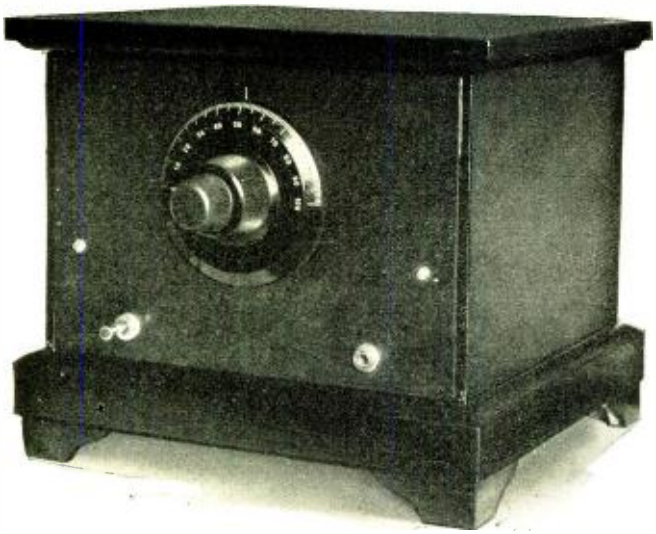
While Schenectady, which is only 30 or 40 miles away, was broadcasting its second anniversary program last night, and the set in question hooked up for the first time with no alterations whatever, I was able to pick up Atlanta, Georgia, and Memphis, Tenn., not to mention nearer stations on a loud speaker.

It operates a Western Electric 10A speaker perfectly without the use of the power amplifier with as great volume as any one would ever ask to hear and also without any distortion.

Instead of 201-A tubes, I used 4 UV-199s and only 80 volts of B battery. I used four grid leaks (a variable one on the detector), four grid condensers (Dubilier) and 3 Lavite resistances. one 48,000 and two 80,000 ohms.

WIRELESS AGE is the only publication I have ever been able to build a set according to their instructions and have it work satisfactorily without subsequent alterations. Kindly extend my compliments to Mr. Ringel as well as to WIRELESS AGE.

Most sincerely,
GEORGE HAYNES,
Hoosick Falls, N. Y.



The Twin Control Receiver

An Easily Built Regenerative Set

By H. Mace

THE desire for radio sets which operate with dry-cell batteries, fewer dials, and which are capable of operating a loud speaker efficiently, is taking our radio fans by storm. In this article let me introduce to you a radio set that takes up only one square foot of space on your desk or library table. This set is twin controlled.

It might interest you to know just why we call this a Twin Control; it means, that you tune by means of one dial which has a hole bored through it and through which a shaft is placed to operate a coupler which is mounted on the back of the condenser. This system of control can be used not only for the circuit given, but for any circuits embodying a condenser and coupler.

We will not claim that after you have built your set you will be able to hear night after night a station 750 miles away, but we will say that if it is constructed in accordance with the instructions here given you will get satisfactory results providing that you have at least two good things to aid you besides the set: a good aerial, and a good ground.

As you are not a laboratory worker we do not show a laboratory experiment; we merely show you, as the architect shows you a finished plan of a house, a good radio set that will be a pleasure to look at, and fit for any room in your home. We have made this layout simple and neat.

It is always of advantage to test parts of your set before assembly. You can test several different ways, but the best for your home test is a small voltage battery and a pair of phones. First test the phones and cord and the battery; put one end of

EQUIPMENT

One 23-plate or of .0005 mfd. capacity condenser which is vernier variable. It must have a spring tension on the back to hold the main rotating plates from moving of their own free will, when the vernier attachment is taken off.

One standard make medium size variocoupler.

(The Fischer Single-Trol may be used in place of separate coupler and condenser.)

Three standard tube sockets. These may be of the gang variety.

One 6-ohm rheostat.

One switch lever, with 3 points and 2 stops.

One base panel 8"x9".

One front panel 7"x10", grained.

One phone condenser .001.

One grid condenser .0005 and grid leak ½ to 5 megohms.

Nine lengths of bus bar.

Two brass brackets to mount panels.

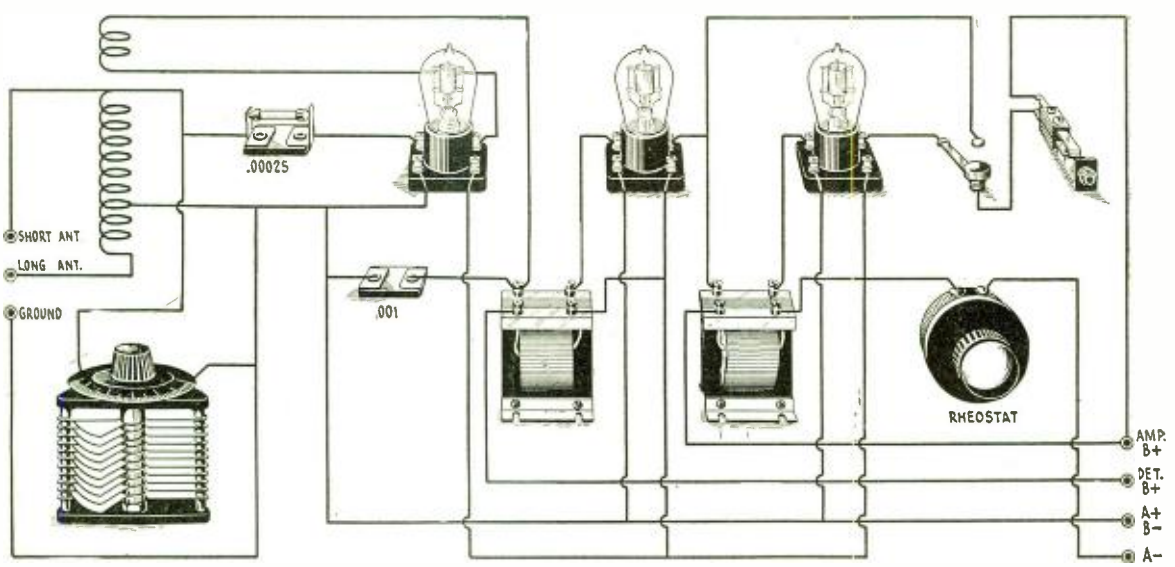
One single circuit jack.

One special shaft of the size to fit the small hole through the condenser and also the coupler rotor.

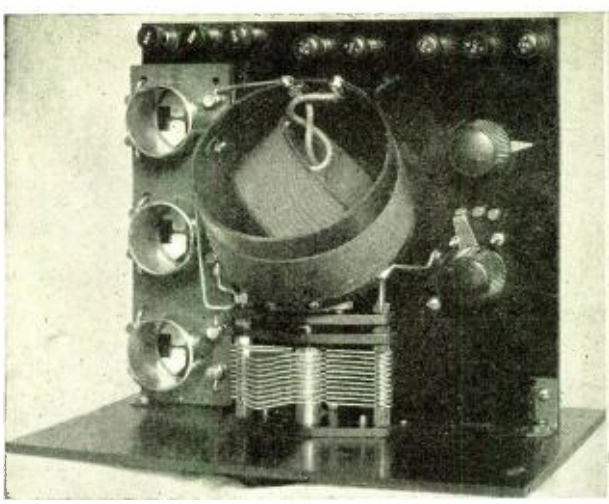
One Cutler hammer—snap switch.

Two audio frequency transformers.

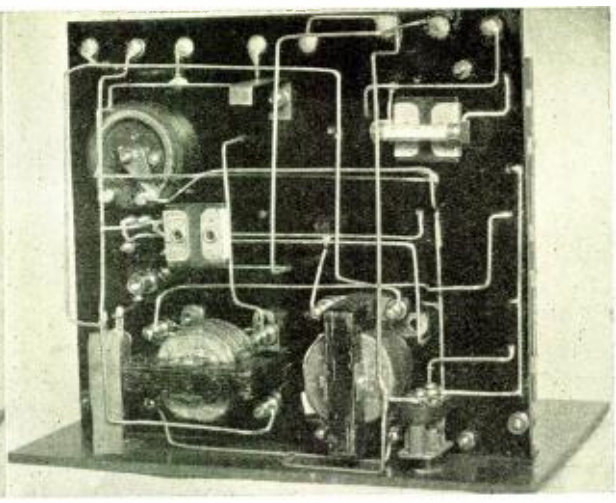
One four-inch dial, and a small knob to fit the smaller shaft.



Circuit diagram of the three-tube regenerative receiver using two controls for tuning



View above the sub-panel showing tube sockets, vario-coupler and variable condenser



The transformers, rheostat, fixed condensers, etc., are placed underneath the sub-panel

the phone cord to the negative post of the low voltage battery; this will give you two open ends which when placed together should give you a click. If this does not happen either the phones are defective or the battery is dead. If it is O. K. you can then test couplers and transformers by placing the ends of the phone cord across the open ends of a single coil of either the coupler or transformer which should give you a click. If there is no click you should look for an open or broken wire in the circuit. If the coupler is defective you can repair it, but if it be the transformer you must take it back to the dealer and have him replace it. Test your variable and also your fixed condensers for shorted plates; of course when a condenser shorts you will get a loud click. If the fixed condenser is defective you must get a new one. If the variable condenser shorts, bend the movable plates.

ASSEMBLY

In assembling this set it is advisable to start assembling the parts on the base panel. Measure up the holes for the different parts, then mark them and drill your panel. Then fasten the angle brackets to the front ends on the edge of the panel, and mount the jack, tuner and switch to this panel. Your radio set is now ready to wire. It is best to put all your sockets on the left hand side and the transformers on the center bottom of the base panel, then the rheostat and switch lever to the right hand side.

WIRING

In wiring the set let me suggest that you start one side of the battery and finish up on all connections on the A battery, then take in the B battery connections. Then take plate connection, by-pass condensers, and then the grid wires and aerial ground binding post connections. After you have finished the wiring check each wire on the set with the connection in the drawing.

When soldering see that all your soldered connections are tight and will not come off when roughly handled. It is advisable, but not necessary, to solder the transformer connections. I used mounted transformers, you may use any type, mounted or unmounted.

It is advisable when the set is finished to first connect the A battery and see if the filament circuit is complete so that your tubes will light. This does not mean that the set is perfect as you may have a mistake in a B battery connection. So after testing the tubes with just an A battery take the tubes out and make all B battery connections along with the A battery connection. Then test with a voltmeter across the filament terminals of the sockets and see that the voltage reads the same as that which is generated by the A battery. If it is above that generated, you must look over your set for a wrong connection in the filament circuit. After you have done the above you must then connect up the aerial and ground, and the phones.

ACCESSORIES

One special cabinet to fit the set.

One A battery of voltage great enough to light the tubes used.

Four 22½ volt B batteries.

Three 201 A or 3 WD-12 tubes.

One pair phones.

One loud speaker.

Two phone plugs.

Several feet of flexible single-wire lamp cord for battery and aerial and ground connections.

I would like to caution you to guard against getting the tickler coil reversed, or the transformer connections reversed. Look out for wrong battery connections. In soldering be careful not to get solder upon the fixed condenser so as to short it. Make sure your connections are all tight.

I have not placed a rubber panel vernier on this outfit, but one might be used to advantage.

Civil Service Examination

THE United States Civil Service Commission announces an open competitive examination for Junior Radio Engineer.

The examination will be held throughout the country on May 7. It is to fill vacancies in various branches of the Government service, at an entrance salary of $1,860 a year.

Applicants must have been graduated with a degree in engineering, preferably in radio engineering, from a college of recognized standing; or must be senior students in such course and furnish within three months from the date of the examination, proof of actual graduation. Applicants who have completed two full years of the engineering course may substitute for each of the additional years, one year of experience in radio engineering.

Competitors will be rated on general physics and chemistry, pure and applied mathematics, practical questions on radio engineering, and education, training and experience. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. Civil Service examiners at the post office or custom house in any city.

When Your Motor Generator Fails at Sea

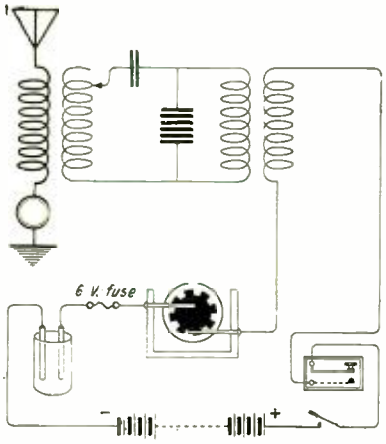
An Emergency Transmission

By Otto E. Curtis

Operator, S. S. *Sugillenco*

ON February 26th, 3 P. M., when our motor generator aboard the *Sugillenco* ceased to operate, I found it necessary to try several ideas in order to restore our ability to transmit.

We took out the armature, repainted the places where it had been scraped,



Hook-up of the emergency transmitter

and replaced it. Tests were made of both fields and armature, but still the armature refused to rotate.

I then devised a system to get alternating current for transmission without the use of the motor generator, the system being to interrupt periodically the direct current from the batteries, running it through the primary of the transformer, and thus get alternating current from the secondary. The theory of operation of the transformer would then be like that of an induction coil.

The rotary gap was first used to interrupt the battery current—contacts to the rotor being placed at opposite points on the stator. The rotor revolved at such high speed that these contacts were either broken or permanently thrown away from the disc. This interrupted the battery current permanently, so the rotary gap could not be used.

The next attempt was to send with an electric fan, operating an interrupting wheel. Connection to the base of the fan and contact to the fan blades could not be used, for when the battery current operated both the fan and the transformer primary, a theoretical condenser was formed between the armature windings and the fan shaft on which the blades were mounted. Theoretical data determined that in time the dielectric stress across the insulation of the armature windings would cause this insulation to deteriorate, and thus short circuit the windings, rendering the motor useless.

Hence an insulated bushing was made with a file by turning a spool mounted on the fan shaft and to this was affixed eight tin fan blades. Contacts to these were made with brushes. Due to the irregularity and flexibility of the tin blades the note was rough and unreadable.

The System That Worked

The final system that worked is shown in the accompanying diagram. A wooden wheel, nine inches in diameter, had mounted upon it a brass wheel cut with eight teeth. A hole was bored in the center of the brass disc, so as to insulate it from the shaft. The entire wheel was then mounted on the fan shaft with appropriately keyed bushings, made from wooden spools. The spaces between the brass teeth were filled with pieces of iron, insulated from the brass and electrically dead. These were for the purpose of making the entire surface "flush" and to prevent a jumping of the brushes. The right-hand brush operated to break the contact every time a tooth of the brass disc passed, while the left-hand brush received continuously the current from the disc.

In the diagram, the current will be seen to pass respectively, from the positive pole of the battery through two opposite safety contacts on the antenna switch, through the key, primary of the transformer, "interrupting wheel," 6-ampere fuse, salt water rheostat, and thence to the negative pole of the battery.

To determine the resistance of the circuit four cells of storage battery in series, giving 8.6 volts, were connected to the circuit battery leads, and the amperage of the circuit measured, first with the salt water rheostat short circuited and then with the resistance of the salt water in circuit. This voltage divided in each case by the amperage ($R = \frac{E}{I}$) gave first the resistance of the circuit without the salt water rheostat and then with it. Thus the proper circuit constants were determined.

Another easy way to make the wheel, would be to saw the brass disc into sectors. Thirty-two sectors would give an easily readable note.

A small induction coil carried by the operator for emergencies in which the motor generator refuses to function and cannot be fixed at sea will eliminate the necessity of any such amount of work.

All messages I had on hand to send were transmitted by this system to WNY, and communication went on without loss of time.

Radio Telegraph Receiving Record

The world's speed record for copying of radio telegraph code signals was shattered when A. E. Gerhard received straight copy at the speed of 59½ words per minute, at a contest held at the Fourth Annual Convention of the

A. E. Gerhard, holder of the radio telegraph receiving record of 59½ words per minute

Second District Executive Radio Council at the Pennsylvania Hotel, New York, March 7th.

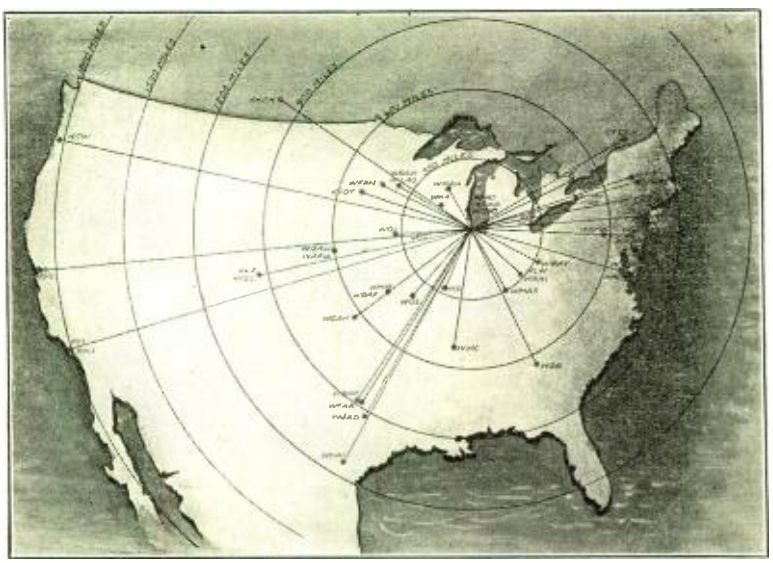
What a remarkable accomplishment this is can best be appreciated, perhaps, when one figures that his record is three times the average speed used in ship radio communication. Gerhard, who is an operator in the employ of the Radio Corporation of America, is here shown holding the trophy awarded by the Second District Executive Radio Council to the winner of the contest.

Non-Radiating One-Tube Reflex

Here Is a Simple, Easily Constructed Set With Single-Circuit Tuning

By W. P. Lukens

THERE can be no denying that the reflex type of circuit has been much in the public eye of late, but it is also undeniable that it has not met with the favor it deserves. This is due to several things. In the first place the reflex circuit has generally been heralded as the solution to all antenna difficulties and is supposed to work on a loop or on a very short inside antenna. This is true, but the general public usually takes such statements to mean that a reflex set will work as well on a small antenna as a regenerative set will on a good outside antenna. That is where disappointment ensues. Recently the makers of the Erla products have stated that while their reflex circuits can be used on loops, reception improves proportionally with better aerials approaching the maximum with a good outside aerial; and that is a true and concise presentation of reflex facts.



Map showing the range of the one-tube reflex receiver

Another element which prevents reflex popularity is the fact that so much emphasis has been placed on multi-tube circuits and not enough on the single tube. The latter is highly efficient, easy to build, easy to operate, surprisingly stable in its action and very true in its reproductive qualities. I am hoping that more and more of the single tube sets may be used and that experimentation with multi-tube circuits will be left to the laboratories and specialists. There is no reason why eventually it may not be as easy to build and operate a 3-tube reflex as it is a 3-tube regenerative, but right now the single-tube reflex is all I choose to bet on for 100 per cent. results in the hands of the usual B.C.L.

Let me recount a few of my own experiences, then decide for yourself whether the reflex has merit.

Some eight months ago I had run the gamut of Armstrong, Reinartz, Ultra-audion and similar circuits; had read and heard much about the "Super," Flewelling, and others of that class, and had finally decided—considering the presence of a potentiometer and an R. F. transformer in my junk box—that the reflex afforded considerable fields to conquer. For several weeks I collected circuits ranging from 6-tube R.F. to single tube reflex, studying them until I had some little idea of what went on in them. Then one day in a newspaper I found a simple little single-tube reflex circuit which looked easy to start on. As I recall, it had so many resemblances to my ultra-audion with one stage that I promptly re-wired the latter in accordance with the reflex diagram—using as extra parts an R.F. transformer, crystal, fixed condensers and potentiometer from my junk box. Even the socket of

(Continued on page 76)

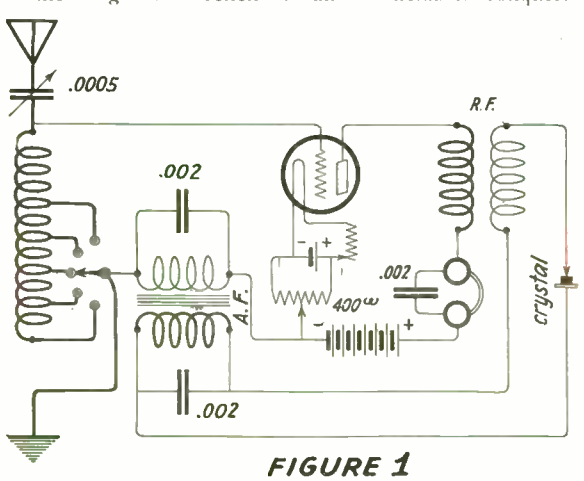


FIGURE 1

Hook-up of the one-tube reflex using a tapped primary instead of a variometer for tuning

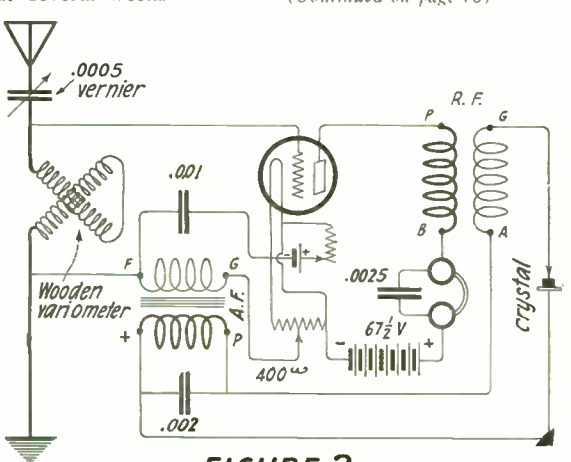


FIGURE 2

The standardized reflex hook-up used by the author

E. F. W. Alexanderson, chief consulting engineer of the Radio Corporation of America

Your Future as a Radio Engineer

With Thousands of Experimenters Planning to Become Radio Engineers, the Field May Appear Overcrowded, But the Process of Elimination Has Left Plenty of Room at the Top

By M. B. Sleeper

Radio Designer and Technical Publisher

WHEN you see, on a radio man's card, Imanex Pert, A. M., I.R.E. Radio Engineer, don't take him too seriously. Associate membership is extended quite broadly to persons who are interested in the work of the society; but full membership is another matter and a real radio engineer, who will probably be a full member of the Institute of Radio Engineers, is an individual whose qualifications are worthy of emulation.

Of all branches of engineering, radio is one of the most interesting, and, within the last few years particularly, those who have made real contributions to the art have been adequately rewarded. Others, who have done important, if not spectacular work, have no cause to complain, for they have been able to command high salaries for work of a most fascinating character.

In every man's life there is usually the recollection of a council of war, held during the third or fourth year of high school, on which his whole future turned. I imagine that, in many of these councils nowadays, radio is the topic under discussion. Perhaps you are thinking that your war council is not far off, and you are preparing for it, reading, asking questions, taking stock of yourself.

Before all others, you must settle one point—do you like mathematics? Don't side-step or temporize. Either you enjoy mathematics and get good marks, or you hate the subject and you get poor marks. If you can eat figures, stand by for the next questions. If equations are just groups of little dancing devils, you are probably headed in the wrong direction.

Don't say, "Yes, but I love to play with radio, and I know I can become a radio engineer." No doubt you do love to play with radio, and perhaps you can make a success of radio as a life work, but not as an engineer. Your part may be in manufacturing, broadcasting, publishing, or selling.

A radio engineer, by degree, must first go through the four years of college necessary for the degree of electrical engineer, followed by two years of postgraduate work before he be-

RADIO AS A CAREER

In the December number of THE WIRELESS AGE, Mr. Pierre Boucheron contributed a highly interesting article which presented a survey of the opportunities in radio today. This subject, of vast concern to thousands of American boys and young men and their "dads" and well-wishers, has been developed more in detail in later numbers. In February, Mr. M. B. Sleeper, the author of this article, contributed a story describing how one may become a radio salesman. In March, Mr. W. S. Fitzpatrick, whose activities lead him into daily contact with the careers of a great many ship-operators, told of the opportunities that await the energetic and ambitious young man who decides to become a ship operator. In our April number, Mr. Sleeper, who has had considerable manufacturing experience in his own career, told of the opportunities in radio factories.

This series of helpful Radio Career articles is designed to satisfy an insistent and definite craving on the part of great numbers of people to know just what opportunities this rapidly developing business of radio offers to the earnest and ambitious success-seeker.

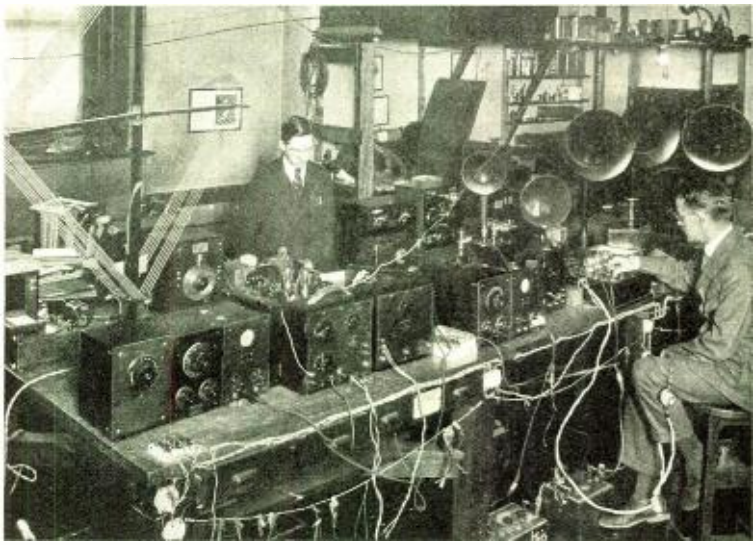
Students in radio engineering receiving instruction in practical work of assembling apparatus and conducting laboratory experiments

comes a radio engineer. There is another problem to be settled. Are you willing to put in those six years of study, and can you afford it? Perhaps you feel that the four years are only preliminary, and that you'd like to start on the last two right away. If so, you are wrong, for an engineer is a man of education, not merely a product of a college laboratory. Studies other than engineering subjects contribute to the general education of an engineer, for he cannot carry on his work most effectively without an understanding of and an interest in the world affected by his endeavors. As for the studies required for the degree of electrical engineer, thy are absolutely essential, for radio is electrical engineering plus special training covered by the extra two years. In many cases, the radio engineer is assisted by electrical engineers.

I have had experimenters say to me, "That's all very well, but the knowledge required for Armstrong to invent regeneration was no more than I have right this minute." Wrong again! Any experimenter may know enough to hook up a feed-back circuit, but it was the imagination of a trained engineer that first conceived the idea that something useful could be accomplished by coupling the grid and plate circuits. Moreover, it is not enough to

R. H. Langley, in charge of the Receiver section of the radio department of the General Electric Company who produce the Radiolas, is a graduate of Columbia University. He has been an engineer with the Wireless Improvement Company, the Marconi Company, and has been with G. E. Co. the past four years. He has taken out several patents covering specific features of radio design

invent, for the fundamental idea is of little value until it is expanded into the widest usefulness. If Fleming had added a grid to his valve, it would have been an audion. If De Forest had connected his audion differently, he would have set up oscillations, and if Armstrong had controlled the oscillation in one tube by means of varying the plate current in another tube, he would have invented the modulating system contributed by Heissing.



Laboratory testing of receiving apparatus

These men were not merely experimenters. They had educated imaginations capable of conceiving that particular ends might be achieved by certain means. We have been taught that high power, transmitted at long wavelength, was necessary for transmission across the Atlantic, but Frank Conrad built a special set, of low power, operating not on twenty thousand meters or even six hundred meters, but on one hundred meters, a wavelength below that used by amateur stations, and his set was picked up in England with sufficient volume so that it was possible to re-transmit the speech and music from English broadcasting stations.

The untrained imagination of an experimenter would not have prompted such an attempt. On the other hand, it would have accepted the general understanding that it was impossible.

But suppose you do go through the six years of college. What then? You leave with a training that has fitted you for radio research work, but what does that mean? That you know everything about radio? By no means! You know the radio of the laboratory and such practical phases as you may have interested yourself in particularly. The problem is in finding a place where your knowledge is wanted. There are only a few of those places.

You may carry on at the university for a year or two as an instructor, where you will have a chance to do work of your own, perhaps of such value that the returns from it will provide a sizable income. You may act as a consulting engineer for radio manufacturers. If, during your years as a student, you have established a reputation by writing for the technical publications, you can maintain a general consulting practice.

All the larger concerns connected with radio, such as the General Electric, Western Electric, and American Telephone and Telegraph, have opportunities for radio engineers who can handle research problems, some of which are directly concerned with products to be manufactured, or which are involved in manufacturing, while others are intended to supply information and knowledge on matters which seem, at the time, unrelated.

Some research workers grow into the laboratory, while others grow out of it. That is largely dependent upon the personality of the individual. Success, which is a point of view, may come equally to the man who loses himself in the research laboratory, or who becomes prominent in the public mind, perhaps as a chief engineer or as an executive leader in a new scientific achievement.

You have no reason to fear that you will be unable to make use of your training if you really become a radio engineer, for the number who can carry on through those six years at college is all too few. They are difficult years, trying the ability and the strength of purpose to the limit, making the title of Radio Engineer well earned and valuable to hold.

There is no crowding at the top of the ladder in this profession because, of thousands of radio experimenters who think they would like to be engineers, only one wants to make the grade hard enough to be willing to work and make the sacrifices which are required. If you do carry through

(*Continued on page 82*)

A HIGHLY EFFICIENT SHORT-WAVE RECEIVER

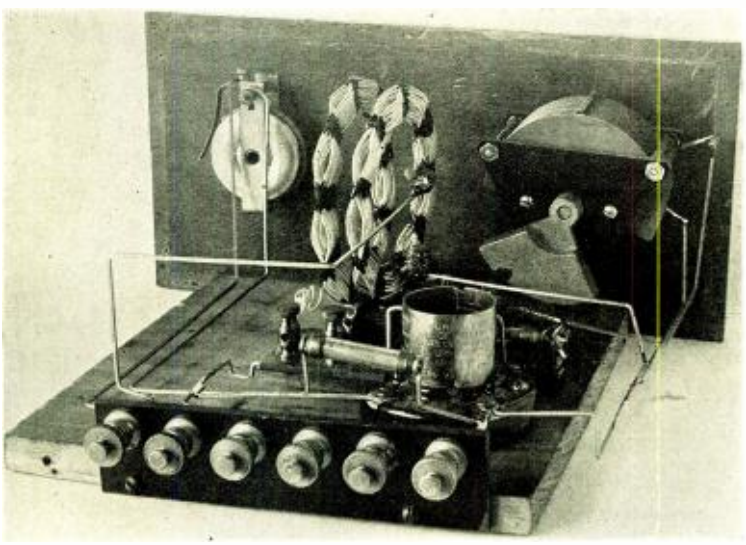
A "Golden Rule" Set That Is Also Adaptable To Broadcast Reception With Excellent Results

By R. B. Bourne

The outstanding features of this tuner are great selectivity, exceptional signal strength with but one stage of audio frequency amplification—remarkable ease of adjustment—Two controls!—Practically non-radiating because of an untuned antenna circuit. This makes it impossible to bring the secondary circuit into resonance with the antenna which brings about re-radiation.

IN choosing a design for a short wave receiver, several things must be taken into consideration. Among these the most important are wavelengths to be covered, high efficiency, freedom from vagrant capacity effects and ease of control.

The receiver herein described was designed especially for the recent trans-Atlantic receiving tests. Although the wavelength range of the receiver is from about 80 to 220 meters, it will be shown later on in this article how this remarkable tuner can be easily changed to cover the 220-550 broadcasting wave band with excellent results. All the well known types of receiving circuits were considered, from the superheterodyne to the single circuit regenerative tuner. The superheterodyne was the only circuit using radio frequency amplification which was favorably considered, but there was no time in which to build one, as the tests were already under way.



The Bourne short wave receiver remodeled for broadcast reception

Experience with many types of receivers had shown the writer that where the time for making best adjustments is limited, as in amateur relay work, the best results are to be expected from a tuner with two controls at the most. A further advantage might be expected if one of these adjustments were to be very broad so as to hold for a relatively wide band of wavelengths.

Accordingly the circuit chosen was that shown in the accompanying diagram. It will be seen that this is a three circuit tuner, with an aperiodic or untuned antenna circuit, tuned secondary and ordinary tickler. It might seem at first thought improbable that, with but one stage of audio frequency amplification, signals from European stations could be heard with so simple an arrangement. Nevertheless no less than twenty-seven different European stations were copied, some of them with a signal strength sufficient to enable them to be copied ten feet from the phones. This was particularly the case with f8AB, Nice, France, whose 110-meter signals were copied every night of the tests.

This reception is primarily the result of elimination of all losses possible. Taking each part of the circuit separately, let us see what losses can occur and what can be done to reduce them. We must remember we are dealing with very high frequencies, as the tuner must be capable of tuning well below 100 meters.

The coil system as shown consists of two spiderweb inductances. These are so mounted that the tickler can be rotated with respect to the antenna and secondary coil. The secondary must tune from about 80 meters to 220 meters. No taps are provided, the whole coil being used for every adjustment. Theoretically, stronger signals will be received on a given wavelength when the inductance is high and the capacity small. It will appear therefore that better results on the upper part of the range would be obtained if a larger coil and smaller capacity were used, but we must remember that it is of vital importance to be able to shift quickly from 200 to 100 meters. The reason for this as as follows: Signals from Europe at times fade completely out. It is necessary to be able therefore to cover many different wavelengths and to be able to shift back to any station instantly. This is particularly true when listening for several stations all of which are supposed to be transmitting at the same time. With all this in mind, it was decided that the gain realized from having the best possible ratio of inductance to capacity would be offset by the losses incurred in using switches and the time lost in making adjustments.

In the diagram, L_1 and L_2, the antenna and secondary coils respectively are wound as one coil. L_1 consists of three turns and L_2 of 15. The coil is made on a form consisting of nine spokes made from six-inch spikes driven into a wooden hub. Holes are first bored in the hub making the withdrawal of the spikes easy. The hub is two inches in diameter. Enough cord is wound on this form to make the diameter two and three-quarter inches. The purpose of the cord is to make the removal of the coil from form easy, as it drops off when the winding is complete and the spokes removed.

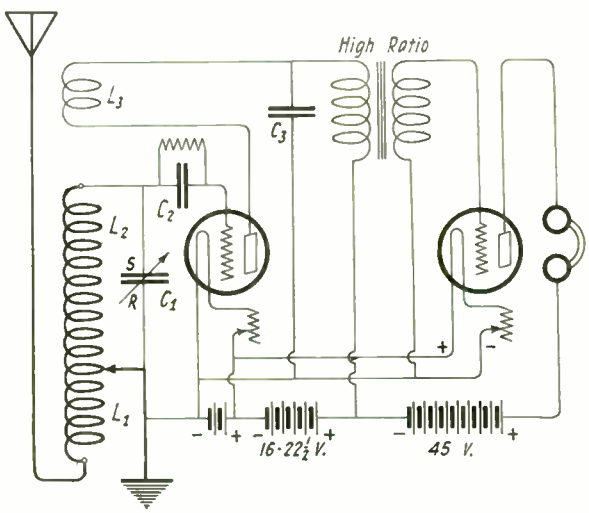
We start winding from the high potential end and wind on 15 turns of number 22 D.C.C. wire. At this point the wire is looped and twisted for the

ground tap. The insulation is bared close to the coil and the wires soldered. Three more turns are then wound on, in the same direction. This brings the antenna tap of the coil on the outside. The reason for this is that with the antenna and ground turns outside of the secondary, the latter is shielded by the winding itself and if the coil is mounted so that its plane is at right angles to the panel, no capacity effect from the hand will be noticed, on this account. When the winding is finished it is made rigid so that it can be removed from the spokes and be self-supporting.

Varnishing or dipping such a coil into collodion increases its capacity which defeats in a measure the purpose of the spiderweb method of winding. We must keep the insulation high and make the coil rigid and yet not increase the capacity of the windings appreciably. The best dielectric known is air and we rely on air for both insulation and low loss dielectric, excepting where the turns cross in the spiderweb. It is at this point where moisture may be in the insulation on the wire and cause leakage. Accordingly we bake it out and make the coil rigid by running into the winding molten shellac. Pure flake shellac is pulverized and a small quantity spread on the winding where the turns weave in and out. A moderately hot iron is then used to melt the shellac and impregnate the windings at this point. The iron is kept on until the shellac no longer bubbles showing that the moisture present has been boiled out. No more shellac is used than is necessary to thoroughly impregnate the criss cross point. When the shellac cools it will be found to be extremely hard and the coil may now be removed from the form, and any bare spots on the inside touched up with the hot iron.

The tickler coil is wound on the same form and consists of 20 turns of the same size wire. Flexible leads are soldered to the tickler terminal wires. The tickler is mounted on a hinged support made of thoroughly seasoned mahogany. An elliptically shaped dowel is made to fit into one of the open spaces around the edge of the coil and the dowel fitted to the wooden shaft which extends through the panel and is fitted with a knob. The antenna and secondary winding is mounted in the same manner and the two so arranged that the coupling may be varied by turning the tickler. The polarity of the tickler is best determined by trial.

In constructing receiving sets nowadays the average man pays more attention to adding three or four tubes to his set in an endeavor to reach out, than he does to cutting down losses in his tuning apparatus and the selection of his tuning instruments. For instance, a simple regenerative set was made up using a well known—though not very efficient variable condenser to tune the secondary with. A log was made of the stations heard and their respective audibility. Then this condenser was removed and another substituted in its place. This second condenser had exceptionally low losses and while it cost perhaps a dollar more, the log of the same receiver using this condenser showed that the selectivity was greatly enhanced and the audibility on distant as well as local stations was much greater, about thirty stations being logged that were absolutely inaudible with the other. This proved unquestionably that when care is used in the selection of the various elements in your set better results can be counted on.



Circuit diagram of the receiver that tuned in twenty-seven different European stations

The next and probably the most important part of the circuit from the standpoint of losses which may exist is the variable condenser. It is of .0005 mfd. capacity and was chosen because of its rigid construction and very low losses. Hard rubber is the solid dielectric used. The rotary plates and shaft are grounded, thereby eliminating further losses and body capacity effects. This condenser will tune the secondary inductance from 80 to about 220 meters. To check the efficiency of your condenser, substitute others in its place. Some condensers will render inaudible signals on 100 meters which with a good condenser are entirely readable.

The grid condenser is of about .0002 mfd. and is made up of three sheets of copper foil with mica dielectric. The active surface of the plates is about ¾ inches square. The grid leak was found by trial to be 1.5 megohms.

C_3 is a by-pass condenser and is of mica with a capacity of .001 mfd. This is connected from the battery side of the tickler direct to ground so that no radio frequency passes through the B batteries and phone cords.

The whole arrangement was mounted behind a piece of thoroughly seasoned wood. The variable condenser is mounted in the usual way. Terminals are brought out in the rear on a small subpanel of hard rubber.

One point of importance is the wiring. Air is used for insulation as much as possible and the wiring is so arranged that the shortest possible lengths are used. Square copper bus is employed as this lends itself to neat wiring and is rigid. Soldering of joints is very important in keeping the set quiet. The flux used is rosin dissolved in alcohol. Dry rosin is O. K. but harder to work with. The iron must be hotter than when using paste. Rosin flux has the additional advantage of forming a protective coating over the joint soldered.

This set was used in conjunction with an antenna 30 feet high and 60 feet long, a single copper wire. It is important that all joints in the antenna be soldered. It is better and not difficult to bring the antenna wire right into the set itself. The fewer insulators used the better. We have to deal with very weak signals of extremely high frequency and no precautions must be overlooked. A loose connection in either the antenna or ground system may introduce high enough resistance to render wasted all the other precautions taken.

It is found in tuning that the tickler may be turned out as far as possible for 100-meter work and regeneration controlled nicely by the filament rheostat. For 200-meter work, the tickler must be brought up close to the secondary. It is not necessary to change this adjustment for a range of wavelengths between 160 and 220, leaving the receiver uni-controlled for this range. The set oscillates nicely over

(Continued on page 74)

It might seem improbable that, with only one stage of audio frequency amplification, European stations could be heard with this simple hook-up. Nevertheless, twenty-seven stations in Europe were heard with it.

Königswusterhausen

(*Continued from page 43*)

To get the highest possible efficiency now, the aerial and earth are conducted across a special self-induction coil with variable collector and two parallel block condensers to the two electrodes of the arc (connection Herzog). The aerial output is considerably increased in this way. By joining an intermediate circuit a sharp tuning of the sender and an absolute freedom from harmonics is obtained.

The new operating method, which is used today in each and every Lorenz-Poulsen sender, is based upon the total checking of the aerial current as far as the zero value because of increased damping. Operating is accomplished by directing the current in the auxiliary magnetization circuit. The coil is employed in a peculiar connection.

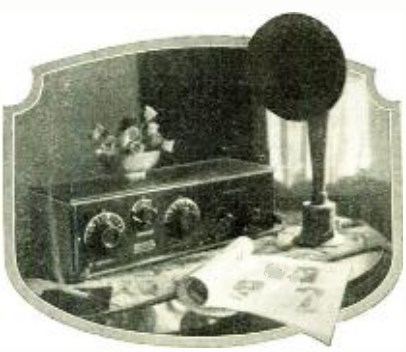
The new telephony method also employs the magnetic influencing coil. As early as in the year 1913, the first trials were made with the new telephony method. Till then the energy in the Poulsen transmitters had been directed immediately to the aerial by microphones connected in parallel, but it became clear that this method could not be used with efficiency as the number of microphones became too great and the synchronous use of them was impossible. Therefore, Dr. Pungs elaborated a system which, for transmitting the oscillations of the sound to the aerial, uses a coil with an iron core. In this method the coil with a particular iron core is connected to the aerial. The speaking and telephony current is conducted to it by means of the microphone and special amplifier-devices. By this varying current the iron alters its magnetic resistance and therefore the current in the aerial. In this way it is possible to control any energy in the aerial by a single microphone. The energy in the aerial varies according to the size of the station by 10, 20, or more H. P. in time intervals which may amount to fractions of 1/1000 of a second, owing to the sounds of the speech.

In the course of time there has been used at Königswusterhausen a good many senders of small and gradually increased energy. Already in 1919, it was possible to transmit, by means of a small arc-generator with an aerial energy of about 3 kilowatts, telephonic communications as well as concerts, which were received with clearness at Moscow, a distance of 1,700 kilometers. In June, 1921, the play of the great opera in Berlin was transmitted to the whole of central Europe. For this purpose small microphones were installed at the stage boxes. The music and singing excited the microphones, and were thus transferred over the wires to the radio station at Königswusterhausen. Here they were imposed on the 4-kilowatt sender and radiated into space.

From nearly all countries in Europe the perfect reception of the wireless opera was confirmed. In August, 1921, the first wireless conversation was carried out from a subscriber's apparatus in Berlin over the normal lines to Königswusterhausen and thence by radio.

By these and other successes, which followed rapidly, it was proved that the arc transmitting system could work in the same way as the high-frequency and the tube system. As a result the station of Königswusterhausen was completed for telephonic and telegraphic transmission.

At present it contains a great number of arc senders and a corresponding number of aerials. The smaller of its senders — partly tube senders — are used for the German traffic. The two arc senders of 10-kilowatt (aerial-energy) for a wave-length of 2,600 to 9,000 meters and 32-kilowatt (aerial-energy) for a wave-length of 4,000 to 20,000 meters are for the European traffic, the latter one also for the traffic with Asia. A further great arc-sender of 50-kilowatts will be built and transferred later on into a new building.



The C. D. Tuska Superdyne receiver of the type described on page 34, installed in home surroundings

Survey of the Ether

(*Continued from page 47*)

which indicates the field strength in thousandths of volts per meter. The average crystal receiving set requires a field strength of approximately 10 of these units for satisfactory operation, while a sensitive vacuum tube receiver may operate with field strengths ranging from ½ to as little as 1/10 of a unit.

If the progress of ether waves was not affected by man-made obstructions and better transmission over water, each volume level of reception would be indicated by a perfect circle with WEAF as its center. But the panorama indicates very clearly the effect of various surface conditions. The tall buildings in the Times Square area cause a heavy dent inward so that the distance from WEAF to the 100 millivolt circle pointing northward is less than one-quarter the distance east and west. The absence of high buildings directly east and west of the station and the improved transmission over the surface of the water, considerably elongates the curve.

The curves indicating field strengths of 75, 50, 41, 30 and 20 millivolts all concentrate in the district of high buildings at the lower tip of Manhattan, a distance of two miles. Yet slightly to the west of this direction, where the waves travel largely over the water, the same 20 millivolt circle extends so as to include practically all of Bayonne, New Jersey, some points on the circle being a distance of nearly 10 miles from WEAF; as compared with but two miles in the direction of the Battery.

Another interesting area is that indicating the poor reception in Central Park. The southern end of Central Park is but six miles distant from WEAF, yet because of the tall apartment buildings surrounding it, there is a remarkable reduction in the energy received. The southern end of the park is on the circle indicating a level of 7.5 units. This falls rapidly to 5 units, then a few hundred yards further north to 2½, 2, 1½, and finally at the center of the park to a level of reception of but one millivolt per meter.

At greater distances it was found that the city of Newark is on a level of 10 units reception. Directly west of Newark there is a large inward indentation, showing the influence of the steel buildings in Newark on reception beyond. Messrs. Bown and Gillett, however, draw the conclusion that such effects are quite local. They are radio shadows, which, like the shadows caused by tall buildings as the sun sets, have but little or no effect on the illumination over very large areas. As a result, curves such as those just given are only of local interest and do not give any indication of how clearly more distant receiving sets will hear a broadcasting station. They should not be interpreted as meaning that a receiving set many miles behind a row of tall buildings will be seriously affected by their presence. Only high mountain ranges and large bodies of water, and immediate local conditions need be considered in judging the possibility of receiving from a particular direction.

It is to be hoped that more extensive data will be collected in the future. The work already done has proved such a revelation and developed so many interesting facts, that further investigation is sure to bring out much additional evidence as to how ether waves travel and what conditions obstruct their progress.

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Newhouse Hotel .....Salt Lake City, Utah	360
KDYM	Savoy Theater .....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYW	Smith Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin .....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co. .....Seattle, Wash.	270
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co...Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and The Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral .....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	236
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)...Billings, Mont.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Fygare.....Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agricultural College....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. Everett Cutting.....Bozeman, Mont.	248
KFDR	Bullock's Hdw. & Sporting Goods, York, Nebr.	360
KFDV	Gilbreth & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engs., St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendeleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheffel Motor Co.....Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iawo	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Plucus & Murphey.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co..Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford Univ., Calif.	360
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Radio & Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co.....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seattle, Wash.	283
KFHS	Clifford J. Dow.....Lihue, Hawaii	275
KFHX	Robert W. Nelson.....Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.).....Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage.....Iola, Kans.	246
KFIF	Benson Polytechnic Institute.....Portland, Ore.	360
KFIL	Windisch Elec. Farm Eqip. Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fond du lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash.	270
KFJF	National Radio Mfg. Co..Oklahoma City, Okla.	252
KFJI	Liberty Theatre .....Astoria, Ore.	233
KFJK	Delano Radio & Electric Co....Bristow, Okla.	242
KFJL	Hardsacg Manufacturing Co.....Ottumwa, Iowa	280
KFJM	University of North Dakota..Grand Forks, N. D.	280
KFJQ	Electric Construction Co..Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112th Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Ment.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.....Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KFMT	George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Sateren.....Houghton, Mich.	266
KFMX	Carleton College .....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club.....Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr.....Corsicana, Tex.	254
KFNF	Henry Field Seed Co.....Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop....Warrensburg Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co.....Helena, Mont.	231
KFNZ	Royal Radio Co.....Burlingam, Calif.	231
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFOB	Glenwood Technical Assn., Minneapolis, Minn.	224
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow .....Portland, Ore.	263
KFOJ	Moberly High School Radio Club..Moberly, Mo.	246
KFOL	Leslie M. Schafbuch.....Marengo, Iowa	234
KFON	Echophone Radio Shop.....Long Beach, Calif.	234
KFOP	Wilson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service..Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co. .....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	509
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Co and Radio Research Society of Long Beach, Calif., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co.....San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co., Modesto, Calif.	252
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co..Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZN	The Deseret News.....Salt Lake City, Utah	360
KZV	Wenatchee Bat. & Motor Co, Wenatchee, Wash.	360
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	John B. Lawrence.....Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.....Bangor, Me.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agricultural College....Storrs, Conn.	283
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WABP	Robert F. Welnig.....Dover, Ohio	266
WABQ	Haverford College Radio Club.....Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church..New Orleans, La.	263
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co.....Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBE	Alfred R. Marcy.....Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya .....Mattapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBI	Indianapolis Radio Club.....Indianapolis, Ind.	234
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co., Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook .....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Associations....Rossville, N. Y.	244
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	224
WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222
WBBY	Washington Light Infantry....Charleston, S. C.	268
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227
WBL	T. & H. Radio Co.....Anthony, Kans.	261
WSB	D. W. May (Inc.).....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel..... Houston, Tex.	253
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp. of Texas, San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.	280

WCAT	South Dakota State School of Mines, Rapid City, S. Dak.	240
WCAU	Durham & Co. Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co. Little Rock, Ark.	360
WCAX	University of Vermont Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co. Milwaukee, Wis.	261
WCAZ	Carthage College Carthage, Ill.	246
WCBA	Charles W. Heimbach Allentown Pa.	280
WCBC	University of Michigan Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva Zion, Ill.	345
WCBE	Uhalt Radio Co. New Orleans, La.	263
WCBG	Howard S. Williams Pascagoula, Miss.	254
WCBH	University of Mississippi Oxford, Miss.	242
WCK	Stix-Baer & Fuller Dry Goods Co. St. Louis, Mo.	360
WCM	University of Texas Austin, Tex.	360
WCX	Detroit Free Press Detroit, Mich.	517
WDAE	Tampa Daily Times Tampa, Fla.	360
WDAF	Kansas City Star Kansas City, Mo.	411
WDAG	J. Laurance Martin Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South), El Paso, Tex.	268
WDAK	The Courant Hartford, Conn.	261
WDAO	Automotive Electric Co. Dallas, Tex.	360
WDAP	Board of Trade Chicago, Ill.	360
WDAR	Lit Brothers Philadelphia, Pa.	395
WDAS	Samuel A. Waite Worcester, Mass.	360
WDAU	Slocum & Kilburn New Bedford, Mass.	360
WDAY	Radio Equipment Corporation, Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co. Lancaster, Pa.	258
WDM	Church of the Covenant Washington, D. C.	234
WDZ	James L. Bush Tuscola, Ill.	278
WEAA	Frank D. Fallain Flint, Mich.	250
WEAF	American Tel. & Tel. Co. New York, N. Y.	492
WEAH	Wichita Board of Trade Wichita, Kans.	280
WEAI	Cornell University Ithaca, N. Y.	286
WEAJ	University of South Dakota Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. Providence, R. I.	273
WEAO	Ohio State University Columbus, Ohio	360
WEAP	Mobile Radio Co. Mobile, Ala.	360
WEAR	Baltimore American and News Publishing Co., Baltimore, Md.	360
WEAS	Hecht Co. Washington, D. C.	360
WEAU	Davidson Bros. Co. Sioux City, Iowa	360
WEAY	Iris Theater Houston, Tex.	360
WEB	Benwood Co. St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co. Houston, Tex.	360
WEW	St. Louis University St. Louis, Mo.	261
WFAA	Dallas News and Dallas Journal Dallas, Tex.	476
WFAB	Carl F. Woese Syracuse, N. Y.	234
WVX	H. C. Spratley Radio Co. Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co. Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrum't Co., Asheville, N. C.	360
WFAM	Times Publishing Co. St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College Cameron, Mo.	360
WFAT	New Columbus College Sioux Falls, S. Dak.	258
WFAV	University of Nebraska Lincoln, Nebr.	275
WFI	Strawbridge & Clothier Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd Pensacola, Fla.	360
WGAQ	Glenwood Radio Corporation Shreveport, La.	252
WGAW	Ernest C. Albright Altoona, Pa.	261
WGAZ	South Bend Tribune South Bend, Ind.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co. Buffalo, N. Y.	319
WGV	Interstate Electric Co. New Orleans, La.	242
WGY	General Electric Co. Schenectady, N. Y.	380
WHA	University of Wisconsin Madison, Wis.	360
WHAA	State University of Iowa Iowa City, Iowa	484
WHAB	Clark W. Thompson Galveston, Tex.	360
WHAD	Marquette University Milwaukee, Wis.	280
WHAG	University of Cincinnati Cincinnati, Ohio	222
WHAH	Hafer Supply Co. Joplin, Mo.	283
WHAK	Roberts Hardware Co. Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music), Rochester, N. Y.	283
WHAP	Otta and Kuhns Decatur, Ill.	360
WHAR	Paramount Radio & Elec. Co., Atlantic City, N. J.	231
WHAS	Courier-Journal and Louisville Times, Louisville, Ky.	400
WHAV	Wilmington Elect. Spec. Co., Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute Troy, N. Y.	380
WHB	Sweeney School Co. Kansas City, Mo.	411
WHK	Radiovox Co. Cleveland, Ohio	283
WHN	George Schubel New York, N. Y.	360
WIAB	Joslyn Automobile Co. Rockford, Ill.	252
WIAC	Galveston Tribune Galveston, Tex.	360
WIAD	Howard R. Miller Philadelphia, Pa.	254
WIAF	Gustav A. DeCortin New Orleans, La.	234
WIAI	Heer Stores Co. Springfield, Mo.	252
WIAJ	Fox River Valley Radio Sup. Co., Neenah, Wis.	224
WIAK	Journal-Stockman Co. Omaha, Nebr.	278
WIAO	School of Eng'g of Milwaukee, Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co. Marion, Ind.	226
WIAR	Paducah Evening Sun Paducah, Ky.	360
WIAS	Home Electric Co. Burlington, Iowa	360
WIAU	American Trust & Savings Bank..Le Mars, Iowa	360
WIK	K. & L. Electric Co. McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co. Washington, D. C.	360
WIP	Gimbel Bros. Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories, Waco, Tex.	360
WJAF	Muncie Press and Smith Elec. Co., Muncie, Ind.	360
WJAG	Norfolk Daily News Norfolk, Nebr.	283
WJAK	Clifford L. White Greentown, Ind.	254
WJAM	D. M. Perham Cedar Rapids, Iowa	268
WJAN	Peoria Star Peoria, Ill.	280
WJAQ	Capper Publications Topeka, Kans.	360
WJAR	The Outlet Co. Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250
WJAT	Kelley-Yawter Jewelry Co. Marshall, Mo.	360
WJAX	Union Trust Co. Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory Chicago, Ill.	448
WJD	Denison University Granville, Ohio	229
WJH	William P. Boyer Co. Washington, D. C.	273
WJX	Deforest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corporation of America..New York, N. Y.	405
WJZ	Radio Corporation of America..New York, N. Y.	455
WKAA	H. F. Paar Cedar Rapids, Iowa	268
WKAD	Charles Looff (Crescent Park), E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co. Wichita Falls, Tex.	360
WKAN	United Battery Service Co. Montgomery, Ala.	226
WKAP	Dutee W. Flint Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College, East Lansing, Mich.	280
WKAV	Laconia Radio Club Laconia, N. H.	254
WKAY	Brenau College Gainesville, Ga.	280
WKY	WKY Radio Shop Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation, Minneapolis, Minn.	417
WLAH	Samuel Woodworth Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co. Waco, Tex.	360
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co. Tulsa, Okla.	360
WLAP	W. V. Jordon Louisville, Ky.	360
WLAQ	Arthur E. Schilling Kalamazoo, Mich.	283
WLAV	Electric Shop Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y., New York, N. Y.	360
WLAX	Putnam Electric Co. Greencastle, Ind.	231
WLB	University of Minnesota Minneapolis, Minn.	360
WLW	Crosley Mfg. Co. Cincinnati, Ohio	309
WMAB	Radio Supply Co. Oklahoma, Okla.	360
WMAC	Clive B. Meredith Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp. Dartmouth, Mass.	360
WMAH	General Supply Co. Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co. Kansas City, Mo.	275
WMAK	Norton Laboratories Lockport, N. Y.	360
WMAL	Trenton Hardware Co. Trenton, N. J.	256
WMAN	First Baptist Church Columbus, Ohio	286
WMAP	Utility Battery Service Easton, Pa.	246
WMAQ	Chicago Daily News Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute Auburn, Ala.	250
WMAW	Wahpeton Electric Co. Wahpeton, N. Dak	254
WMAY	Kingshighway Presby. Church, St. Louis, Mo.	280
WMAZ	Mercer University Macon, Ga.	268
WMC	Commercial Appeal Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co. Washington, D. C.	261
WNAC	Shepard Stores Boston, Mass.	278
WNAD	University of Oklahoma Norman, Okla.	360
WNAL	R. J. Rockwell Omaha, Nebr.	266
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.	286
WNAP	Wittenberg College Springfield, Ohio	275
WNAQ	Charleston Radio Elec. Co. Charleston, S. C.	360
WNAR	C. C. Rhodes Butler, Mo.	231
WNAS	Texas Radio Corp. and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Brothers Co. Philadelphia, Pa.	360
WNAV	Peoples Tel. & Teleg. Co. Knoxville, Tenn.	360
WNAW	Henry Kunzman Box 167, Fort Monroe, Va.	244
WNAX	Dakota Radio Apparatus Co. Yankton, S. Dak.	273
WNJ	Shotton Radio Mfg. Co. Albany, N. Y.	360
WOAC	Page Organ Co. (H. P. Maus) Lima, Ohio	266
WOAD	Friady Battery & Electric Corp. Sigourney, Iowa	360
WOAE	Midland College Fremont, Neb.	360
WOAF	Tyler Commercial College Tyler, Tex.	360
WOAG	Appollo Theatre Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation Charleston, S. C.	360
WOAI	Southern Equipment Co. San Antonio, Tex.	385
WOAN	James D. Vaughn Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co. Mishawaka, Ind.	360
WOAP	Kalamazoo College Kalamazoo, Mich.	283
WOAR	Henry P. Lundskow Kenosha, Wis.	229
WOAT	Boyd M. Hamp Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 112th Inf., Erie, Pa.	242
WOAW	Woodmen of the World Omaha, Neb.	526
WOAX	Franklyn J. Wolff Trenton, N. J.	240
WOC	Palmer School of Chiropractic. Davenport, Iowa	484
WOI	Iowa State College Ames, Iowa	360
WOK	Pine Bluff Co. Pine Bluff, Ark.	360
WOO	John Wanamaker Philadelphia Pa.	509
WOQ	Western Radio Co. Kansas City, Mo.	360
WOR	L. Bamberger & Co. Newark, N. J.	405
WOS	Missouri State Market'g Bu. Jefferson City, Mo.	441
WPAB	Pennsylvania State College..State College, Pa.	283
WPAC	Donaldson Radio Co. Okmulgee, Okla.	330
WPAH	Wisconsin Dept. of Markets Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp. New Haven, Conn.	268
WPAK	North Dakota Agricultural College, Agricultural College, N. Dakota	360
WPAL	Avery & Loeb Electric Co. Columbus, Ohio	286
WPAM	Auerbach & Guettel Topeka, Kans.	360
WPAP	Theodore D. Phillips Winchester, Ky.	360
WPAQ	General Sales & Engineering Co. Frostburg, Md.	360
WPAT	St. Patrick's Cathedral El Paso, Tex.	360
WPAU	Concordia College Moorhead, Minn.	360
WPAZ	John R. Koch Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr. Parkesburg, Pa.	360
WQAC	E. B. Gish Amarillo, Tex.	360
WQAD	Whitall Electric Co. Waterbury, Conn.	242
WQAE	Moore Radio News Station Springfield, Vt.	275
WQAF	Sandusky Register Sandusky, Ohio	240
WQAL	Coles County Telep. & Teleg. Co. Mattoon, Ill.	258
WQAM	Electrical Equipment Co. Miami, Fla.	283
WQAN	Scranton Times Scranton, Pa.	280
WQAO	Calvary Baptist Church New York, N. Y.	360
WQAQ	W. Texas Radio Co. (Abilene Daily Reporter) Abilene, Texas	360
WQAS	Prince-Walter Co. Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.) Greenville, S. C.	258
WQAW	Catholic University Washington, D. C.	236
WQAX	Radio Equipment Co. Peoria, Ill.	360
WRAA	Rice Institute Houston, Texas	360
WRAD	Taylor Radio Shop Marion, Kans.	248
WRAF	The Radio Club Laporte, Ind.	224
WRAH	Stanley N. Read Providence, R. I.	231
WRAL	Northern States Power Co. St. Croix Falls, Wis.	248
WRAM	Lombard College Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co. Waterloo, Iowa	236
WRAO	St. Louis Radio Service Co. St. Louis, Mo.	360
WRAV	Antioch College Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop Reading, Pa.	238
WRAX	Flexon's Garage Gloucester City, N. J.	268
WRAY	Radio Sales Corporation Scranton, Pa.	280
WRAZ	Radio Shop of Newark Newark, N. J.	233
WRC	Radio Corporation of America, Washington, D. C.	469
WRK	Doron Bros. Electrical Co. Hamilton, Ohio	360
WRL	Union College Schenectady, N. Y.	360
WRM	University of Illinois Urbana, Ill.	360
WRR	City of Dallas, Police and Fire Signal Dept. Dallas, Texas	360
WRW	Tarrytown Radio Res'rch Lab., Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College, Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural Col., Clemson College, S. C.	360
WSAD	J. A. Foster Co. Providence, R. I.	261
WSAG	Loren V. Davis and George Prestman, Sr., St. Petersburg, Fla.	244
WSAH	A. G. Leonard, Jr. Chicago, Ill.	248
WSAI	United States Playing Card Co. Cincinnati, O.	309
WSAJ	Grove City College Grove City, Pa.	360
WSAL	Franklin Electric Co. Brookville, Ind.	246
WSAN	Allentown Radio Club Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co. Plainview, Tex.	268
WSAW	John J. Long, Jr. Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory Chicago, Ill.	268
WSAY	Port Chester Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop. Pomeroy, Ohio	360
WSB	Atlanta Journal Atlanta, Ga.	429
WSL	J. & M. Electrical Co. Utica, N. Y.	273
WSY	Alabama Power Co. Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co. Fall River, Mass.	248
WTAC	Penn Traffic Co. Johnstown, Pa.	360
WTAF	Louis J. Gallo New Orleans, La.	268
WTAG	Kern Music Co. Providence, R. I.	258
WTAH	Carmen Ferro Belvidere, Ill.	236
WTAJ	The Radio Shop Portland, Me.	236
WTAL	Toledo Radio & Electric Co. Toledo, Ohio	252
WTAM	Willard Storage Battery Co. Cleveland, O.	390
WTAP	Cambridge Radio & Electric Co. Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son Osseo, Wis.	254
WTAR	Reliance Electric Co. Norfolk, Va.	280
WTAS	Charles E. Erbstein Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co. Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co. Tecumseh, Nebr.	360
WTAW	Agricultural and Mechanical College of Texas, College Station, Tex.	280
WTAX	Williams Hardware Co. Streator, Ill.	231
WTAY	Todar-Oak Leaves Broadcast. Sta., Oak Park, Ill.	283
WTAZ	Thomas J. McGuire Lambertville, N. J.	283
WTG	Kansas State Agri. Coll. Manhattan, Kans.	360
WWAB	Hoenig, Swern & Co. Trenton, N. J.	226
WWAC	Sanger Bros. Waco, Tex.	360
WWAD	Wright & Wright (Inc.) Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley Joliet, Ill.	227
WWAF	Galvin Radio Supply Co. Camden, N. J.	236
WWAO	Michigan College of Mines Houghton, Mich.	244
WWI	Ford Motor Co. Dearborn, Mich.	273
WWJ	Detroit News Detroit, Mich.	517
WWL	Loyola University New Orleans, La.	280

Canadian Stations

CFAC	The Calgary Herald Calgary, Alta.	430
CFCA	Star Publishing & Printing Co. Toronto, Ont.	400
CFCF	Marconi Wireless Telegraph Co. of Canada, Montreal, Que., Canada	440
CFCH	Abitibi Power & Paper Co. Iroquois Falls, Ont.	400
CFCJ	La Cie. de L'Evenement Quebec, P. Q.	410
CFCK	Radio Supply Co., Ltd. Edmonton, Alta.	410
CFCL	Centennial Methodist Church Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd. Calgary, Alta.	440
CFCO	Semmelhaack-Dickson, Ltd. Bellevue, Que.	450
CFCQ	Radio Specialties, Ltd. Vancouver, B. C.	450
CFCR	Laurentide Air Service, Ltd. Sudbury, Ont.	410
CFCW	The Radio Shop London, Ont.	420
CFDC	Sparks Co. Nanaimo, B. C.	430
CFQC	The Electric Shop, Ltd. Saskatoon, Sask.	400
CFRC	Queens University Kingston, Ont.	450
CFUC	University of Montreal Montreal, Que.	400
CFXC	Westminster Trust Co. New Westminster, B. C.	440
CHAC	Radio Engineers Halifax, N. S.	400
CHBC	The Albertan Publishing Co. Calgary, Alta.	410
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd. Toronto, Ont.	440
CHCD	Canadian Wireless & Elec. Co., Quebec, Que.	410
CHCE	Western Canada Radio Supply..Victoria, B. C.	400
CHCL	The Vancouver Merchants Exchange, Ltd., Vancouver, B. C.	440
CHCM	Riley & McCormack, Ltd. Calgary, Alta.	440
CHCS	The Hamilton Spectator Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd. Montreal, Que.	341
CJCA	The Edmonton Journal, Ltd. Edmonton, Alta.	450
CJCM	J. L. Phillipe Landry Monti Joli, Que.	400
CJGC	London Free Press Printing Co. London, Ont.	430
CJCD	The T. Eaton Co., Ltd. Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co. Vancouver, B. C.	420
CJCI	Maritime Radio Corp., Ltd. St. John, N. B.	400
CJCN	Simons Agnew & Co. Toronto, Ont.	410
CJCX	Percival W. Shackleton Olds, Alta.	400
CJSC	The Evening Telegram Toronto, Ont.	430
CKAC	La Presse Publishing Co., Ltd. Montreal, P. Q.	425
CKCD	Vancouver Daily Province Vancouver, B. C.	410
CKCE	Canadian Indp. Telephone Co. Toronto, Ont.	450
CKCH	Canadian National Railways Ottawa, Ont.	435
CKCK	Leader Publishing Co., Ltd. Regina, Sask.	420
CKCO	Dr. G. M. Geldert (For Ottawa Radio Assn.), Ottawa, Ont.	400
CKCX	P. Burns & Co., Ltd. Calgary, Alta.	440
CKOC	Wentworth Radio Supply Co. Hamilton, Ont.	410
CKY	Manitoba Telephone System Winnipeg, Man.	450
CFYC	V. W. Odlum Vancouver, B. C.	400

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower)	2,600
8AJ	Paris	1,780
ESP	Paris	450

Cuban Stations

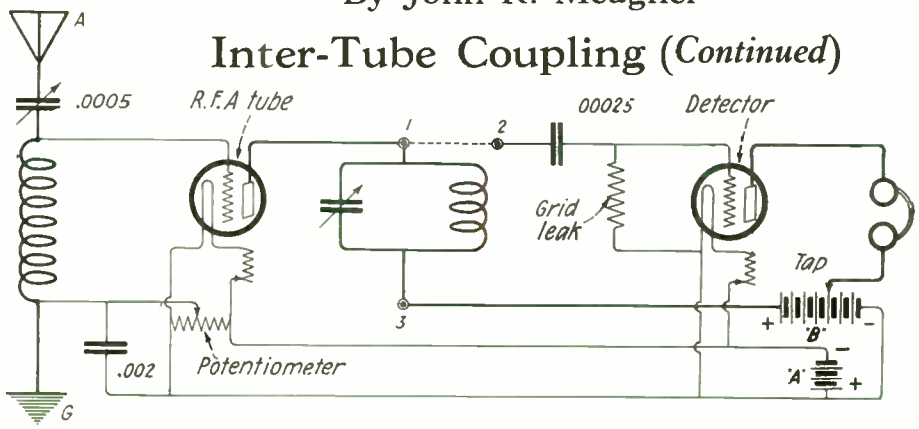
PWX	Cuban Telephone Co. Habana	400
2DW	Pedro Zayas Habana	300
2AB	Alberto S. de Bustamante Habana	240
2OK	Mario Garcia Vélez Habana	360
2BY	Frederick W. Borton Habana	260
2CX	Frederick W. Borton Habana	320
2EV	Westinghouse Elec. Co. Habana	220
2TW	Roberto E. Ramirez Habana	230
2HC	Heraldo de Cuba Habana	275
2LC	Luis Casas Habana	250
2KD	E. Sanchez de Fuentes Habana	350
2MN	Fausto Simon Habana	270
2MG	Manuel G. Salas Habana	280
2JQ	Raul Pérez Falcon Habana	150
2KP	Alvaro Daza Habana	200
2HS	Julio Power Habana	180
2GL	Oscar Collado Habana	200
2WW	Amadeo Saenz Habana	210
5EV	Leopoldo V. Figueroa Colon	360
6KW	Frank H. Jones Tuinucu	340
6KJ	Frank H. Jones Tuinucu	275
6CX	Antonio T. Figueroa Cienfuegos	170
6DW	Eduardo Terry Cienfuegos	225
6BY	José Ganduze Cienfuegos	300
6AZ	Valentin Ullivarri Cienfuegos	200
6EV	Josefa Alvarez Calbarién	225
7AZ	Pedro Nogueras Camaguey	225
7BY	Salvador Rionda Camaguey	350
8AZ	Alfredo Broocks Santiago de Cuba	240
8BY	Alberto Ravelo Santiago de Cuba	250
8FU	Andrés Vinnet Santiago de Cuba	225
8DW	Pedro C. Anduz Santiago de Cuba	275
8EV	Eduardo Mateos Santiago de Cuba	180
8GT	Juan F. Chibas Santiago de Cuba	260

RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Inter-Tube Coupling (*Continued*)



THOSE students who have built up the test set described in the February *Radio Engineering* may readily make relative tests of the efficiency of different methods of inter-tube coupling by merely adding an extra socket, rheostat and potentiometer to the rest of the equipment and making a few minor changes. Arrange the circuit as shown in the diagram so that there will be one stage of radio frequency amplification with a single circuit aerial connection and a vacuum tube detector.

Provide three Fahnestock clips (1, 2 and 3) in order that any type of coupling system may be connected in the circuit.

Then, while some good broadcasting station is on, try each of the methods of coupling shown on this page last month. Make a note of the results with particular regard to volume.

It should be found that the 'variometer tuned impedance' and the 'condenser tuned impedance' are very much alike. The 'air core choke' (being merely a broad—not definitely tuned—tuned impedance) may be represented by leaving the variometer tuned impedance in one position, that is, not adjusting it for each wave length. If the variometer were wound with resistance wire and had very little distributed capacity it could be used as an untuned air core choke—being adjusted once only to obtain sufficient inductance at the maximum wave length in order to make the RF tube oscillate over the entire range. In this connection, as to the proper value of impedance in the plate circuit, we may point out that an infinitely high value would be best for 'transformer action' but when a certain amount is reached, the RF tube oscillates and it is necessary to use either less impedance or else place a so-called 'looser' in the grid circuit of the first tube—the latter is by far the better plan.

Doubtless the resistance coupling will be found very poor, for wave lengths under 300 meters at least. The iron core choke, when properly designed, differs from the air core choke in that it is broader or presents a high impedance to a greater range of frequencies. We have often heard of the high impedance of telephone receivers to RF variations; if this is true they should make excellent RF inter-tube chokes or couplers. If an extra pair is on hand try them for this purpose—it will be found that they are rather poor and we can thus safely question the necessity for 'by-pass' condensers.

So far we have considered only auto-transformation—where one impedance is common to two circuits—here the grid and plate. A more practicable scheme is inductive transformation—using transformers.

The best type of transformer for any particular frequency would be one in which both the primary and secondary circuits are tuned to that frequency.

The next best type of transformer for any particular frequency would be one in which the secondary is tuned to that frequency and in which the primary has sufficient impedance to secure a voltage variation across its terminals consistent with the maximum possible variation; and this impedance value can safely be lower than the highest value which is infinity—because the voltage variation across the primary does not increase in direct proportion to the impedance.

For untuned transformers to operate over a broad band of frequencies it is necessary to keep the distributed capacity and the circuit capacity as low as possible; otherwise the windings will have well defined peaks and be poor at other frequencies. In designing untuned RF transformers one point has generally been overlooked—that is, the effect of any impedance in the plate circuit upon the grid conductance of the same tube: the static capacity of the grid is much less than the actual capacity when the plate impedance is high.

(*To be continued.*)

THIS is the fourth of a series of articles forming an educational and interesting course in radio fundamentals. Have you followed it from the start? If not, hunt up your back copies and read them thoroughly. Written in the language of the layman, this course started with a few simple instruments: variable condensers, coils and tube accessories—a home laboratory outfit, the use of which, as outlined by Mr. Meagher, teaches the mystery of radio in an easy-to-understand and interesting-to-learn fashion. The author, working on the theory that a principle is more easily understood when a person works it out with his own hands than when it is told to him or when he reads it out of a book, has given a thorough course in fundamental circuits and their operation. The experimenter has a chance then to actually see the results of his experimentations and does not have to depend on the words of others. We sincerely advise all our readers to follow this series and learn radio fundamentals easily and thoroughly. The author, in the first installment, recommended that students of this course supplement his instructions by reference to E. E. Bucher's "Wireless Experimenter's Manual" which is published by the Wireless Press, Inc., also "Radio Communication Pamphlet No. 40" published by the Bureau of Standards.

Selected Radio Hook-Ups

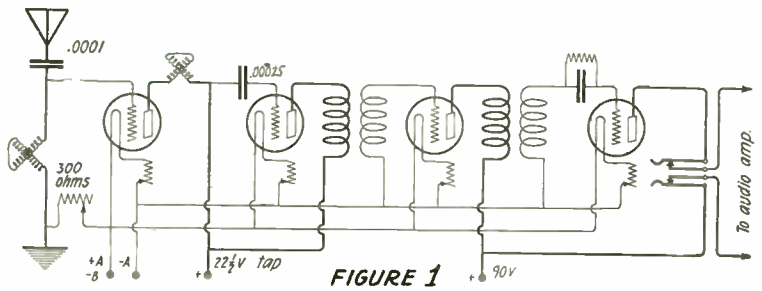


FIGURE 1

FIGURE 1 shows an adaptation of THE WIRELESS AGE Three-Tube Set described in the March issue. Instead of using a crystal for a detector, a standard tube is used, and the output of the Tuned Impedance tube is fed into two stages of the ordinary untuned radio frequency amplification. This comprises a receiver which is almost the utmost in sensitivity. The antenna for use in connection with this set may consist of about 20 feet of No. 18 paraffined bell-wire. It may be found necessary to insert a leak of about one and one-half megohms between the grid of the second tube and its positive filament leg to prevent the tube from blocking.

WE have had many requests from our readers for the Harkness Two-tube Reflex Circuit shown in figure 2. The antenna tuning coil consists of 15 turns of No. 28 DSC wire wound on top of the secondary coil which is wound with 40 turns of the same wire. A piece of 2½" cardboard tubing will suffice as a form for these windings. The Radio Frequency transformer is wound on a similar piece of tubing, the primary having 35 turns instead of 15 and the secondary 40 turns. The circuits are tuned by means of two 23-plate .0005 mfd. variable condensers. The condenser across the secondary of the first audio frequency transformer is a .0005 mfd. fixed.

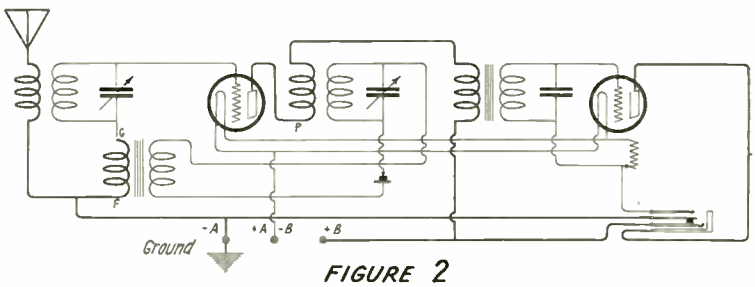


FIGURE 2

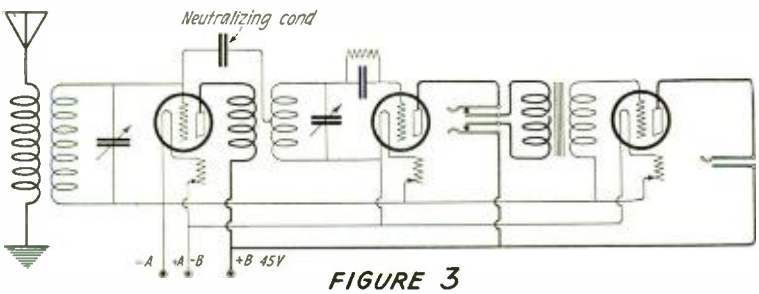


FIGURE 3

FIGURE 3 shows a corking three-tube set along the lines of a neutrodyne, in fact it really is a "one-horse" neutrodyne using just one tuned radio stage with neutralizing condenser, instead of the more common two stage. The two radio frequency transformers consist of 15 turns of No. 22 DCC wound on a 3" form and about ⅜" from this another winding of 50 turns more. In each case the larger winding is shunted by a 23-plate variable condenser and tunes the grid circuit.

IN figure 4 there is shown the hook-up for a very simple regenerative receiver using a detector and one stage of audio frequency amplification. There are only two tuning controls; the secondary condenser and the plate tickler. The tuning unit may be made by removing about 10 turns from the primary of a standard 180° variocoupler and winding in their place about 6 turns of No. 22 DCC wire. This winding forms the primary circuit while the winding from which the 10 turns were removed forms the secondary coil. The rotor of the variocoupler is then used as a tickler coil. This set tunes much more sharply than the old "single circuit" and is every bit as easy to construct. The tuning condenser across the secondary is a 23-plate .0005 mfd. variable.

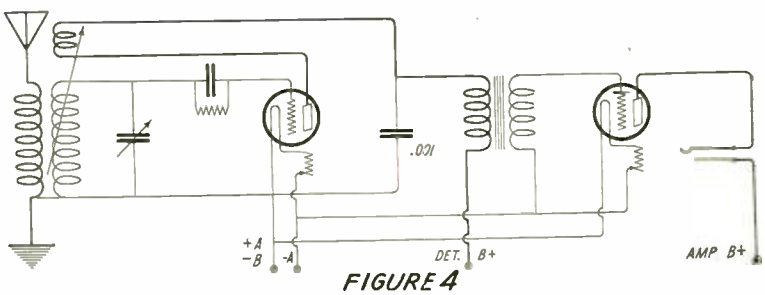


FIGURE 4

NEW APPLIANCES AND DEVICES

K. E. Loud Speaker

THE Kirkman Engineering Corporation, New York City, manufacturers for 10 years of the K. E. line of electrical protective and wiring devices, announces the perfection of a new design radio loud speaker.

Dealers, jobbers, and radio experts declare it unusually faithful in sound reproduction.

"Knowing the limitations of acoustical laws," says a well known New York dealer, "I would unhesitatingly agree that the K. E. Loud Speaker has secured perfection in volume and clarity as far as is humanly possible."

No batteries are used with the K. E. Loud Speaker. An adjustable diaphragm controls the volume and eliminates distortion. The 14-inch bell horn is finished in handsome black crystalline and nickel. The Alpha Electric Company of 151 West 30th Street, New York City, is the distributor of the New York district. The price is $25.00 list.

Mozart Baby Grand Reproducer

THE Mozart-Grand Co. of Newark, N. J., announce the production of a complete line of Mozart Baby Grand, Mozart-Grand and Mozart Concert Grand "reproducers." Shipments have commenced on the Baby Grand.

While instruments of the reflex type, broadly speaking, are not new, the design is entirely original and has been developed with a technical and practical care, probably never previously bestowed on this class of merchandise. Its extraordinary reproducing qualities, its extremely low center of gravity, with resultant steadiness and its general beauty of outline guarantee it a worthy place among all that is superlative in radio necessities today.

The design is certainly original insofar as placing the electrical unit in such an accessible position. The best of these units, like any other piece of delicate mechanism, may require attention at times and if they have to be sent back to their manufacturers, why should it be necessary to return the whole horn or even a heavy and bulky base?

The color scheme is black and gold. The unit and other fittings are heavily gold plated, the combination resulting in a charming effect which will harmonize perfectly with any furnishings from the simplest to the most pretentious.

The dimensions, of the Mozart Baby Grand are: diameter of bell, 12"; height overall, 12½"; length overall, 12½". Price complete with unit and cord, ready for attaching, $10.00.

New Dial Has Ribs for Grip

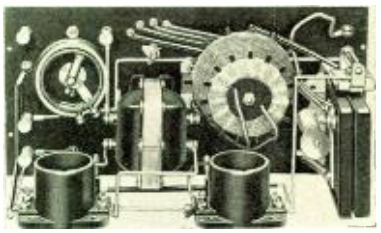
AN innovation in Radion dials has appeared in the form of a dial having a ribbed surface. They are made in black and mahoganite with gold graduations in three and four-inch diameters. The ribs radiate from the knob nearly to the beveled edge and provide easy rests for the fingers when delicate tuning is necessary. A vernier effect is thus obtained, and a very small

motion of the dial may be secured with a considerable movement of the finger tip placed near the periphery.

This dial is equipped, as are other Radion dials, with a semi-circular slot in the back which corresponds to the scale indications and fits a stop peg in the panel, thus preventing damage to internal rotor leads and limiting the dial movement to the semi-circular scale. The metal insert is made to fit a one-fourth-inch shaft, but there is a removable sleeve which may be inserted for use with a three-sixteenth-inch shaft.

New Crosley Two-Tube Receiver

THE New Crosley Model 51 incorporating a tuning element of the Model V receiver, used by Leonard Weeks of Minot, N. D., in his consistent handling of traffic with MacMillan's expedition at the North Pole, has met with instantaneous success since it was first placed in the hands of distributors by The Crosley Radio Corporation. This new set sells for $18.50 and consists of a detector using the genuine Armstrong regenerative tuning and detector circuit, with the addition of one stage of audio-frequency amplification. This makes it possible to use a loud speaker upon local stations or with stations that have exceptionally high power transmitters. One Multistat takes care of both filament voltages in the two tubes used. Provision is made for a "C" battery and a grid leak if the owner desires to use them. A two-step audio frequency amplifier may be used in connection with this set.



Reports have already been received from owners of this new set, one man having received 68 stations, including some on a loud speaker. This little set is built in a handsome mahogany cabinet and makes an ideal receiver for placing in the living room or any other part of the home. Its operation is so simple that children can use it with ease and any type of vacuum tube may be used with good results.

F-F Battery Charger

INCREASING interest has been displayed lately in the type A. B. F-F charger manufactured by the France Mfg. Co. of Cleveland, Ohio.

This charger incorporates all the features that have made the type 6 charger so popular, and embodies new and exclusive refinements that are of interest to the user of the storage battery.

The type A. B. charger charges 2-4-6-volt radio "A" batteries. 6-volt auto batteries and "B" batteries from 20 to 120 volts; therefore it is rightly called the triple duty charger.

Some distinctive features of the F-F chargers are: Carbon to carbon contactors that cannot burn or stick; a high charging rate that tapers down as the requirements diminish; acts independently of battery, therefore it will charge a dead battery.

The new bulletin of the France Mfg. Co. containing information on battery maintenance, station calls and wiring diagrams for basement installation of batteries is just off

the press and can be had by sending a postal to the above company at 10360 Berea Rd., Cleveland.

Sherman Wire Fittings

Assortment number three of the Sherman Wire Fittings for Radio, manufactured by the H. B. Sherman Mfg. Co., Battle Creek,

Mich., contains small terminals for use in building radio sets and labor-saving wire fittings for installing them.

It includes genuine Sherman Fixture Connectors, the famous device by which strong, safe connections between wires can be instantly made without soldering.

The workmanship and material of this line are the very best. Articles included are those which wide experience and active participation in radio development have proven practical and popular.

New York Condensers

THE New York Coil Company have developed a line of 23 and 43-plate condensers of both vernier and standard types. Possessed of high electrical qualities, they are of metal frame construction with genu-

ine bakelite insulation. The plates are of heavy hard aluminum with wide spacing and the contact is of the spring type.

They have adjustable cone bearings to take up wear and knobs and dials are furnished with the vernier type.

INDUSTRIAL INKLINGS

THROUGH an agreement just signed between the Radio Corporation of America and the Brunswick-Balke-Collender Company, phonograph manufacturers, millions of radio fans throughout the United States will receive for the first time, operatic and musical programs rendered by famous artists whose services have hitherto not been available to broadcast companies. Under the contract recently concluded, the phonograph company gains the right to install radio receiving sets in combination with Brunswick phonographs. In turn the phonograph company will add its share to the public service now rendered by the principal broadcast stations and aid the development of free broadcasting to the public, by permitting the stations of the Radio Corporation of America and those of its associates to broadcast during the periods when its artists are recording for phonograph reproduction and to encourage artists to aid the program at other times as well. Another interesting provision in the contract places at the disposal of each company, the technical and research facilities as developed by the other, so that the experiences of both industries may be available in the development of the art in the future.

THE Buffalo Forge Company manufacture the Junior Bench Drill. The features which have made it adaptable to radio parts manufacturing is the fact that the spindle can be driven at 3,000 r.p.m., and still remain in perfect balance. The drill has a substantial cast iron frame and a round table mounted on a substantial support. It is regularly supplied with a No. 2-A Jacobs chuck. The construction is of the latest design and may be either pulley or direct motor driven.

THE American Hard Rubber Company, New York City, send out regularly publicity by Brainard Foote, their radio engineer, which is of an excellent character.

CHARLES H. LEHMAN has resigned as President and General Manager of the Dictograph Products Company. Mr. Lehman was the founder of this organization and under his active management the company has developed from a small beginning into an international organization with world-wide distribution. Mr. Lehman has been interested in the radio field since the early days of the industry, and his genius as an executive has been recognized as an important factor in the upbuilding and stabilization of the radio industry. He has also been prominently identified with several other industries and is a director of the Falls Motor Company and of the Kookwik Products Corporation.

Mr. Lehman has not as yet announced his future plans, but it is understood that he is to head a very large radio organization now being incorporated for development and manufacturing purposes.

His successor in the Dictograph Corporation has not yet been selected.

ALDEN MANUFACTURING CO., Springfield, Mass., have devised a unique method of publicity in circular letters to the trade which embody information of a pertinent sort. These letters are so constructed that they can easily be made into an article by editors of publications.

THE Manhattan Electrical Supply Company, Inc., New York City, have a window display on Red Seal Dry Batteries which cleverly portrays their use in radio rather than the article itself as an individual unit.

MR. H. T. GREELEY has been appointed Advertising Manager of the General Radio Company of Cambridge, Mass. Mr. Greeley was a member of the class of 1919, Dartmouth College, and was formerly of the advertising staff of the Winchester Repeating Arms Co. of New Haven, Conn.

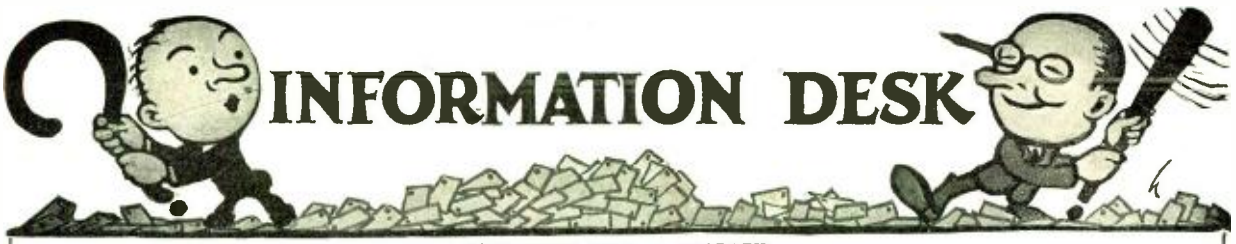
The General Radio Company of Cambridge, Mass., have purchased 20,000 feet of land adjacent to their present factory and will start construction at once on a four-story concrete building. This new unit will have the same capacity as their present building, thus doubling their present facilities.

THE Mica Insulator Company, 68 Church St., New York City, has had an election of officers.

Mr. L. W. Kingsley becomes chairman of the Board, Mr. Edward T. Wood, becomes President, Mr. Edward Nelson becomes Secretary and Treasurer.

These gentlemen have for a very long time been identified with the Mica Insulator Company. This company has been one of the pioneer developers of insulation products for almost all electrical application. Many of their products having been employed for thirty years in the electrical industry. Some of their better known trade-mark brands include Micanite, Armatite, Empire, Conducell, etc.

THE Shaw Insulator Company of Newark, New Jersey, report the appointment of Benjamin Phillips as their Cleveland District Sales Manager, with offices in the Stuyvesant Building, 3030 Euclid Ave., Cleveland, Ohio.

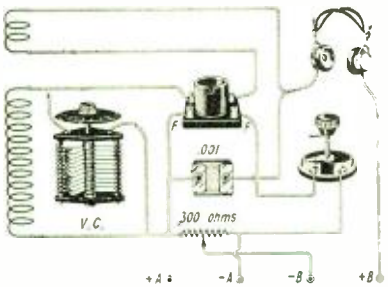


CONDUCTED BY R. A. BRADLEY

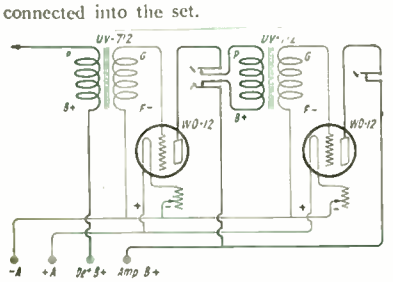
Due to the great volume of correspondence which this department entails we are forced to remind our readers on the following points: Be sure to enclose a self-addressed stamped envelope with your letter. Make your questions clear and concise. If you wish information on your set please enclose a rough sketch or hook-up if possible. Do not ask us to make comparisons between different makes of apparatus or sets.

Detector Tubes

Mr. J. H. Warden of New York City has been having a great deal of trouble with his detector tube, a UV-200. He says, "When I have a station tuned in and then attempt to bring it up in volume by turning up the plate variometer, the tube flops over into oscillation. When I turn the variometer back again, then, the station goes completely out."



Mr. Warden, you have, in the UV-200, the most sensitive detector tube in existence, but also the most critical and hardest to humor. A UV-200 is a good test for a man's self control. It is critical in plate voltage using anywhere between 16½ and 22½ volts. The proper voltage can only be discovered by experimenting. The filament voltage is almost as critical, requiring generally, less than five volts. A vernier rheostat of some description can be used to good advantage in controlling this. Now the way to get the most out of a UV-200 or any "soft" detector tube is to use a good potentiometer across the "A" battery to control the B-battery voltage. This also acts as a sort of vernier adjustment in controlling regeneration and is the secret to DX reception in a regenerative receiver. The circuit in figure 2 shows how this is connected into the set.



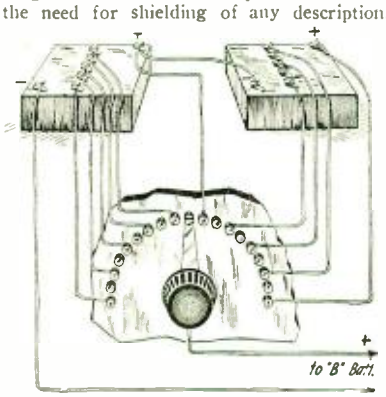
Two-Step Amplifier

Mr. B. H. Law of Reading, Pa., requires a hook-up for 2 UV-712 R.C.A. audio frequency transformers in connection with 2 WD-12's. Below is shown the hook-up for a two-stage amplifier using these instruments.

"B" Battery Control and Shielding

"I want to apply a switch to control my B batteries of which I have two 45-volt units. I would like to use a tapped voltage from 45 to 90. Also I would like to know if I would profit any by shielding the back of each variable condenser dial with a thin sheeting of copper. Should this be grounded to the axis of the condenser?" Signed, A. F. Berkley, Cincinnati, Ohio.

The diagram for using a switch to regulated your B battery voltage is shown below. The purpose of the "dead" contacts between the "live" contacts is to prevent shorting the cells of the battery in case the switch is left touching two adjacent contacts. Answering your second question, if in connecting up your variable condenser in the circuit, you connect the rotor plates to the ground or filament side of the circuit and the stator plates to the high potential or grid side of the circuit you will obviate the need for shielding of any description.



If it is variometers that are giving you the trouble then it will be necessary to shield. In any case do not allow the shielding to come in contact with any metal part of the instrument. Any attempt at shielding the dial of the instrument, itself will be entirely unsatisfactory.

Harkness Reflex Circuit

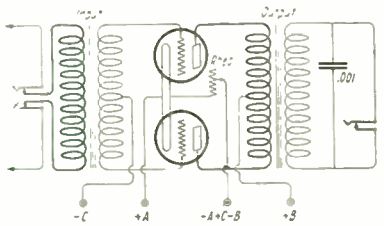
Mr. Harvey G. Rice of Burke, Va., asks for the diagram of the Harkness Reflex Circuit Receiver. The diagram for this set is shown on our page of circuits in this issue.

Three Circuit Regenerative Receiver

Mr. Henry L. Galson writes, "I want to thank you for the answer to my inquiry about my three circuit regenerative receiver. I have no trouble in getting distant stations. KDKA I have every evening and KFKX quite as regularly on my one tube set. This proves the quality of information given out by your magazine, which I am recommending to my friends."

Push-Pull Amplifier

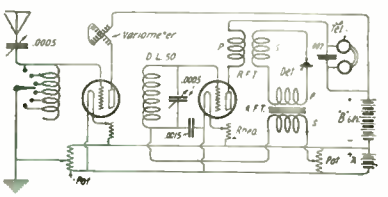
I have read much about "Push-Pull" amplification and I would like to add a step of it to my present two-stage amplifier. But I do not know how to hook it up. Will you please send me a diagram for one stage of push-pull to be added to an ordinary home made set. Thus writes Mr. J. A. Ramsey of New Orleans, La.



The hook-up for this amplifier is shown below. The outstanding features of push-pull amplification are increased volume, clearness of reproduction and elimination of distortion, although distortion already present in the straight audio amplifier will be quite as much in evidence in the push-pull stage. Although all tubes lend themselves well to this type of amplifier the UV-201A and the 216A serve the best. In the February issue of THE WIRELESS AGE there was given a very fine treatise on push-pull amplification, including among other things hints on the use of the ordinary audio frequency transformer in such an amplifier.

Improved Reflex Set

Below is shown a diagram for connecting up an "Improved Reflex Set" published in



the May, 1923, issue of THE WIRELESS AGE, for which Mr. M. A. Robinson of Washington, D. C., asks. This set can be made up from parts usually found around the experimenter's laboratory or workbench. The antenna tuning inductance consists of fifty turns of No. 24 D.C.C. wire tapped every ten or twelve turns.

(*Continued on page 86*)

Amplifiers

(*Continued from page 37*)

where L is the inductance, C the capacity, and R the resistance of the tuned plate circuit. If a curve is taken of the amplification which this system gives at different frequencies it will have the appearance of figure 6. From this curve it is seen that maximum amplification occurs at the fundamental frequency of the tuned circuit, and that for other frequencies on either side of the fundamental the amplification falls off very rapidly. Consequently such an amplifier differs from those previously discussed in that it is a selective amplifier. The more selective the amplifier is the greater will be the amplification at the particular frequency to which it is tuned, and the less the amplification at other frequencies. Consequently such an amplifier involves to some extent a so-called critical adjustment. This is what makes tuned radio frequency amplifiers so difficult to get working right, as all amateurs know by now.

Let us see what conditions determine the selectivity of the amplifier. The main factor determining the selectivity of the amplifier is the sharpness of tuning of the radio frequency circuit LRC in the plate circuit. As the resistance R of the coil decreases the decrement or damping of the circuit likewise decreases. The condenser tuning will then become finer and more critical, the result being great selectivity with high amplification at the natural frequency of the circuit, and relatively less amplification at other frequencies. But a low coil resistance means that the tuned circuit is a very efficient circuit, since the resistance losses are low. Hence we see that an efficiently tuned circuit will make a highly selective amplifying circuit.

Furthermore from equation (1) which gives the effective resistance of the tuned circuit, we see that the effective resistance is directly proportional to the ratio L/C. The higher the ratio L/C the greater is the effective resistance, and therefore the greater the damping. The greater damping results in broader tuning and therefore gives a less selective amplifier. Thus to maintain a highly selective amplifier the tuned circuit must be built so that the ratio of L/C is low; that is there must be low inductance and high capacity.

If amplification is desired on one wave length or over a very narrow band of wave lengths, this circuit has a great advantage in that other frequencies other than those at which amplification is desired are not amplified very much. For a highly selective tuned circuit amplifier, then, we see that the following conditions must be met. First the resistance of the in-

ductance coil L must be very low. Second the tuned circuit must be so designed that the ratio L/C is small, that is capacity must be predominant. If on the other hand a relatively non-selective tuned amplifier is desired, that is one which will amplify equally well on a wider band of wave lengths, then the following conditions must be met. First the resistance of the tuning coil should be high. Second the ratio L/C of the tuned circuit should be high, that is the inductance should predominate.

This system in amplifiers possesses very great importance. For while we have thus far considered the tuned circuit to be composed of a lumped inductance and a lumped capacity, it will shortly be seen that this need not necessarily be the case in order to have a tuned circuit. Thus we may have in high frequency amplification an apparent inductance amplifier, but which in reality is a tuned circuit amplifier owing to the distributed capacity acting as the tuning condenser. Thus inductance amplifiers may be very selective due to this reason. This same reasoning applies also to transformer coupled amplifiers.

The Theater in Radio

(*Continued from page 24*)

imagine herself talking into a telephone. Whereupon, she discoursed with seeming eloquence on the subject of Douglas, and was nearly through her compliment when her hand trembled and she quoth, "Dear me, I am terribly nervous." Forthwith, she regained her confidence, as her secret was out and nothing of great consequence came of it.

Then Douglas, none the worse for microphone fright, did speak most gallantly on the subject of Mistress Mary, he becoming so enthusiastic he half arose from his chair and gesticulated in such fine fashion I did regret his pantomine could not be broadcast. Nor was I at an end to my envy, having seen him in person, for I bethought me of the furnishings I had wrecked in my home, so incompetent am I in the matter of leaping about, and I have been at great pains to match his sprightly conduct.

A bank of seven cameras faced them before they had finished broadcasting which did suit their notion of how to finish off in great style, and I was in particular impressed with their patience, of which I have small store, they posing for near fifty minutes. Great numbers of pictures were made and I secretly praying that some plague smite all photographers. Mistress Mary doffed her hat, she acting in accord with a protest that any of her face could register over well and I was struck in especial with the mar-

veil of her hair which was a golden corn yellow in color, and I bethought me what a pity it was that films prove so inadequate in the matter of portraying such beauty. Whereupon I was at pains to converse with Mistress Mary and Douglas on the limits of the cinema, but he put me at score straights on the problem of broadcasting even the approximate results achieved in the silent drama. Nor had I recourse to aught than speculation on the possibilities in the public prints which I deemed could furnish pictures of the cast and such scenes as would illustrate what play was broadcast. To which he acquiesced lustily enough, pointing out that such methods were sufficient for radio plays, but did flout me on the score that musical comedies are of a character which the public prints and radio do enhance, and I was reminded of my inclination to go straightway for tickets after I had listened in on those that were transmitted from the stage. And he did convince me finally.

Mistress Mary, attentive betimes, bespoke me seriously for being such a dullard, she telling me that her radio discourse on "The Thief of Bagdad," which Douglas was at some length to produce, would so arouse curiosity that the Liberty Theater would scarce hold the crowds. And Douglas quoth that he likewise had told the radio audience of such episodes that were of interest concerning Mary's new picture, "Dorothy Vernon of Haddon Hall," and he deemed the seating capacity of the Criterion Theater would be, forsooth, scant enough.

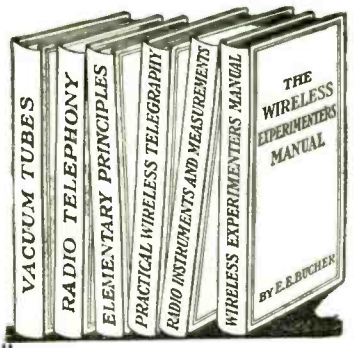
I did learn that neither had been unduly liberal in their estimate of radio for I had great difficulty to purchase even standing room, but I was not at any great pains to endure no seat at all as I found both shows to my liking, the more for having learned of things that did not appear on the screen.

* * *

After some reflection, I did decide that radio provides me with more pleasure than ever I thought was possible in this day of costly entertainments. The theater in radio means that I may twirl the dials of my receiver in quest of a good show and trust to none other than my own best judgment. Dramatic criticisms and the council of my friends have cost me dearly, for no one, save myself, can know what show I like best. And I have likewise been a victim to great inconvenience because of my suburban residence.

In truth, the twirling of the dials on my radio will now be a pastime in which I may overindulge with impunity.

The theater has, indeed, come to radio for its broadcast blessing. And I do believe I am, myself, blessed for that.



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How to Pass U. S. Government Wireless Exams.	E. E. Bucher	.75	10
How to Conduct a Radio Club	E. E. Bucher	.75	10
Alexanderson System	E. E. Bucher	1.25	18
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Acquiring the Code	Gordon	.50	6
Practical Aviation	J. A. White	2.25	30
Prepared Radio Measurements	Batcher	2.00	30
Modern Radio Operation	J. O. Smith	1.75	26
Radio Inst. and Measurements	Bureau of Standards	1.75	26
The Oscillation Valve	Bangay	2.75	40
Elementary Principles of Wireless—Part 1	Bangay	1.75	25
Standard Tables and Equations	Hoyle	3.25	50
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Technical Instruction for Wireless Telegraphists	Hawkshead and Dowsett	3.50	55
Elgie's Weather Book	Elgie	2.00	20

BOOK	AUTHOR	Regular Price	Class No.
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1923 Year Book of Wireless Tel. & Tel. (Paper)		2.50	30
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Short-Wave Receiver

(*Continued from page 59*)

the entire range excepting at about 145 meters where careful adjustment is necessary. The tube oscillates very readily at 100 meters.

Now in order to change this receiver so that it will cover the broadcasting wavelength range it is only necessary to add a few turns of wire on the two coils. The antenna circuit (L_1) instead of having 3 turns should have 6 turns of wire. The secondary coil (L_2) is a continuation of L_1 and should be wound with 40 turns instead of 15. The tickler coil should have about 20 turns and if the whole receiver is made with great care and according to these instructions even less turns may be used.

[A set embodying these changes was built in our laboratories and has been used with great success in receiving distant broadcasting stations, proving unquestionably superior to another set of reliable manufacture which embodied three stages of radio frequency amplification. — EDITOR'S NOTE.]

Afloat and Ashore With the Operators

(*Continued from page 49*)

and will be remembered as one of the heroes of the *Monroe* disaster in 1913, in which his partner, Frederick J. Kuehn, lost his life after giving his life belt to a woman passenger. Etheridge is now on the Standard Oil tank steamer *Baton Rouge*.

Harold Hatton, now on the steamer *I. C. White*, was a well known ship operator running out of New York twelve years ago.

Eugene O. Lemieux, now on the Canadian steamer *Ormes*, but running between New York and the West Indies, received his first assignment on an American ship in September, 1907.

Emanuel J. Marschall was assigned to a passenger ship twelve years ago. He is now senior on the Red D Liner *Maracaibo*.

Frederick W. Harper, operator on the *Hahira*, has been a radio man since April, 1912.

M. B. G. Rabbitts has traveled to all points of the globe during his thirteen years' continuous radio service and is now on the tanker *Standard*.

E. W. Rogers started as a radio operator in June, 1909, and has had many experiences during the past fifteen years, the most peculiar of which was when he read his own death notice in the newspapers following his return from a voyage to South Africa on a

sailing vessel during the war. He left New York at the time the German submarines were along the American coast and in a storm the first day out his wireless equipment was demolished, and a life boat was lost. The finding of the life boat and the fact of no word being received from the vessel seemed to furnish proof that she had been torpedoed and sunk with all hands. Rogers is a big man physically, has a big deep voice, a big heart and a big knowledge of radio operating. He is well thought of by his co-workers. He is now on the *Winona*.

Charles L. Fagan, who has been senior operator on the Grace Liner *Santa Elisa* for the past two years with no thought of a change, is rounding out his twelfth year as an exclusive passenger ship operator, this record being broken only by about six months spent as a railroad operator in 1918, but on leave of absence from his employers.

Charles E. Stevens on the *Santa Cecilia* has seen more than a decade of years go by while serving as a ship wireless operator; George Kavanagh, senior on the *City of Birmingham*, about as many, and C. S. Thevenet, senior on the *City of Chattanooga*, about twelve, the most of which has been on the Savannah Line, with the exception of his service as a naval radio operator during the war.

Carl L. Jones is another old-timer and has run on ships under six different flags in the past nine years. He is now on the tanker *Joseph Seep*.

These men represent the pioneers of the Atlantic coast who are still radio operators aboard ships in active duty. It is to be regretted that the presentation could not be completed by photographs of all. If there is a pioneer whose name should have been mentioned and is not, we would be glad to hear of him.

One Tube Reflex

(*Continued from page 55*)

the amplifier tube was useful as a socket for the R.F. transformer, and only my grid leak and one rheostat were left over. It worked 100 per cent. as soon as the last connection was made.

On local stuff it gave volume enough for one room; its distance range was approximately the same as for the ultra-audion; it was practically as easy to tune as the ultra-audion—especially when using the WD-11 tube; but the quality of reproduction, particularly on distant stations, was far superior to that of any regenerative set.

Further experimentation has led to standardizing the single-tube reflex

shown in figure 2 as the most satisfactory type.

In place of the wooden variometer shown there may be used instead, a tapped tube-wound coil, a fixed coil, a honey-comb coil or an Estru variometer, but the results will be not quite as good. The All-American audio transformer and Acme A-2 transformer have been found to give about equally good results. The All-American radio transformer and the Acme R-2 have been tried, and function about equally well. Several types of potentiometers have been tried and .001 fixed condensers have been used instead of the .002 and .0025 shown. Perhaps it is a matter of personal preference, but I use All-American audio and radio transformers, a Fada 400-ohm potentiometer and any good variometer, while the fixed condensers are usually Micadons of the value indicated. The thing which makes this circuit unusual is the fact that almost any sort of apparatus may be used with good results and none of the values are critical.

TUNING THE SET

In tuning, I usually set the variable condenser with the plates one-quarter to one-third in, then leave it alone, except as the vernier blade is used for very fine adjustment. Practically all tuning is done on the variometer and if the condenser is left alone in a certain setting the variometer dial may be calibrated very closely to wave length readings, or a station may be identified by the variometer reading.

The potentiometer is most useful on distance work. Thus it will be found that one extreme position gives maximum oscillation and volume and the other extreme position gives minimum oscillation and volume. For the long wave lengths the potentiometer is set for greater oscillation, and this is also true for stations of less than 360 meters. As the wave length decreases from 500 meters to 360 meters the potentiometer must be moved toward the "low" end, as otherwise the excessive oscillations will produce howling and whistling. On local stuff the potentiometer is not very critical, but on distance it is very important. When using a WD-11 or WD-12 tube the potentiometer may almost be disregarded.

The type of crystal is not very important, and a fixed crystal—Grewol, Erla or "B" metal—is usually used. I prefer the Grewol. Any sort of crystal may however be used, for all you need is some species of rectification.

A 2-TUBE SET WILL GIVE LOUD-SPEAKER VOLUME

Then if you want real volume on this set, just hook on one stage of amplification. Local stuff will come in

loud enough to fill the house and distance will usually loud-speak sufficiently to fill a room. Also the amplified signals will be remarkably clear and undistorted, especially if you place a .0005 fixed condenser across the secondary of the amplifying transformer. Without this you may experience a thin, shrill whistle. Common "A" and "B" batteries may be used, but I prefer separate "B" batteries, placing from 125 to 150 volts on the amplifier plate. either with or without a "C" battery. Of course, use a 201-A tube in the amplifier as well as in the set. for best and loudest results.

If you add the amplifier unit you now have a 2-tube set. and you can plug into either the first or second tube, just as with a regenerative circuit. For headphone work you will seldom plug into the second tube, because on local reception it would buckle the phone diaphragms and also your ear drums. For distance work on head phones you may occasionally use the second tube. Primarily however the second tube is for loud speaking.

Now you will want to know what you can expect from this circuit. I am using a single wire aerial about 40 feet high, 75 feet long, with about 35 feet of lead-in. The map shows the stations received during the first nine days of November, on the single tube. on headphones. Of these stations I have tested only a few for loud speaking on the second tube. However, very good volume in one room was obtained on the following:

KDKA—Pittsburgh	WOAW—Omaha
WLW —Cincinnati	WDAF —Kansas City
WGR —Buffalo	WHB —Kansas City
WOS —Jefferson City, Mo.	WFAA —Dallas
	KFKB —Kansas
KSD —St. Louis	

It is my belief that the set will loud-speak on the second tube any station it gets clearly on the first tube. Thus KHJ, Los Angeles, was audible three feet from the phones, on the first tube, while WDAF, WHB, KDKA and WFAA are often audible all over the room on the first tube.

By way of experiment a bed has been used as an aerial, bringing in practically the same stations as on the outside aerial, but with less volume. This is in a first-floor apartment. On ten or fifteen feet of wire as an aerial, all of the local stations will loud-speak on the second tube, and several outside stations were received clearly. The set has received Cincinnati without ground or aerial; operates beautifully on distance without any ground; will always bring in ten to fifteen outside stations in the course of an evening while there are from one to three local stations on; and on a silent night captured just 30 outside stations, one being KFEL—Denver—and one being KFI—Los Angeles.

I almost forgot to say that in spite of its single-circuit tuning it is fairly selective, especially so when operating without a ground; that it picks up practically no static, operating very nicely during a rainstorm; and that it will not re-radiate, even to another set a few inches away. Now what more could a person demand from a radio set? Nothing, probably; yet because a radio nut is always nutty, I'm experimenting with the addition of one tube of straight radio frequency. If it works I suppose I'll receive London or Honolulu!

Your Future as a Radio Engineer

(*Continued from page 57*)

with it you can expect big things of yourself.

When you are turning over in your mind the question of college training you may feel that you'd like to take a short cut, to save all or part of those six years by going to work at once in the laboratory of one of the radio companies. To be sure, that has been done, although men who are listed among the few successful engineers, whether in radio or other branches, are almost without exception college graduates. And if you ask the man who has won through entirely on his own, he will tell you that his was the long road, not the short one. That doesn't mean, either, that the degree makes the engineer, for men of the same age, with or without university training, can start on equal footing. It is in the ability to handle unusual problems, special jobs, that both the technical as well as the social background of college shows up. Not so long ago an exceptionally promising self-trained engineer was invited to the home of an executive who intended to discuss with him the possibility of taking charge of important work abroad, an undertaking which involved contact with various government officials. But the work wasn't even mentioned after all. Why? Because he ate with his knife and drank his coffee with his spoon in the cup! That is not a story to illustrate a point. It actually happened in New York City.

Take a few moments to look over the careers of the radio engineers whose names come quickly to your mind. You know of Ernest Alexanderson because he is Chief Consulting Engineer for the Radio Corporation of America, and because he invented the Alexanderson alternator, employed in all the trans-oceanic radio stations. He is a graduate of the University of Lund and the Royal Institute of Technology, Sweden, after which he took a post-graduate course in Berlin.

Dr. Pupin has written a fascinating story, "From Immigrant to Inventor."

of his career, the kind of a book which is a real inspiration to every young chap who is looking to the experiences of others as a guide for his own plans. Not only did Dr. Pupin graduate from Columbia University, but he studied at Cambridge and Berlin. He has devoted his life to educational work—he is Director of the Research Laboratory at Columbia—but his inventions and consulting practice have brought him far greater monetary returns than his salary as a professor.

Somewhat similar has been the work of Dr. Pickard. He was educated at Lawrence Scientific School, Harvard, and Massachusetts Institute of Technology. When he was twenty-two years old he took up radio research work under a grant from the Smithsonian Institute. For a number of years he has been associated with the Wireless Specialty Company, although he has a considerable practice as a consulting engineer and patent expert.

No story of radio development could be told without giving John V. L. Hogan a place in every chapter, particularly at the present time, when we are learning the full significance of the heterodyne in radio reception. A graduate of Scientific School of Yale University, where he specialized on mathematics and physics, he has served both as a research worker and a practical engineer with Dr. de Forest in the development of the audion, and the radio telephone, with Fessenden at Brant Rock, on alternators and heterodyne reception, as manager of the International Radio Company, and now as consulting engineer to Westinghouse and as a patent expert.

Dr. de Forest, whose record needs no reciting here, did his first work on the audion while he was acting as instructor after he had completed his college courses. He gave up that work to form the original de Forest Wireless Telegraph Company. Major Armstrong, on the other hand, is still a professor at Columbia, from which college he was graduated, for he has licensed manufacturers to use his inventions, instead of undertaking to operate his own company, as Dr. de Forest did. Major Armstrong, by the way, is the youngest of the first rank radio engineers. I hope he will not object to the disclosure of his birthday date, which was December 18th, 1890.

The careers of Dr. Goldsmith, Dr. Fessenden, John Hays Hammond, Jr., Dr. Kolster, Alexander Reoch, Major-General Squier, and Dr. Kennelly are all built upon years of university work, training that has provided them with great stores of scientific understanding. No, you can't argue yourself away from college without proving that you will be satisfied to accomplish less than these men have done.

Information Desk

(*Continued from page 67*)

More About the Wireless Age Three-Tube Set

Many of our readers have written us, asking what the two binding posts between the Bradleystat and the grid variometer dial were for on THE WIRELESS AGE Three-Tube Set described in the March issue. As we mentioned in the article these two posts were to be connected to an external crystal detector mounted anywhere convenient, on the table or stand on which the set is placed, or on the wall, or some place free from vibration and out of the way, and at the same time in a position where it can be easily adjusted for best sensitivity. Crystal detectors mounted in a set, or on a panel are often awkward to adjust. The leads from these two binding posts run to the plate of the radio frequency tube and the B plus post of the first audio frequency transformer.

In experimenting with this receiver several types of crystal detectors were employed and the best and most consistent results were obtained with a compression zincite-bornite crystal that seemed incapable of misbehaving in the matter of adjustment. This crystal detector was made by the Westinghouse Electric & Mfg. Co., for the Radio Corporation of America for use in their sets, and proved to be just the thing for our purpose.

Many also wrote in about the two binding posts for the antenna. The diagram shown in connection with the article showed clearly how they were used. But it is evident that the explanation could have been made more clear. Just beneath the two binding posts marked "Antenna" are two small Micadon fixed condensers, one a .00025 mfd. and the other a .0001 mfd. These two condensers act as compensators for antennae of various lengths. After the set is connected up, the antenna lead-in should be brought to one of the two antenna binding posts and several stations tuned in. After noting the call letters of the stations, their approximate wavelength and position on the left hand dial, then disconnect the antenna lead-in from this binding post and connect it to the other and execute the same performance. Note which post gives the more desirable tuning range and stronger signal strength. Then use that connection. Bear in mind, however, that only one is to be used and that one is to be determined by the above method.

This receiver can be made a most satisfactory portable receiver for taking along on vacations, motor trips or on the yacht. Of course for the UV-201A's the dry cell tube UV-199 can be substituted. This receiver was tried out in our laboratory, using approximately 25 feet of No. 18 paraffined cotton-covered bell wire as the only antenna. WDAP and KDKA were brought in with loud-speaker intensity at six o'clock in the evening. The UV-199 tubes should be mounted on some sort of shock-absorbing base. This will not only prevent microphonic effects, but also decrease the possibility of ruining the tube through excessive vibration or shock.

Mr. H. E. Carter of Shelbyville, O., writes, "I built the special three-tube set described in the March issue and I was very much pleased with the results. I find it much more sensitive than any three-tube regenerative receiver I have ever tried. I won-

dered if I couldn't feed the output of the tune impedance radio frequency amplifier into, say, two stages of ordinary untuned radio frequency amplification. This, it seems to me, would make a very sensitive receiver, judging from the results that I have already obtained.

Fine! Mr. Carter. You took the very words right out of our mouth. A circuit hook-up for this scheme is shown on the special page of circuits in this issue. In this combination, the first stage of radio frequency is tuned—grid and plate—to the exact frequency of the incoming signal and the greatly increased signal voltage impressed across the terminals of an ordinary untuned radio frequency transformer and amplified in that fashion through another stage of radio. This puts an enormous signal voltage on whatever is used as a rectifier. A crystal detector in such a set would be shortly rendered useless, through burn-out or absolute loss of sensitivity. A hard tube detector such as the UV-199 or UV-201A should be used for best results.

A DX Receiver

Mr. B. J. Gregory of Lewistown, Pa., asks for the hook-up of a receiver with which he can tune in San Francisco and Los Angeles on the loud speaker.

Mr. Gregory, you really want an awful lot. Nothing short of a Super-heterodyne receiver will do this consistently.

Crystal Detector Must Make Contact

Mr. Jacob Arnfeldt of New York City has constructed THE WIRELESS AGE *Special Three-Tube Receiver described in the March issue, and reports very faint signals. He is using a fixed crystal detector.*

From our own experience, we should say that this crystal has been probably jarred from contact on a sensitive spot. If it is possible to adjust this contact by all means do so. If not, better purchase a good adjustable contact detector. When the crystal detector in this circuit does not make contact, the plate circuit of the first tube is opened and no signals are heard.

Dry Cell "A" and "B" Batteries

Mr. Iverson Nelson of San Francisco, Calif., wants to know what the difference is between dry cell "A" and "B" batteries and if it would be possible to make up a "B" battery out of a number of No. 6 dry cells.

The ordinary "B" battery really consists of a number of tiny dry cells (flashlight cells) connected in series to give the necessary voltage. Since the "B" battery does not have to supply as much current as the "A" battery it may be made much smaller. The "A" battery used with dry-cell tubes may be ordinary large size, No. 6 dry cells or in the case where a single UV-199 is used, flashlight cells. A very satisfactory "B" battery is made by connecting a number of No. 6 dry cells in series.

Two Tube Reflex

Mr. Howard Dreisbach of Peoria, Ill., wants a selective two-tube reflex hook-up.

This circuit is shown on the Circuit Page of this issue, together with necessary constructional data. He also would like to know the greatest length for an antenna to be used with this set. A single wire approximately 125 feet from the far end to the set, including all angles and bends, will probably best serve his purpose.

Can Build Set in Phonograph

Mr. Henry C. Hamilton of Westfield, N. J., wishes to construct a receiving set which can be installed in his phonograph and one that will give excellent tone quality.

If the Special Three-Tube Set described in the March issue of THE WIRELESS AGE had been specially designed for Mr. Hamilton, it could not better fulfill his needs. We recommend this receiver to him, knowing that it is ideal for his purposes. With this receiver we have used with very satisfactory results a 15-foot length of wire placed under the rug on the floor for an antenna. For best results, however, we recommend an antenna 125 feet long. Bare Number 14 copper wire should be used.

Convert into Three-Circuit Tuner

Mr. Herbert F. Evans of Wilkes-Barre, Pa., reports excellent results on a single-circuit "squealer" set and wants to know how to prevent annoying his neighbors without losing his present efficiency. He is using now a variocoupler and a variable condenser.

By purchasing a variometer of good make and inserting it in place of his present plate connections, and by connecting the rotor coil of the variocoupler to the grid and filament of his detector tube, he can convert his single circuit set into a three-circuit tuner. This, although it does not prevent oscillations from entering his antenna, will stop it to a great extent, if properly used.

Resistance-Coupled Amplifier

Mr. George Haynes of Hoosick Falls, N. Y., wishes to tell us that he has obtained excellent results with the four-tube resistance-coupled amplifier described in the December issue of THE WIRELESS AGE *by Mr. Abraham Ringel.*

Quoting his words, "It does everything the writer claims and far more. In addition to the most perfect and clear reception, he finds it possible to plug in several sets of headphones on the second and third stages without affecting the operation of the loud-speaker in the least." Note:—This can only be accomplished when using "single circuit jacks." Mr. Haynes used four UV-199 tubes instead of the UV-201A. He goes on to say that "THE WIRELESS AGE is the only publication I have ever been able to build a set according to their instructions, and have it work satisfactorily without subsequent alterations."

Aluminum Frames

Mr. M. Murphy of Belleville, Ontario, would like to obtain some of the Quinby Aluminum Frames used in constructing the One-tube Reflex Set described in the February issue of THE WIRELESS AGE.

They can be obtained from the Quinby Radio Construction Company, 587 West 181st street, New York City. Their ad appears in this issue.

Use UV-199 in "The Wireless Age" Reflex

Mr. A. Ford of Fitchburg, Mass., would like to build the one-tube reflex set described in the February issue of THE WIRELESS AGE *and would like to know if he can use a WD-12 tube in it.*

We would not recommend his doing so, as the WD-12 and WD-11 are made for use as radio frequency amplifiers. A UV-199 will probably work the best and a UV-201A will also give good results.

Stations Worked and Heard

2BXD—JOHN G. ARSICA, Newark, N. J. (March).

1adn, (1aqm), fone, 1axz, (1ayb), 1ayt, 1azr, 1bbh, 1bbp, (1bid), 1biz, 1boa, 1bth, 1bzp, 1cg, 1cit, 1cmx, 1fh, 1kc, 1ml, (1xu), 1zo, (1zt).

(4ab), 4ajs, 4bz, 4cd, 4er, (4ft), 4fz, 4hs, 4it, 4jr, 4ll, 4my, 4oa, (4og), 4pk, (4rr), (4sh), 4xc.

5abn, 5aeq, 5agn, (5aiu), 5ajb, 5alo, 5alv, (5amh), 5bm, 5cc, 5cg, 5ka, 5kr, 5lp, 5nw, 5pk, (5ql), (5rg), 5rh, 5ua, 5wk, (5xa).

6aao, (6adt), (6ahp), 6avj, 6bbr, (6bbc), (6bnt), 6cb, (6cdg), 6cgw, 6ck, 6cyw, 6gt, 6hi, 6jh, 6py, 6xad, 6dp.

7ads, (7co), 7ih, 7kz, 7xd.

(8aeg), (8aig), (8alx), 8aoi, 8aol, (8aon), (8aq), 8aqo, 8aaj, 8atr, 8avj, 8axi, 8axk, 8bay, 8bdv, 8bfz, (8bwk), 8bvr, 8bvv, 8cdi, 8cei, 8cej, 8cjd, 8ck, 8cke, 8cun, 8cur, 8cuu, (8cwp), (8cwu), (8dgp), 8dhp, 8dhq, 8dia, 8dii, 8dm, 8eb, 8hx, (8ii), fone, 8na, 8nf, (8qh), 8rj, 8tj, 8tt, 8tx, 8vn, 8xe, 8zc.

9aal, 9ach, 9adp, 9ago, 9ahh, 9aia, fone, 9aid, 9ajw, 9amu, (9aox), 9apf, 9aqf, 9aqg, 9aqz, 9ash, 9asw, 9atw, 9awv, 9awy, 9axu, (9azj), 9bal, 9bbg, 9bcs, 9bez, 9bfg, 9bgx, 9bhy, 9bkk, 9biw, (9bkh), 9bks, 9bky, 9bn, 9bnu, (9boi), (9bqp), 9bqy, 9brk, 9brl, 9bvn, 9bye, 9cga, (9cgu), 9chf, 9chk, 9cju, (9ckh), (9cko), (9clx), 9cur, 9cvh, 9cyw, 9czj, 9czn, 9dbf, 9deq, 9dfb, 9dgy, 9dhr, 9dpr, 9dro, (9dtn), 9dwa, 9dxu, (9dvy), 9dzc, 9er, 9eji, 9ep, 9eld, 9ely, 9en, 9jc, 9lb, 9qi, 9ry, 9ty, 9xbe, 9xaw, fone.

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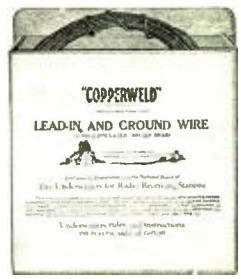

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8 NU J. H. Ferris.....R. F. D. No. 1, Elberta, Mich.
8 NW T. H. Cooper.....Coopers, West Va.
8 OA K. A. Duerk.....1000 Wilhelm Ave., Defiance, O.
8 OD P. O. Farnham....36 Butler St., Ticonderoga, N. Y.
8 OF Dayton Co-operative High School.....Dayton, O.
8 OG L. F. Flld.....2077 W. 42nd St., Cleveland, O.
8 OX T. D. Eckhardt.....57 Wade Ave., Buffalo, N. Y.
8 PB T. Smith, Jr.....707 Burlingame, Detroit, Mich.
8 PG W. K. Morris..715 Mulberry St., Clarksburg, W. Va.
8 PH R. C. Husselman.....134 Seneca, Youngstown, O.
8 QO R. J. Neff.....R. F. D. No. 1, New Carlisle, O.
8 QR J. T. Moore....5915 Alder St., E., Pittsburgh, O.
8 SC F. J. Humphreys.....328 Center St., Ionia, Mich.
8 SG R. Huff.....919 Virginia Park, Detroit, Mich.
8 TA A. L. Bailey.....347 S. Maple Ave., Akron, O.
8 TN Nelson Emmons.....R. F. D. No. 16, Dayton, O.
8 TQ B. A. Norris.....1267 Parkwood, Cleveland, O.
8 TW J. M. Barnhart....927 N. 7th St., Steubenville, O.
8 UA G. W. Carter..Cor. Cass and Warren, Detroit, Mich.
8 UG L. R. Skelly.....816 E. 2nd St., Lima, O.
8 UJ Detroit Institute of Tech., Y. M. C. A., Detroit, Mich.
8 UM J. B. Reed.....256 W. 3rd St., Marysville, O.
8 VD H. Ritchey.....Lima, O.
8 VF O. W. Barton.....217 Whitney St., Conneaut, O.
8 VJ C. F. Nelce.....Box 332, Gilfardville, Pa.
8 WO L. H. Van Beeclaere, M.D., 4471 W. Jefferson Ave., Ecorse, Mich.
8 WU C. G. Roberts.....157 Park Ave., Buffalo, N. Y.
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8 ABU L. Charmicky, 10214 Mt. Auburn Ave., Cleveland, O.
8 AMD Edwin L. Murrill, 935 Third Ave., Huntington, West Va.
8 ANA Forrest P. Wallace, 919 W. Washtenaw St., Lansing, Mich.
8 AUI Karl H. Keller, 2412 Woodmere Dr., Cleveland Heights, O.
8 AYV Joseph L. Heferle, 1515 Kelsey Ave., Toledo, O.
8 BEK George M. Kinsey, 61 Clinton Height Ave., Columbus, O.
8 BIS Alvin D. Barkeloo..South Henry St., Deaware, O.
8 BPZ H. L. Lackwood.....14 Clinton St., Kane, Pa.
8 BRY Chas. M. Schindel, 623 Penna. Ave., Wilkinsburg, Pa.
8 CFW William H. Brown, 206 S. Jackson St., Jackson, Mich.
8 CJL Alton D. Junkel, 22 E. Corydon St., Bradford, Pa.
8 CTS Walter E. Kinney..207 W. Center St., Detroit, Mich.
8 EY H. E. Burns..S. Queen St., Martinsburg, West Va.
8 FI Harold L. LeWanway, 241 Saginaw St., Lansing, Mich.
8 TW John M. Barnhart, 927 N. 7th St., Steubenville, O.

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8 XBP Albert Allen.....1549 Temple Ave., Detroit, Mich.
8 XAY Crosley Radio Corporation, Colerain and Alfred Sts., Cincinnati, O.
8 XBX The University of the City of Toledo....Toledo, O.
8 XBQ Clyde E. Darr..137 Hill Ave., Highland Park, Mich.
8 XBR Union Trust Co.....925 Euclid Ave., Cleveland, O.

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8 YAE Oberlin College .....Oberlin, O.

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8 AXX Clark Galbreath...311 E. Main St., Endicott, N. Y.
8 AZH Harry Eldridge.....Franklin, O.
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8 BDI H. L. Reddaway.....1158 Dorr St., Toledo, O.
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On Tuesday afternoon, February 5th, night letters were sent to the leading distributors of The Crosley Radio Corporation announcing this new model which had been called MODEL 51. Wednesday afternoon, the orders commenced coming in, showing the faith of the distributors in anything brought out by this company. Announcements were made in leading metropolitan newspapers of the country on Saturday and Sunday, February 9th and 10th. Shipments commenced about February 13th, and were immediately followed by an avalanche of complimentary letters and orders, and have increased steadily ever since.

Production started at 50 a day—was increased to 200—then 300—and on February 28th, just 24 days after the thought of this set had been put into being, the production reached 500 a day. Orders were received on February 28th for 1,115 of these sets—every effort being made to increase the production to 2,000 sets per day to supply the phenomenal demand for this new model.

This message was written on February 29th in the face of promises of an even greater record than is indicated here.

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